Proceedings

The Global Interdisciplinary Conference: Green Cities

Business, Engineering, Architecture, Design, &

Technology

June 27 - 30, 2018

ICN Business School – ARTEM Campus

Nancy, France

ICN BUSINESSSCHOOL
key figures

icn business school was first established in nancy in 1905 and is now one of france's foremost schools of management it is a member of the conference of graduate schools and is accredited by the prestigious equis and amba international quality assurance agencies.

one of icn's strengths is its network of international partner institutions. icn is now present on 8 campuses and works with 154 universities and schools worldwide, designing and delivering ever more innovative and international programs for its students.

- **3000 students** with more than 38% foreign students
- **14000 graduates**
- **130 partner universities** worldwide
- **47 STUDENT** ASSOCIATIONS

- **30 years** of soft skills
- **110** administrative **staff**
- **71 tenured professors** and **24 affiliate professors**
- **86%** of the permanent faculty are **phd graduates** and **58%** come from **overseas**
- **300** expert speakers
- **15 databases** included Bloomberg, Ebsco and ABI Proquest
- **33 international double degrees**

3 campuses — 8 locations
- **metz and nancy** france
- **NUREMBERG** germany

5 locations around the world
- **cnit la défense paris** france
- **berlin** germany
- **chengdu and shanghai** china
- **dakar** senegal

ICN BS was awarded with the EQUIS and the AMBA accreditations, both prestigious international accreditations are references for leading management schools. The EQUIS accreditation validates the school's overall strategy, while the AMBA specifically targets the quality of the

MBA program.

Member of the chapter of business schools within the Conférence des Grandes Écoles.

ICN Business School is authorised to issue a diploma endorsed by the Ministry of Higher Education, Research and Innovation for ICN Bachelor SUP'EST and the ICN Grande École program.

2 of our continuing education programs are listed in the National Directory of Professional Certifications (Répertoire National des Certifications Professionnelles): Coach pro RNCP Level I and Formacadre RNCP Level II.

Associated with the University of Lorraine, ICN Business School is actively involved in creating joint projects and double degrees with the University of Lorraine, as well as ISAM/IAE, or Mines Nancy.

ICN Business School is a recognised organisation in the Greater Region in terms of continuing education in the managerial domain, and today is one of the first references on the Datadock list under the decree of quality

professional training.

ICN has obtained the "Établissement d'Enseignement Supérieur Privé d'Intérêt Général" (EESPIG) qualification by ministerial decree on the 8th of June, 2016, published in the 'Bulletin Officiel'

on 07/07/2016.

The Global Interdisciplinary Conference:
Green Cities
Business, Engineering, Architecture, Design, & Technology
June 27 – 30, 2018, Nancy, France

ICN ARTEM Building

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Welcome to Nancy
Mayor Laurent Hénart
Nancy, France

I would like to take this opportunity to welcome you to the City of Nancy. As the Mayor of Nancy, one of my major goals is creating a "Digital Nancy" and a "Sustainable City" with the opportunity for private-public partnerships in order to enhance the economic development of the greater Nancy area.

Academic institutions are of the utmost importance in development of a digital and an eco-city. Digital information and implementation of strategies for an eco-city are sources for jobs in health, materials, energy, transportation, and cultural and creative industries among others. Meanwhile, we would like to keep the tradition and history of Nancy in the decorative arts.

According to a study by the L'Usine Nouvelle, Nancy ranks number three in France in the number of graduates in engineering. Nancy intends to occupy an important place in the knowledge economy and the graduates of the universities in Nancy will play an important role in achieving our goals.
The Green Cities Conference, with its interdisciplinary theme encompassing business, engineering, architecture, design, and technology, will provide knowledge, information, and exchange of ideas that are essential in creating a "Digital & Eco-City" and enhancing private-public partnerships.
Enjoy our beautiful city.

Laurent Hénart
Mayor of Nancy

François Werner, Vice-president
Higher Education, Research, & Innovation
Greater Nancy Region (Métropole du Grand Nancy)

From June 27th to the 30th, the ARTEM campus in Nancy is welcoming "The Global Interdisciplinary Conference: Green Cities – Business, Engineering, Architecture, Design and Technology" thanks to a partnership between ICN Business School and Roger Williams University.

We all know green cities are built thanks to the synergy of knowledge and public policies, so that all the indicators of well-being can be present: employment, housing, access to education, to healthcare…
But a green city is also a culture shared with its architecture, its arts and heritage, whether built or green.

ARTEM is an alliance of knowledge to promote entrepreneurship, creativity and, in a nutshell, collective intelligence.

The conference in June will be the opportunity to reflect together on "global and interdisciplinary" to act on a local level in favor of the planet and its inhabitants.

Welcome to all in Nancy, and let us work well to build a better world together.

François Werner, Vice-President

Higher Education, Research, & Innovation
Greater Nancy Region (Métropole Du Grand Nancy)

Message by Dr. Florence Legros, Dean, ICN-ARTEM Business School

The ICN Business School's mission is to "*provide innovative and trans-disciplinary educational programs to enable students and practicing managers to become responsible professionals with the skills to operate in a global commercial environment.*" In order to achieve this mission, ICN Business School has cultivated alliances with local, national, and international organizations and institutions to incorporate the principles of sustainable development and corporate social responsibility into its education programs. In 1999, ICN Business School became part of the ARTEM alliance with the schools of engineering and arts and design, **École des Mines de Nancy** and **École Nationale Supérieure d'Art et de Design de Nancy**, to promote interdisciplinary educational programs.

For the past 10 years, ICN Business School has been part of the "Global Impact" and the "Principles for Responsible Management Education" (PRME) of the United Nations. In addition, the report of 2017 indicates 10 years of initiatives of the ICN Business School in advancing sustainable education and training that have resulted in development of economic models with attention to the welfare of living beings and the physical environment. With 13,000 graduates of the ICN Business School working across the globe, such training and education have the potential of greening our planet.

ICN Business School has been hosting a sustainability conference for the past few years. This year, with the interdisciplinary conference on "Green Cities" allied with Roger Williams University, École des Mines de Nancy, the Office of the Mayor of Nancy, and the Office of the Higher Education, Research, and Innovation of Greater Nancy Region (Métropole du Grand Nancy), and participation of faculty and students from across three continents, we will be taking another step in implantation and enhancement of the principles specified in our mission.

See you in Nancy and at ICN Business School.

Florence Legros, Dean
ICN Business School
Nancy, France

Message by Dr. Donald Farish, President, Roger Williams University

At Roger Williams University, our collective goal is to "Build the University the World Needs Now," and we strive to do that, in part, by "promoting sustainability as a core principle on the campus and in the community." So it is with great pleasure that I commend the many talented faculty members from RWU who have traveled to the ARTEM campus in Nancy to partner with the ICN Business School for "The Interdisciplinary Conference: Green Cities – Business, Engineering, Architecture, Design and Technology."

We are crossing not only international borders but also the borders between a variety of disciplines to focus on how to build sustainable, green cities that will grow and nurture the jobs and the innovation, the architecture and the technology of the future.

Over the course of our conference, RWU's scholars will present information on topics ranging from alternative sources of energy to coastal resilience, from "smart buildings" to "smart growth," from the "net zero" carbon emission economy to ethical actions that serve corporate social responsibility goals. And just as importantly, we will learn from others, bringing back a wealth of knowledge to help RWU pursue its purpose of strengthening society through engaged teaching and learning.

Donald J. Farish, President

Roger Williams University
Bristol, Rhode Island, USA

Green Cities Conference Program Chairs
Welcome to the Green Cities Conference
Nancy, France
June 27 - 30, 2018

Dr. Minoo Tehrani
Professor & Director of International Programs
Gabelli School of Business
Roger Williams University
Bristol, Rhode Island, USA

Dr. Nuno Guimarães da Costa
Dean of Faculty & Research
ICN-ARTEM Business School
Nancy, France

Greetings to all:

We would like to take this opportunity and thank you for participating in the Green Cities Conference 2018, Nancy, France.

We are delighted to report that we have more than 130 participants including 101 authors of the accepted submissions representing 50 universities and organizations from 14 countries across three continents. In addition, for our 39 tracks, we have 78 track chairs representing 13 countries.

With the diversity of countries, universities, organizations, and academic disciplines represented in this conference, we will have a fantastic opportunity to share our knowledge.

We look forward to meeting you and wish you a great time in Nancy.

Best,

Minoo & Nuno

Green Cities Conference Program Committee

Dr. Florence Legros
Dean, ICN Business School
Nancy, France

Dr. Donald Farish
President, Roger Williams
University Bristol, RI, USA

Dr. Carol Leary
President
Bay Path University
Longmeadow, MA, USA

Dr. Anthony Caprio
President
Western New England University
Springfield, MA, USA

Mr. Jean-Pol Mura
CEO, Saudi Arabia
Mobility Division
Siemens Ltd

Dr. Charles Manz
Chaired Prof of Leadership
Isenberg School of Mgt
University of Massachusetts
Amherst, MA, USA

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Dean, College of
Management, National
Yunlin Univ of Science &
Tech Taipei, Taiwan

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Dean, College of Bus Admin
University of Rhode Island
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Business School Nancy, France

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Communications
Tokyo, Japan

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Accounting

    May Lo…………………………….………….....….…Western New England University

    Cristiane Benetti……………………………….….………....**.**ICN Business School

Asian Studies

    Arthur Cheng-Hsui Chen………......…National Yunlin University of Science & Technology

    Yuh-Yuan Tsai………………….……………………...…….…National Dong Hwa University

Big Data & Business Intelligence

    Manouch Tabatabaei………………….……………....…....Georgia Southern University

    Adrian Gardiner……………………………………..……Georgia Southern University

Behavioral Operations Management

    Carine Sonntag.…………………………………….…………ICN Business School

    Thierry Houé………………………….……………….…ICN Business School

Branding & Luxury Management

    Maxime Koromyslov……………………….……….…………..ICN Business School

    Irina Skorobogatykh………………….….……..Plekhanov Russian University of Economics

Business Law, Ethics, & Corporate Social Responsibility

    Samuel Mercier…………………………………….….……… Université de Bourgogne

    Thomas Langdon………………………………….…....…..Roger Williams University

Case Studies

    Eric van de Luytgaarden………………….……………………..Europe Zuyd University

    Betty Woodman…………………………….…....……..….……University of New Hampshire

Corporate Communication

    Amiee Shelton………………………………………………Roger Williams University

    Patricia Tehami…………………………………………..University of Strasbourg

Design & Smart Buildings

    Patrick Charles……………………………………....…….….…Roger Williams University

    Uwe W. Schulz…………..…………….………Lucerne University of Applied Science & Arts

e-Commerce

    Q. B. Chung……………………………….….……….….………Villanova University

    Suhong Li………………………………………….………….……...Bryant University

Economics

    Luis Rivera-Solis…………………………….…..………...Capella University

    Patrick Dümmler…………………………………….…………………Avenir Suiss

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Energy

    Peter Richner………..…..Swiss Federal Laboratories for Materials Science and Technology
    Adrian Altenburger……………………..…Lucerne University of Applied Science & Arts

Entrepreneurship

    Jean-Claude Tagger …………………………………….…..…Skema Business School
    Stanislas Eyrames…………………………………........................ICN Business School

Finance & Financial Management

    John Malindretos……………………………………....………..William Paterson University
    T. Homer Bonitsis…………………..………………....New Jersey Institute of Technology

Financial Engineering

    Mark Wu……………………………….……………...………Roger Williams University
    Emily Xu…………………………………………….....…University of New Hampshire

Health Care Management

    Lawrence Fulton………………….…………………...……………Texas State University
    Kostas Nikolopoulos.……………………….…………….....………Bangor University

Healthy Cities & Suburbs

    Suzanne Lanyi Charles.……………………………………...……….Cornell University
    Gary Graham…….………………………………….…...…..Roger Williams University

Hospitality Management

    Tung-Shan Liao……………………….…………………...………..…Yuan Ze University
    Rosella Sorio……………………….…………………….…….…ICN Business School

Human Resource Management

    Krista Finstad-Milion……………………….…………….…..ICN Business School
    Brendan D. Bannister……………………………….…...………...Northeastern University

Innovative Education

    Susan Bosco……….………………………………...Roger Williams University
    John Weber……………………………………………….…...………DeVry University

Information Technology & Enterprise Security

    Doug White…….……………………………..…………….Roger Williams University
    John Affisco…….……………………………………………….…Hofstra University

International Business

    Martins Priede……………………………….……..…….……Estonia Business School
    Gayatree Siddhanta………………………..……….…..………...Linfield College

Green Cities 2018 Conference Track Chairs (cont'd)

Knowledge Management
     Jann Hidajat……………………………………..................Bandung Institute of Technology
     Shouhong Wang…………………….……………University of Massachusetts-Dartmouth

MS/OR: Techniques, Models & Applications
     Irem Ozkarahan……………………………………...............................Pace University
     Carolyn LaMacchia……………………………………….……Bloomsburg University

Manufacturing Management
     Aya Ishigaki……………………………………………......Tokyo University of Science
     Jiahua Weng…………………………………………….……..…….Waseda University

Marketing: Theory, Application & Practice
     Kathy Micken………………………………………….....Roger Williams University
     Gilles Nakhle……………………………………….…....INSEEC Business School

Negotiation
     Elizabeth Volpe…………………………………….…..Roger Williams University
     Guy Deloffre…………………………………….…………....ICN Business School

New Product Development & Project Management
     Matthew Liberatore………………………………….…..................Villanova University
     Farbod Farhadi………………………………………….........…Roger Williams University

Organization Behavior & Leadership
     Deseré Kokt………………………………………….....Central University of Technology
     Alexander Knights…………………………………...……..….……Roger Williams University

Quality & Productivity
     Natalia Szozda……………………………….……..... University of Economics-Wrocław
     Artur Swierczek……………….…………………..…… .University of Economics-Katowice

Risk Management
     Stefan Stoeckl…………………………..……………....ICN Business School- Nuremberg
     Andreas Rathgeber………………………………..…….…………….. Universität Augsburg

Service Management
     Mahour Mellat-Parast…………………………..……... North Carolina AT&T University
     Silvester Ivanaj……………………….……………….…..……….. ICN Business School

Social Media
     Sharmin Attaran……………………………………..…….……..……….Bryant University
     Robin Saunders………………………………….…….…..…….…Bay Path University

Green Cities 2018 Conference Track Chairs (cont'd)

Sport & Entertainment Management
Xiangrong Liu…………………………...……………..…………Bridgewater State University
Theo Stengelhofen……………………………………...……………ICN Business School

Statistics & Business Analysis
Josephine Namayanja…………………………………. University of Massachusetts-Boston
Khalid Al-Hamdouni……………….………..…….…..……….…Roger Williams University

Strategy & Competitive Intelligence
Tamym Abdessemed……………………………………..…....ICN Business School
Robert Fiore…………………………….…..……..…….....…….Springfield College

Supply Chain Management
Mohsen Ahmadian………………………………….… University of Massachusetts-Boston
Yu Cui………………………………………………….Otemon Gakuin University

Sustainability
Bilge Çelik……………………………………….…..……Roger Williams University
Amine Ghanem…………………………………………....Roger Williams University

Green Cities Conference Best Paper Award Winners

Richard Briotta Best Paper Award in Knowledge Management/Strategy

If, When, and How Financial Decisions Affect Firm's Value: A Meta-Analysis
Markus Hang, Universität Augsburg
Jerome Geyer-Klingeberg, Universität Augsburg
Andreas Rathgeber, Universität Augsburg
Stefan Stoeckl, ICN Business School

Best Paper Award in Innovative Education

Café Solar® – Sustainable Coffee in Central America
George Joseph, University of Massachusetts - Lowell
Richard Trubey, Mesoamerican Development Institute

Best Paper Award in Application of Theory

Multi-Period Stochastic Programming Portfolio Optimization for Diversified Funds
Lawrence Fulton, Texas State University
Nathan Bastian, United States Military Academy

Best Presentation Award, Ph.D. Students

Suppliers' Learning: Aggregate and Individual Levels
Mohsen Ahmadian
University of Massachusetts - Boston
Faculty Supervisors:
Roger Blake, University of Massachusetts - Boston
Ehsan Elahi, University of Massachusetts - Boston

Best Paper Award, Undergraduate Students

"Net Zero" Carbon Emission Economy
Brendan White, Roger Williams University
Dari Tavekelian, Roger Williams University
Faculty Supervisor: Minoo Tehrani, Roger Williams University

Sponsors
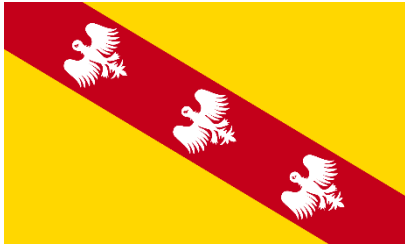
Office of the Mayor of Nancy

Office of Higher Education, Research, & Innovation
Greater Nancy Region (Métropole du Grand Nancy)

ICN Business School

Roger Williams University

École des Mines de Nancy

Guest Speaker: Jean-Pol Mura
Siemens Corporation CEO Mobility Division, Saudi Arabia

Jean-Pol Mura has over 25 years of experience in electronic and data processing technology. He is a qualified electronics and electrical engineer, with extensive multi-disciplinary and international experience in real time software application development, project management, sales, marketing and general management.

Jean-Pol began his career with Schlumberger as a software engineer, subsequently appointed project manager and then R&D Manager. He then moved to Germany and gave his career an international sales & marketing orientation working for the Thales electronics and defense group. Moving back to France, he was appointed Marketing Director in another Thales group division. He then moved to ABB as a Regional Unit Manager. Jean-Pol joined Siemens Corporation in 2003 based in France and Germany where he occupied several managerial positions including Sales and Marketing Senior Vice President at Siemens France with a responsibility of 250 million Euros of sales.

In 2012, Jean-Pol was based in Mumbai, India, as the General Manager of the Business Unit Rail Automation of Siemens Limited India and CEO of Siemens Rail Automation Pvt Ltd (ex Invensys Rail). He oversaw a team of 200 employees with revenues of 35 million Euros. He has been intensively involved with railway and metro signaling projects and made several conference appearances over the past 10 years.

Since 2016, he has been based in Al-Khobar, Saudi Arabia, where he is the CEO of the division of Siemens Mobility supervising 200 employees for a turnover of 100 million Euros. Siemens is the premier corporation in Saudi Arabia where Jean-Pol Mura oversees installation of signs and Telecom (ERTMS) of the Dammam-Riyadh, the Haramain high-speed train, and the electrification of the Mecca Maschaer metro line. Siemens also delivers the turnkey system for lines 1 & 2 of the Metro of Riaydh.

Green Cities 2018 Conference Reviewers

Affisco, John……………………………………………….…Hofstra University
Ahmadian, Mohsen…………………………………….…University of Massachusetts-Boston
Bosco, Susan…………………………………………….. Roger Williams University
Çelik, Bilge………………………………………….…… Roger Williams University
Charles, Suzanne……………………………….……….…..Cornell University
Cui, Yu……………………………………….…….Otemon Gakuin University
Duemmler, Patrick……………………………….……….…...Avenir Suisse
Fiore, Robert…………………………………….……………....Springfield College
Fulton, Lawrence………………………………….………....Texas Tech University
Ghanem, Amine……………………………………….…...Roger Williams University
Graham, Gary………………………………….………..Roger Williams University
Hidajat, Jann………………………………………….Bandung Institute of Technology
Hikmet, Neset……………………………………….…University of South Carolina
Houé, Thierry……………………….……ICN Business School - CEREFIGE – University of Lorraine
Koromyslov, Maxime………………………………………………..ICN Business School
Langdon, Thomas………………………………….………...Roger Williams University
Lo, May……………………………………...Western New England University
Luytgaarden, Eric……………………………….……………...Zuyd University
Nikolopoulos, Kostas……………………….……………….Bangor University
Ozkarahan, Irem…………………………………….……………...Pace University
Perry, Andrew………………………………………….Springfield College
Priede, Martins…………………………….………………….Estonian Business School
Rambo, Robert………………………………….……….Roger Williams University
Rivera-Solis, Luis…...……………………………………….…..Capella University
Safizadeh, Hossein……………………………………………...Boston College
Schulz, Uwe W……………………………………….....University of Applied Sciences & Arts
Siddhanta, Gayatree……………………………………….……………Linfield College
Swierczek, Artur……………………………….……University of Economics in Katowice
Szozda, Natalia……………………………………...Wrocław University of Economics
Tehami, Patricia…………………………………….……….University of Strasbourg
Tehrani, Minoo……………………………………….Roger Williams University
Volpe, Elizabeth…. …………………………………..…..Roger Williams University
Wang, Shouhong……………………………….…………University of Massachusetts - Dartmouth
White, Doug…………………………………………….......Roger Williams University
Woodman, Betty………………………………….………......University of New Hampshire
Wu, Mark…………………………………….………...Roger Williams University
Xu, Emily…………………………………………………...University of New Hampshire

Knowledge Management Assessment in Government
Agency

Dr. Clemens (Scott) Kruse, Stone Oak Solutions, LLC
Mr. Leslie Pierce, Stone Oak Solutions, LLC

Abstract

Purpose

In response to requests by federal agencies in the U.S., a knowledge maturity model was developed. A model from The American Productivity and Quality Center (APQC) was tailored to fit a federal agency, and the new model was designed to be cumulative in nature.

Design/methodology/approach

Through a Delphi Model, the authors designed a maturity model based on their 55 years combine active federal service. This model was then tested using a federal agency in the D.C. area.

Findings

The maturity model that we designed provided an objective evaluation of a complex research organization in the U.S. Army that spans multiple states across the country. The organization optimized its processes by over 30% and adopted a key document management system around which its organization ran.

Research limitations/implications

The maturity model has only been used on one federal agency, so its broad appeal is largely unknown. However, as future opportunities surface, we will continue to develop and adapt its effectiveness.

Practical implications

This model has practical application for agencies in the federal government. It assesses the level of knowledge management maturity of both the organization and its people in an iterative cumulative manner.

Originality/value

Previous models have not addressed the specific needs of the federal agencies and their specific culture.

Introduction

While assisting a military research organization with content management, my colleague and I analyzed several maturity models, but none was appropriate for the organization. The levels defined by the models were not appropriate in their descriptions, levels, or cumulative nature. The way we resolved the dissonance that we experienced was to begin from basic terminology and build a model that fit the organization we pledged to support.

Conceptual background

Knowledge Management (KM). KM is a methodology to create, collaboration, access, and preserve an organization's intellectual capital. Alavi and Leidner (2001) point out that an increasing number of organizations initiate knowledge management ventures to maximize innovation benefits and competitive advantages, exploit and retain their collective intellectual capital, and foster collaborative working and learning between organizational members. Knowledge is the highest form of intellectual capital beginning with data and facts, and adding a sufficient amount of context to enable a decision. Demonstrated explicit and codified knowledge is derived from an individual or group's tacit ideas, insights, expertise, skills, and work behaviors. KM initiatives document the exchange of knowledge between employees (or others as appropriate) and the development of common knowledge within the organization, the knowledge is the property of the organization rather than the private property of the worker. This knowledge is expected to be owned and maintained by the organization, and therefore should be methodically collected and periodically updated. The success of knowledge management depends on interpersonal interaction and relationship quality within the organization, and should not depend on the mere presence of technology (Szulanski, 1996).

The collection of knowledge management needs to be embedded in the organization's social practice and should be viewed as an organization's cultural artifact which can be affected by organizational values, beliefs, and norms (Tesluk et al., 1997). The organization must foster a culture of knowledge sharing with trust and collaboration (McDermott and O'Dell, 2001) and resolve ethical issues within the organization immediately as these can erode the fabric of collaboration and trust. Some argue that ethical culture is a key driver to enhance organizational learning, which will influence how people participate in knowledge management activities (Janz & Prasarnphanich, 2003), and as such it serves as the most important antecedent of knowledge management behavior because a poor ethical culture affects perception of individual power and competition which lead to information hoarding. As summarized by Tseng and Fan (2011), there are many impediments to an effective knowledge management program including knowledge hoarding (the feeling that a person's productivity is his/her personal value to the organization, and is therefore private in nature), knowledge leaking and the economic loss that can follow to the organization, apprehension over failure in public, fear of criticism, security and privacy violations, and the "not-invented-here" philosophy in a hostile environment (Ardichvili et al., 2003).

This last statement also addresses the organization's climate which is an individual's perception of the organization's value, authority system, and motivation policies. The climate of an organization is the informal teacher of norms through interpersonal interaction and vicarious observation (Tesluk et al., 1997). Several characteristics of the climate such as fairness, affiliation, and innovativeness can significantly affect knowledge-sharing behaviors among the ostensible agents of the organization (Bock et al., 2005). A good knowledge-management system includes an extensive content management program.

CContent management is the administration of digital content (images, video, audio, multimedia, forms, policies, other text) throughout its lifecycle, from creation to permanent deletion (or archival). Gartner has traditionally used the term "enterprise content management" (ECM) to describe products with a range of capabilities for managing unstructured enterprise content. Progressive ECM is a part of a functional evolution from a centralized, back-end, command-and-control focus on managing unstructured content to a more integrated approach that prioritizes content usability, processing and analysis. The results of ECM should emphasize the strategic need for a dynamic, flexible and adaptable approach to content within enterprises. An integral part of content management is document management.

Document Management (DM) is the general ability to create, capture, image, classify, mange, view, edit, utilize, archive, and delete content assets. This is a small subset of content management. The DM portion of CM is used to track, manage and store documents and reduce paper.

The Knowledge Management Maturity Model for Federal Organizations.

Our maturity model contains eight domains, four each in categories people and organization, along six cumulative levels with a negative variable representing an organization moving in the wrong direction and a positive five representing an organization performing on the level of a learning organization. Figure 1 illustrates our model and its domains. In the category of people, we included the domaines of strategy/plans, metrics, competency, and culture. In the category of organization, we included strategy/plans, metrics, technology, and culture.

Figure 1: Knowledge Management Maturity Model for Federal Agencies
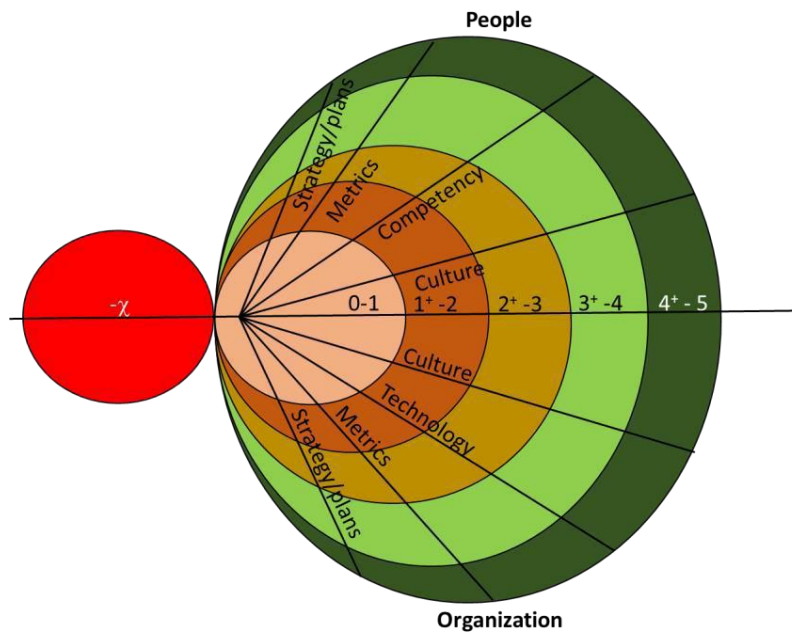
Signs of an organization moving in the wrong direction are low trust and low levels of collaborations. Knowledge hoarding is evident in key positions. Distrust exists between teams, and there is unhealthy competition. There is no impetus for or great resistance to change. The organization, and hence the people lack strategy, goals, and metrics. Common KM tools are not present or are not in use. There is a high impact of knowledge loss when employees leave the organization or when local computer drives crash. The organization is heavily reactionary and requires its people to spend many extra hours to meet basic needs of higher organizations. The organization is not agile in its ability to change direction, and it is not interested in new ways of doing things. Knowledge is heavily siloed.

In level zero to one, the organization is still reactionary, but at least it is headed in a positive direction. The organization probably does not have a strategy in place, or has not published it. It has not identified metrics that could be used in a human capital plan to ensure all needs of the company can be met through employment. As a result, the people do not have metrics that connect their job to the organization's strategy. Either the company has no KM tools available, or it is not promoting the use of those tools. No program is in place to provide institutional legitimacy to the recognition of best practices, or the middle-level management is not communicating such programs to its people. Information is heavily siloed and there is little to no culture of collaboration or basic information sharing. This could be a result of fear of job loss or unhealthy competition between individuals. If teams do exist, they are by name only: There is no team identification. Information gathering is time intensive because generally the group does not know which individual holds specific knowledge. People may not possess sufficient levels of competency to accomplish the mission or strategy of the organization. These behaviors make up an organizational climate that is both tenuous and uncertain. There may be an environment of distrust or even an unresolved ethical issue within the organization. The organization may have a high turnover rate. Annual climate surveys would be consistently low, but the reasons would widely vary from report to report.

At level one to two, the organization has made some advances in some areas that enable it to be more proactive than reactive. Administrative reports required from higher no longer consume a long period of time. The organization has a strategy, but perhaps it has not done a good job of publishing it. Metrics have not been identified that would tie the strategy to a daily mission and enable the upper echelons of the organization to know which units would be responsible to deliver on which metrics. The people, therefore, have very low awareness of the organization's strategy and most likely do not have metrics listed on their evaluations. The organization is investing in KM tools because it realizes the advantages that these tools bring, but perhaps very few people know about them or use them (<50%). The people are hired with the entry level of certain competencies, but they are not developed any further which limits their future potential. The organization is either not promoting a culture of collaboration or middle-level management has not carried it down to the people. Information is still siloed and very little collaboration exists. Because collaboration is so low, knowledge loss and migration has a significantly effect on the organization when one person or several people leave. Office processes are fairly established, but they are not optimized.

At level two to three, the organization has continued to make advantages along the maturity-model continuum. The strategy is established and published. The organization is most likely using a tool like a Balanced Score Card to identify goals and metrics that tie the strategy to the daily mission and divide goals and metrics to specific units. The units have taken these and have listed them on the support forms and evaluations of its people. The people have been hired with basic competencies and the organization spends resources to develop these competencies for mutual benefit. The organization

Figure 2: K-Map current
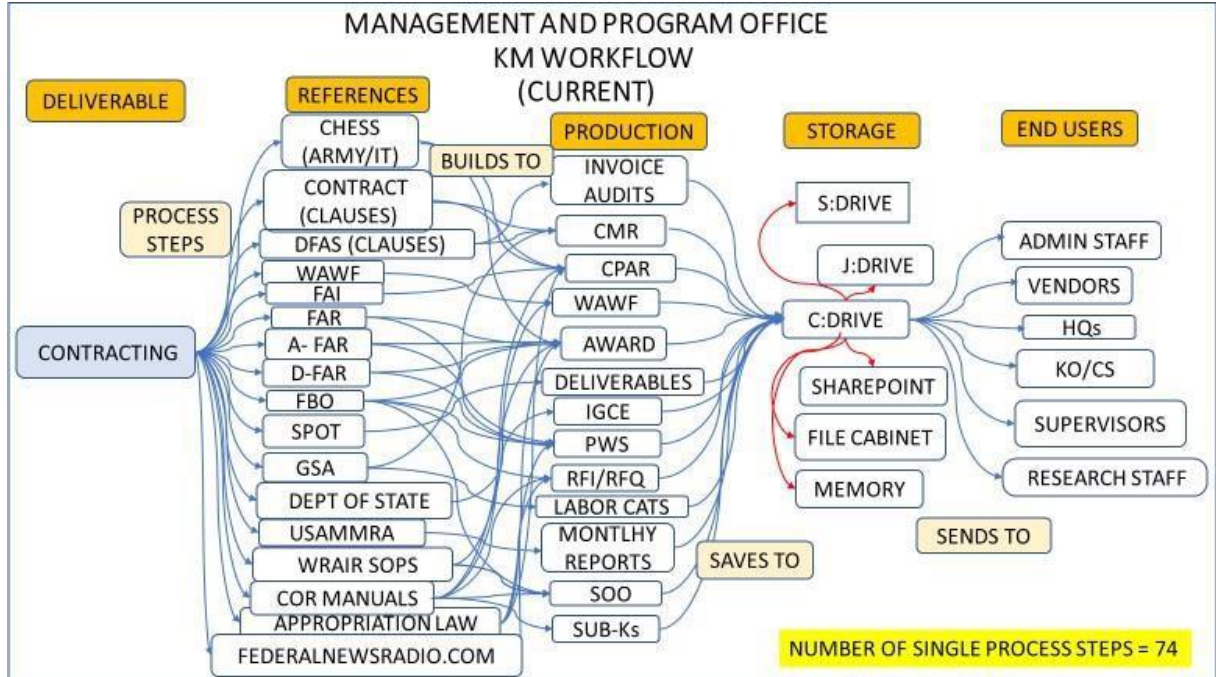
This exercise helped us understand not only the processes of the organization but also how these processes were being performed by the people in the organization. Of note was the number of references used under the deliverable of contracting. About 17 manuals, standing operating procedures, regulations, and federal laws were used to guide this deliverable. These documents were periodically updated without a general broadcast about its existence, and they were located on the Internet in about 17 different locations. The products for this deliverable were many, and these were kept in many places including a local drive and a hard-copy filing cabinet. From these locations, reports, slides, and forms were pushed to end users. A key KM tool, SharePoint, was present, but it was rarely used, and it was certainly not used to its capability. This one deliverable consumed a large part of the productivity of individuals involved.

Our first step in helping the organization was to identify the KM tools already present and ones that could be easily obtained. Since SharePoint was already present, we highlighted that tool as an ideal solution to help optimize their processes, and reports could be automated to pull data and be sent to higher echelons. Figure 3 illustrates an optimized version of these processes. Notice the number of process steps goes from 74 down to 5. By housing the references on SharePoint with dynamic links to the source pages on the Internet, searching for them goes away as does the time spent doing so. By housing all products of the deliverable on SharePoint, the risk to the organization is greatly limited in case of local hard drive failure or loss of personnel. Finally, a process change we suggested with the end users of the products was a pull action rather than a push of reports. Another option was to automate the products through Crystal Reports. Either option could save the resources expended in distribution immensely.

Figure 3: K-Map optimal
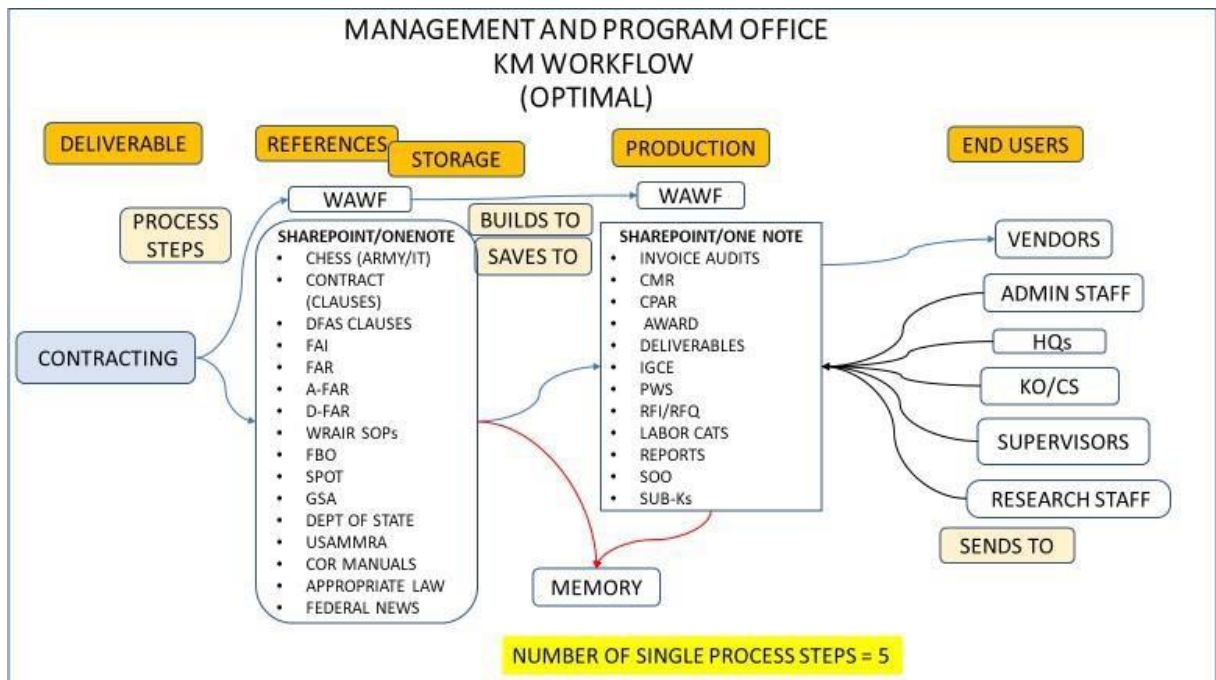
As we explained to the customer, the optimal model does not do much to the processes except to insert the use of a document management solution already organic to the organization, but grossly underutilized. We suggested a pull system whereby the end users would pull the products from SharePoint rather than the people in the organization pushing them to the end users. We strongly suggested that the people in the organization avoid the use of personal space on either local computers or servers because the former would not be backed up, and the latter could not be accessed by others for collaboration (an unnecessary risk to the organization). These small changes would save 93% of the man hours per work cycle, assuming each task is performed once per work cycle.

To help us identify the specific stage of the maturity model at which the organization stood, we also asked each person to fill out a questionnaire. This internally-developed product gave us an idea of each person's level of awareness of how their role fits with the organization's strategy, how collaboration was arranged, and how change was perceived in the organization. Many of the people self-assessed their knowledge of the organization's strategy as high, but they could not come up with specifics of the strategy when asked. This might speak to the climate of the federal office that uses strategic terms often, but seldom publishes the specifics of its own strategy.

Based on the answers to questionnaires and results of the knowledge-mapping exercise, we initially attempted to use the knowledge maturity model provided by the American Productivity & Quality Center (APQC) out of Houston, Texas. However, we experienced a considerable level of dissonance between the results of the questionnaire and the knowledge mapping exercise.

The results of the questionnaire would have placed the organization at a level 4 in some places and at a level 2 in others. The APQC model contained levels, but they did not seem to be cumulative. It did not appear that when a person was a level 4 they had accomplished the attributes of levels 1-3. Because of this dissonance, we chose to modify the model to better fit the specifics of the organization

that we were assisting. What we developed seemed to be more apt for a military research organization and the purpose for this manuscript.

Our assessment based on our maturity model

Based on the K-mapping exercise and the answers to the questionnaire, we assessed the customer at a level 2. The organization did have a strategy, but it had not published anything from it. The organization was not using a Balanced Score Card that would have translated strategic objectives into operational metrics for units to use. As a result, people did not have any metrics associated with their performance reports. SharePoint was in place, but only one employee and one manager were using it. Others were unaware of its presence or potential. Best practices were not recognized, celebrated, or published. Collaboration was sparse, and where present was only within certain teams. We observed instances of knowledge hoarding by some key personnel which speaks to the organization's climate. The organization was a great risk of knowledge loss or migration in the case of a local hard drive crash or loss of personnel. No communities of practice were identified. The K-map exercise highlighted just how busy individuals were, but not necessarily how productive they were. It was an eye-opening exercise for everyone in the room. Not only were the people unaware just how many things they were responsible for per work cycle, but also just how complicated both the people and organization had made these processes, regardless of the reason.

Figure 4: Maturity-Model assessment of customer
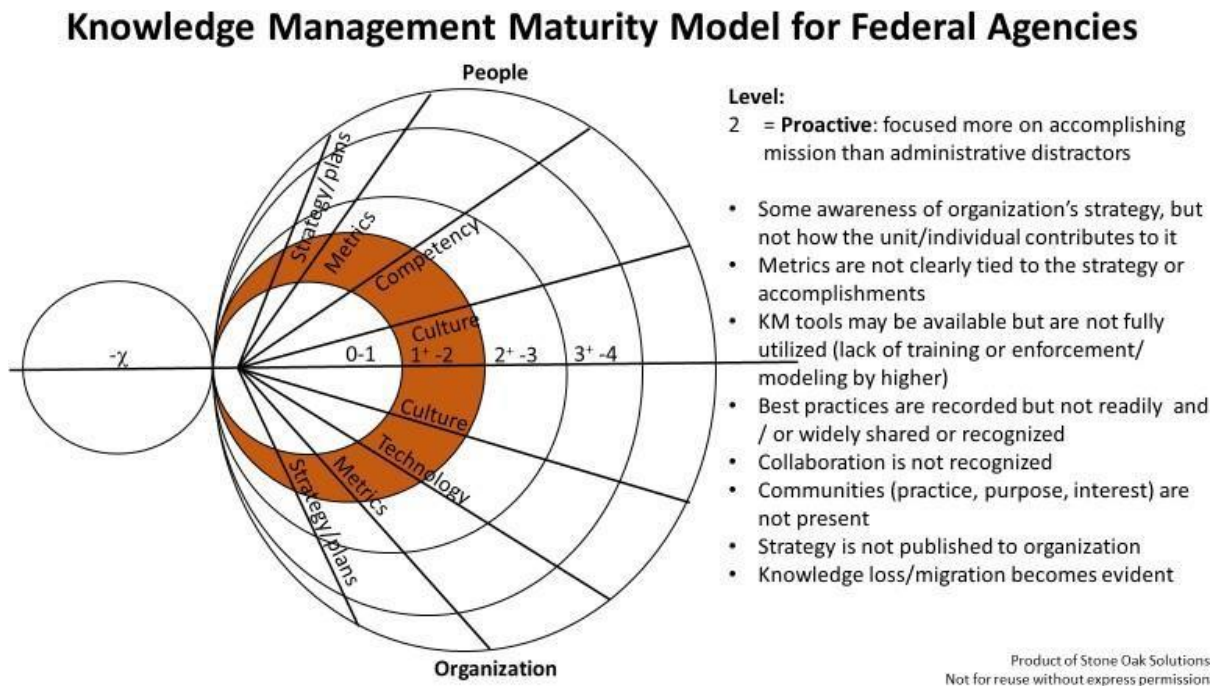
Through some basic realignment of processes using KM tools and collaboration best practices, we could identify more than 70% decrease in process steps for every department in the unit. From this point, we suggested that the customer train its people on SharePoint and ensure no organizational data was stored on local drives or any drive that was associated with a personal profile because the knowledge loss would be too great in case of personnel absence. The Active Directory practices of the

U.S. Army assign profiles to provide a reasonable expectation of privacy for its employees, but this should not pertain to Army-related material: This material should reside on public shares within the organization, restricted to the people within. Permissions can be appropriately set to limit access to only those with a need to know. The same can be said for all documents within SharePoint. We also suggested a standard naming convention that conformed to U.S. Army Library rules (for cataloguing) and to get away from the practice of nested folders on their drives. After a file is nested within 3-5 folders, the name becomes too long to be backed up properly by the server. This also introduces risk to the organization to lost data. Finally, we recommended the organization publish its strategy and adopt a Balanced Score Card approach to identify metrics that can be tied to the peoples' evaluations. Through these recommendations, the organization could bring itself up to a level three within the span of about six months. Advancement to subsequent levels can take several years, but in our model the levels are cumulative, so previous practices should not be abandoned.

Green application

The U.S. Army has experimented with the computers' and monitors' power save mode by forcing the setting for all. Computers are awakened periodically during the night and weekends to push up dates and security patches, but during most of the nonproductive hours the computers, monitors, and printers are in power-save mode. The savings in electricity can be huge.

Using this power-save plan with our time-savings model can also have an additive effect. If we save an organization and its people 70% of its process steps, we are also contributing to times when the computers, monitors, and printers can use the power-save mode. If we only assumed that half of the time savings would be spent off the computer (doing field work or meeting with people), we can calculate the costs just to the one organization that we consulted for. This federal research-organization had 50 employees. On an 8-hour day, saving 35% amounts to hours per employee or hours per day for the organization. Army is a Dell house and most employees use dual monitors, we can do some calculations with known numbers.

Dell published a client energy-savings calculator white paper (n.d.) that enables simple calculations. In sleep mode, the computer's RAM is suspended (not running code) and the monitor is off. Most of the computer's resources are in a suspended state with the exception of a few circuits needed to detect user interaction and network/server-induced wake events. This state is not as effective as the hibernate mode, but it also will not disrupt user productivity for a full wake process. Dell suggests the sleep mode during periods of inactivity and the hibernate mode at night. The latter mode will also start the computer back up if set to "wake on LAN".
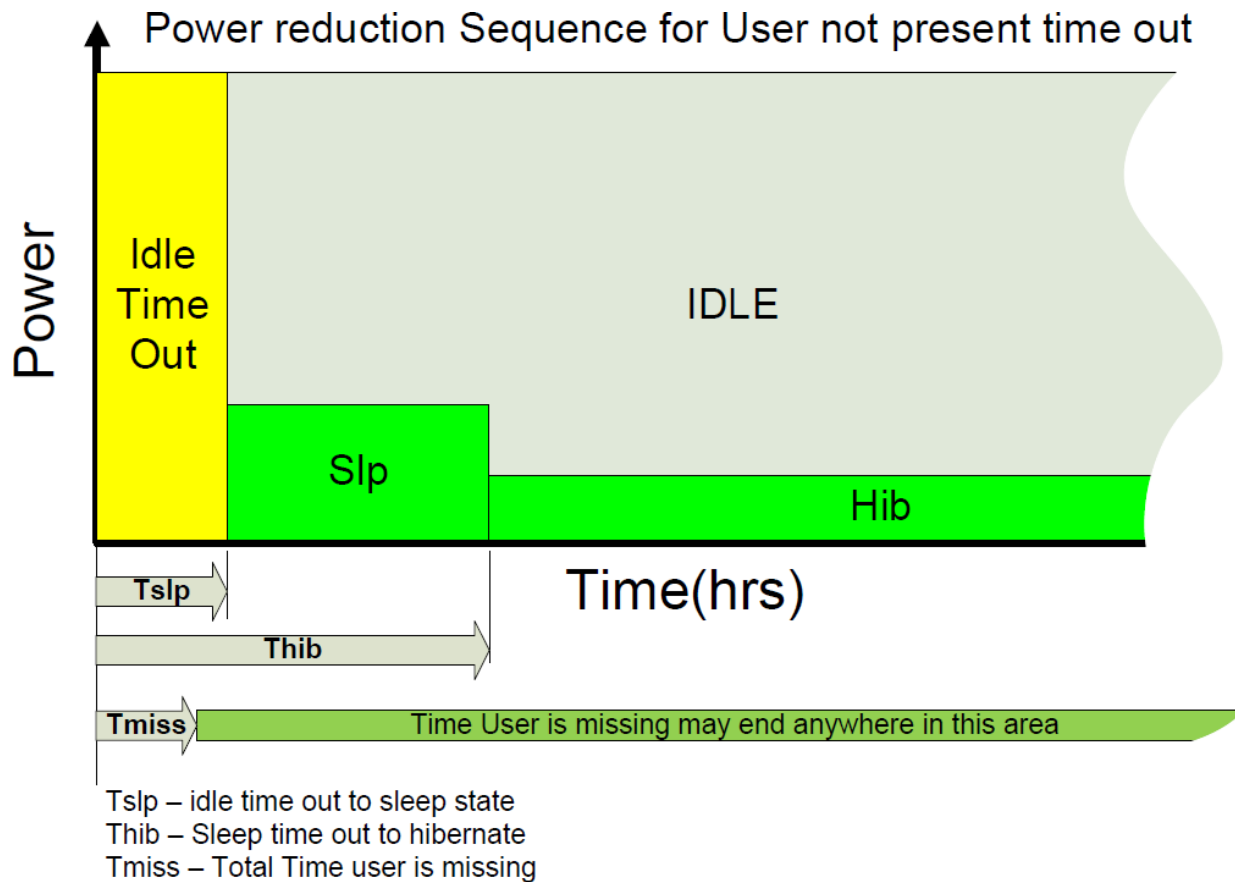
Figure 5: Power transition sequence from Dell.

A web site named "tipsandtricks-hq.com" published some calculations in 2012 using a Dell desktop CPU (Dell Optiplex GX620). These calculations showed a 0.082 kwh and 0.05 kwh consumed by a desktop CPU and monitor, respectively. Assuming the cost of energy is $0.12/kwh, we can calculate the savings in dollars to the organization: $0.12/kWh x (0.082kW + 0.10kW) x 140 hr/day x 250 days/yr= $764/yr of savings for the small organization we worked with.

Using equations from the U.S. Environmental Protection Agency's (EPA) web site, we can calculate the CO_2 / kWh. Removing the cost/kWh from the above equation, the kW saved is 7,640kWh/yr. The EPA uses the equation 7.18×10^{-4} metric tons /kWh. This equates to 5.49 metric tons of CO_2 emissions avoided to produce the 7,640kWh/yr by the small organization we worked with.

We could take this one step further by assuming the organization allows employees to telecommute 2 days/week, as long as productivity remains constant, and assuming the workers are using a remote-desktop or VPN technology to their desktop in their office. This action has three effects:

1) the monitors at the workplace are not consuming energy [0.10kWh/employee x 8hrs/day x 2days/wk x 50 wks x 50 employees = 4,000kWh or an additional $480 in savings and 2.87 metric tons of CO_2 emissions avoided], and

2) the cars they drive to work are not running [20mi/day*2days/wk*50wks*50emp*1gal/19.7mi = 5,076gal/yr*8.81×10^{-3}gal/met ton CO_2=44.72 metric tons CO2 emissions avoided], and

3) the lights in their offices are not on. Using the Food Service Technology Center calculator for linear fluorescent lighting, the organization would save an additional $878 on 7,360 kWh. This calculates to 5.28 metric tons of CO_2 emissions avoided. The combination of these savings would be $1,358 and $253.8 to the organization and each employee, respectively. The environment would see 52.87 less metric tons of CO_2 emissions per year, plus the savings from our "optimization" recommendations would be 58.36 fewer metric tons of CO_2 emissions per year.

Conclusions

Our work on a maturity model for federal agencies was a result of 55 years of combined federal service on the part of the authors. Our experience has been at all levels of the U.S. Army and working within offices of civil service. We are intimately familiar with processes, procedures, and the culture that often exists. We are also familiar with initiating change in organizations with powerful organizational inertia, making it very difficult to change.

Our questionnaire was developed by evaluating that of APQC and modifying the questions to what we felt was more appropriate for federal employees. For instance, in some federal offices, there are very few employees. There might be one supervisor and 50 contractors. These contractors are not evaluated by the supervisor. The supervisor is responsible for managing the contract, but the contractor evaluates the employees. The employees are not employees of the government: They are employees of the contractor. This convoluted organizational structure can make for some very complicated questions. If the question asks about an employee, is it asking from the perspective of the contractor or the government?

Our K-map exercise was developed based on our knowledge of the extensive resources and deliverables that we know that contribute to daily activity, and that how easily the day becomes side tracked due to a short-fuse mission from the higher authority. We have optimized many offices over the course of our careers and we know how it should and can be accomplished within the federal government.

The first application of our maturity model validated our initial thoughts in its development, and it helped us fine tune it in practice. The model by APQC is just not sufficiently applicable for federal agencies, but we feel that ours can be.

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AUTO COMPANIES IN BRAZIL: HAVEN OR HALO?

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ABSTRACT

The research question to be investigated in this study is the presence of the auto companies in Brazil versus the Corporate Social Responsibility (CSR) Hypothesis of Halo or Haven. Can the presence of these companies in Brazil be explained under the Halo Hypothesis or the Haven Hypothesis of CSR. The Haven Hypothesis centers on the notion that polluting companies move to the countries with less strict environmental policies and pollution mandates (e.g., Ibara, 2013; Levinson & Taylor, 2008). On the other hand, the Halo Hypothesis explains how companies that move to emerging countries assist these countries by enhancing the technological knowledge and skills, education, and employment in addition to observing the sustainability principles (Ibara, & Leekley, 2007; Levinson & Taylor, 2008).

In addition, the sustainability strategies employed at the manufacturing facilities of these auto companies at their home versus Brazil are examined. Furthermore, the impacts of the Brazilian government rules and regulations on the auto industry in Brazil will be explored.

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GREEN CITIES: ALTERNATIVE SOURCES OF ENERGY

Dr. Minoo Tehrani, Roger Williams University
Ms. Nicole Paulson, Roger Williams University
Ms. Rebecca Rhodes, Roger Williams University

Abstract

Climate change includes major changes in temperature, precipitation, or wind patterns that occur over several decades or longer. The earth's average temperature has risen 1.5 degrees Fahrenheit over the past century (http://www.globalcarbonatlas.org/en/CO2-emissions). The European Union strategies for 2020-2050 are to have a zero carbon emission economy by the year 2050.

New England states, such as Massachusetts and Rhode Island have to import most of their energy. The City of Providence in the State of Rhode Island has been declared a "Green City". The State of Massachusetts has signed an agreement with Swiss Federal Department of the Environment, Transport, Energy and Communications (DETEC), to develop alternative sources of energy.

This research examines the European Union goals for 2020-2050 in addition to the strategies that the states of Rhode Island and Massachusetts have developed to create alternative sources of energy.

Furthermore, the study explores the strategies that have the potentials of creating a zero carbon emission economy concentrating on alternative sources of energy, solar, wind, and specifically wave energy. The final section of the research discusses the benefits of development of non-fossil fuel energy in creation of a sustainable green economy.

WARRANTY FRAUD IN REMANUFACTURING

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Abstract

One of the more undesirable sources of waste in a manufacturing process is the issue of fraud. The activities that are required to root out sources of fraud are both time consuming and expensive to the manufacturer. Fraud has been previously reviewed extensively in the new product industry, whereas fraud in remanufactured products has not been well explored; therefore this study aims to examine the phenomenon of warranty fraud of products in a remanufacturing environment and establish the relationships between various decision factors that mitigate or propagate fraud.

Keywords: Remanufacturing, Fraud, End of Life, Warranty

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Introduction

Remanufacturing aims at replacing and repairing worn out and obsolete components and bringing the product back to as good as new condition. Of all the EOL processes, remanufacturing involves the most amount of work, and consequently remanufactured products have better quality and reliability compared to repaired and reused products (Ilgin and Gupta 2012). In terms of performance, a remanufactured product may perform as well as a new product; however the consumer may not perceive that as being the case. The fact that a consumer is frequently unsure about the quality of a remanufactured product that is to be purchased, and is therefore unsure of the extent to which the product will render services, might lead to a decision to opt out of buying it. Because of misconceptions held by consumers, manufacturers often search for market mechanisms, such as warranties, that might provide assurance about the reliability of remanufactured products (Alqahtani and Gupta 2017). While warranties are sometimes performed by the remanufacturers themselves, they often outsource such services to third party service providers. With multiple parties, each with their own goals, motivations, and competing interests involved, the likelihood of fraud being committed by one or more parties is inevitable. Due to its relative newness a host of unresolved problems still plague the remanufacturing industry such as warranty planning, product pricing and product quality issues (Alqahtani and Gupta 2017, Zhou *et al*. 2017, Ilgin and Gupta 2011). Many of these problems were addressed by first reviewing the extant literature on traditional manufacturing systems; therefore reviewing literature related to dealing with fraud in the new product industry would be instructive.

Literature review

There are two review papers in Environmentally Conscious Manufacturing and Product Recovery (ECMPRO) area, which were used as a starting off point for this study. Gungor and Gupta (1999) presented a state of the art survey paper covering most papers published through 1998. It was updated in 2010, when Ilgin and Gupta (2010) presented another survey paper in the same area. They cover research activities that took place between 1998 and 2010 by a systematical classification of more than 540 papers under four main categories, namely, environmentally conscious product design, reverse and closed-loop supply chains, remanufacturing and disassembly.

According to Murthy and Jack (2016), fraud can also be carried out by almost any of the parties involved in a financial or service transaction. Kurvinen *et al.* (2016) extensively reviewed the issue of warranty frauds in new product manufacturing from the point of view of the perpetrators. One way of tackling fraud (when the seller is responsible), is through government legislation. In the United States organizations such as the SEC and FTC are responsible for monitoring and punishing fraud. Practices such as internal audits and random inspections help in routing out any discrepancies at a local level.

When the guilty party is the consumer, frauds are usually routed out through actions carried out by investigators on behalf of the seller. Traditionally companies use a predetermined set of business rules to evaluate claims that are sent to them. Widely used statistical classification methods such as linear discriminant analysis and neural network methods have been shown to be effective tools (Hand, 1981, 1997; McLachlan, 1992; Ripley, 1996; Webb, 1999).

Fraud can be seen in all types of insurance sectors, but most notably in healthcare. Fraud in health insurance is the intentional deception or misrepresentation for gaining some benefit in the form of health expenditures. Vendors typically lose 3 to 5 per cent of revenue to warranty and support abuse (The Alliance for Grey Market and Counterfeit Abatement) Substitution fraud occurs when a component part, which is not within the manufacturer's warranty period, is placed in a product which is within the manufacturer's warranty period.

Trendall (2010), Hayes (2005) describes cases of substitution fraud; meanwhile Kalley (2006) proposed a number of ways which highlighted the usefulness of additional identification information in stopping fraud. Often product manufacturers are required to outsource services to outside companies or service providers. Warranty providers outsource their claims to external service agents who charge between 1-5 % for their services (Murthy and Jack, 2016). Many such as Bradford (2004) documented the issue of service agent fraud in the automotive and electronic industry.

Asymmetric level of information can lead to service agents or retailers exploiting the consumer's ignorance of the terms of an implied warranty. Uchtmann and Sarhan (1983) described the situation of implied warranties in the livestock industry. Few studies, such as Tan *et al*. (2006),

proposed the use of a data interpretation unit to obtain warranty information from an electronic product to determine if the product has been exposed to environmental factors outside the ranges that are specified in the warranty agreement.

Problem formulation

Voids in literature

Due to its relative newness, a host of unsolved and unexplored problems still plague the remanufacturing industry such as warranty planning, product pricing and product quality issues. Many of these issues have been addressed in recent literature but one area that has not received as much attention is the issue of remanufactured product fraud. Much work has been done in examining the role of human behavior in the fraud system. However, the performance of current tools continues to be poorer than desired, limiting their use on a stand-alone basis to help identify entities for further investigation. Fraud in the financial sector for instance can be fairly represented through the use of what is known as the fraud triangle (of pressures/opportunities and Rationalization) to understand the mind of the one committing the fraud. Additionally, most research assumes that frauds are planned I.e. that there is an intent to deceive the other parties. Few studies have tackled how one deals with frauds that are committed by accident or because of the negligence of one or more of the concerned parties. While the psychology of the fraudsters is of great interest, studies have also been conducted to examine how the nature of the investigator effects the level at which frauds are discovered (age, gender, expertise etc).

Based on the observed voids in the literature as well proposed solutions to solving issues of fraud and related topics in the new product industry one has enough information to propose a scenario that can be used to test proposed solutions. A remanufactured product warranty servicing scenario is considered where in a warranty provider offers a warranty on a remanufactured product to a customer.

Problems to be addressed

The primary players involved in a remanufacturing fraud scenario are the warranty provider (WP), service agent (SA), and the customer. Based on the parties involved, the problems can be broadly split into 2 types of scenarios. The first are scenarios that consider only 3 players, namely the WP, SA, and the customer. The second case considers all the players simultaneously and addresses collusion scenarios between 2 or more players. The specifics of fraud change on a case by case basis. For instance when the fraud occurs between the customer and service provider, one might wish to determine if a fraudsters perception of being caught (I.e. the confidence of the investigation process) affects their willingness to commit fraud. Another issue is what role the relative experience between the fraudster and investigator may play with regard to fraud detection. On the other hand when the fraud is between the SA and WP, it would be useful for an investigator to know what size a claim that could be overlooked without suffering negative repercussion over the long term. Additionally the consequences of applying theoretical

solutions (for example, the effect of implementing a high initial penalty for committing fraud on the fraudster's long term behavior) would be worth exploring. The relationship between penalty costs and fraud also needs to be examined. Establishing this relationship may lead to envisioning a long-term penalty plan that theoretically will lead to better behavior from a service agent. Cost comparisons between savings in fraud investigation between a new product and a remanufactured product could help in deciding if it is worth pursuing remanufactured product investigations. Once issues between the main players are considered separately, the problem can be further expanded to include additional parties (Parts manufacturer, sales channel, Warranty administrator etc) and consider the system as a whole and not just a case by case scenario.

Approaches to tackling the problem

The fraud triangle theory and fraud diamond theory can be used to surmise that if there are significant financial benefits to be gained and limited risk of getting caught, there are some people and companies who try to take advantage of the opportunity, resulting in fraud. This can occur in the context of individuals and companies. Table 1 shows the key factors that are important in the context of fraud. Naturally, most people and companies have higher integrity and won't take advantage of the opportunity.

Table 1 - Key factors leading to potential fraud	
Opportunity	Consequences of getting caught
Financial potential	Risks of getting caught
Lack of integrity	

Additionally, the likelihood and consequences of getting caught have an impact on the likelihood of fraud taking place. With the current mobile and social media technologies, fraudsters have access to a larger number of potential victims and a statistically better likelihood to find people who will eventually fall into the trap. Much of the risk to the fraudster comes in the form of penalties that are imposed. As fraud hinges on financial benefits, integrity among other factors, multiple approaches may be used to better understand and combat fraud, a few examples are listed below.

Financial approach

Identifying the relationship between the various financial factors of fraud such as the potential benefit, the penalty and inspection cost can be modeled using game theory. A non-cooperative static game formulation is used to model the interaction between the SA and WP with the aim of establishing relationships between the various key factors. Additionally the approach was considered for a number of risk scenarios for the SA and WP. One of the more notable results was that as the individual fraud claim amount increases, the overall probability of committing fraud decreases.

Motivational approach

While it is more traditional to penalize the one committing the fraud based on the defrauded amount, a new basis for penalties was modeled using discrete event simulation that considered other factors such as intent, motivation and prior record of good behavior in order to determine if over the long term the overall fraud could be theoretically reduced, while still remaining cost effective.

Conclusion

The paper described the literature surrounding the issues of fraud and warranties. This review served to show the importance in tacking the issue of fraud in the remanufacturing service industry. The problems and possible issues worth exploring were laid out. And finally, some simple approaches to observe the relationships between the parties and fraud were proposed. This has been an overlooked problem in the area of remanufacturing, and further exploration would prove to be beneficial to all the parties involved.

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MACHINE LEARNING APPROACHES FOR IDENTIFICATION OF ALZHEIMER'S DISEASE USING SOCIAL DETERMINANTS & IMAGERY

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ABSTRACT

The purpose of this study is to predict the presence of Alzheimer's Disease (AD) using socio-demographic, clinical, and Magnetic Resonance Imaging (MRI) 4D data. Early detection of AD enables family planning and may reduce costs by delaying long-term care (Alzheimer's Association, 2018). Accurate, non-imagery methods also reduce patient costs. Extreme Gradient Boosted random forests (XGBoost) predict Clinical Dementia Rating (CDR) presence and severity as a function of gender, age, education, socioeconomic status (SES), and Mini-Mental Status Exam (MMSE). Convolutional Neural Networks (CNN) predict CDR from MRI's transformed to Eigenbrain imagery. XGBoost also predicts CDR with additional clinical variables. XGBoost provides 93% prediction accuracy for CDR using socio-demographic and clinical non-imagery variables-92% accuracy when clinical measures are excluded. CNN using the transformed Eigenbrain imagery results in 93% prediction accuracy. ML methods predict AD with high accuracy. Non-imagery analysis may be nearly as efficacious as imagery prediction at a fraction of the cost.

BACKGROUND

Alzheimer's is a disease for which there is no cure (Mayeux & Sano, 1999). Diagnosing AD early facilitates family planning and cost control (Alzheimer's Association, 2018). The cost for a brain MRI may range from approximately $600 to $1,300 (Vanvuren, 2017), and for the uninsured or underinsured, this might be infeasible.

LITERATURE

Zhang et al. (2015, 2016) used a subset of the Open Access Series of Imaging Studies (OASIS) data (n=126) and proposed methods to identify binary-coded AD using Eigenbrain imagery. They eliminated individuals under 60 as well as incomplete observations, modeled AD as binary, and limited their analyses to a subset of coronal slice images. Chaplot et al. (2006) suggested the use of neural networks, Support Vector Machines (SVM), and self-organizing maps for approaching image classification; however, the emergence of Convolutional Neural Networks (a Deep Learning technique) improves the learning rate of the network through pooling (Wang & Xi, This work extends their efforts by addressing these shortfalls.

DATA & VARIABLES

The OASIS data provides researchers access to cross-sectional and longitudinal MRI data (OASIS, 2018) and is based on the efforts of Marcus et al. (2007). N=416 patients

Response variable: Clinical Dementia Rating. {0= nondemented; 0.5 = very mild dementia; 1 = mild dementia; 2 = moderate dementia} (Morris, 1993)

Demographic predictor variables: Gender: {0=Female, 1=Male}, Age: [18, 96], Education: {1<HS, 2=HS Grad, 3=Some College, 4=Coll^{2}e^{2}ge Grad, 5=Beyond College}, Socioeconomic Status: {1=lower, 2=lower middle, 3=middle, 4=upper middle, 5=upper}

Clinical predictor variables: Mini-Mental Status Exam: [0,30] (Rubin et al., 1998), Estimated Total Intracranial Volume: mm3 (Buckner et al., 2004), Atlas Scaling Factor: [.88, 1.56] (observed) (Buckner et al., 2004), Normalized Whole Brain Volume: [.64, .90] (observed) (Fotenos et al., 2004)

Imagery predictor variables: Brain Imagery. Masked version of the gain-field corrected, atlas- registered image to the 1988 atlas space of Talairach (Buckner et al., 2004)

OBJECTIVES

This study has two major objectives. The first is to predict presence & severity of AD using ML methods with / without imagery. The second is to provide alternatives to imagery for identification of AD for the poor and underserved.

METHODS

Exploratory Data Analysis

EDA techniques included imputation of missing sociodemographic data through Multiple Imputation using Chained Equations [MICE] (van Buuren & Groothuis-Oudshoorn, 2011) and Box-Cox transformation investigation (Venables & Ripley, 2002).

Image Manipulation

The AnalyzeFMRI package (Bordier, Dojat, & Lafaye de Micheaux, 2011) in R Statistical Software (R Development Core Team, 2016) provided image import utility. Principal Component Analysis (PCA) generated the Eigenbrain structures.

Gradient Boosted Tree Ensembles (Gradient Boosting)

The R Statistical Software Package, XGBoost (Chen et al., 2018), generated gradient boosted random forests. Hyperparameter grid search provided parameters for use in building the forests. Ten-fold cross-validation provided accuracy metrics. Individual trees grew no more than three branches to avoid overfitting.

Deep Learning with Convolutional Neural Networks (CNN)

The Keras (TensorFlow backend) package in R served as the means for evaluating images (Chollet, 2015). CNN's take advantage of pooling and are ideal for image recognition.

DESCRIPTIVE STATISTICS

The data include 416 patient diagnostic files with 100 of those files confirming dementia. No patients under the age of 60 were diagnosed with dementia, as this is a rare event. Table 1 provides crosstabs of CDR status by age and gender grouping.

Table 1. Descriptive Statistics for Dementia by Age and Gender (Adopted from OASIS , 2018)

Age	N		Non-Demented				Demented			CDR 0.5/1/2
		n	mean	male	female	n	mean	male	female	
<20	19	19	18.53	10	9	0	.	0	0	.	0/ 0/ 0
[20,30)	119	119	22.82	51	68	0		0	0		0/ 0/ 0
[30, 40)	16	16	33.38	11	5	0		0	0		0/ 0/ 0
[40, 50)	31	31	45.58	10	21	0		0	0		0/ 0/ 0
[50, 60)	33	33	54.36	11	22	0		0	0	.	0/ 0/ 0
[60, 70)	40	25	64.88	7	18	15	66.13	6	9	12/ 3/ 0
[70, 80)	83	35	73.37	10	25	48	74.42	20	28	.	32/15/ 1
[80, 90)	62	30	84.07	8	22	32	82.88	13	19	22/ 9/ 1
[90, 100)	13	8	91.00	1	7	5	92.00	2	3	.	4/ 1/ 0
Total	416	316		119	197	100		41	59	70/28/ 2

The average patient in the dataset was 52.7 years old with a slightly less than perfect mental state evaluation (27.5 out of 30), an estimated brain volume of 1480.53 mm3, and 79% of the intracranial cavity occupied by the brain (nWBV).

Table 2. Descriptive Statistics, Quantitative Variables

Variable	n	mean	sd	median	min	max
Age	416	52.70	25.08	56	18	96
Mini-Mental Status Exam	416	27.50	3.13	29	14	30
eTIV (Intracranial Volume)	416	1480.53	158.34	1475	1123	1992
nWBV (Brain Volume)	416	0.79	0.06	0.8	0.64	0.89
ASF (Atlas Scaling Factor)	416	1.2	0.13	1.19	0.88	1.56

Modal responses follow: 62% women, 28% college graduates, 30% middle class. Spearman's rank correlation between SES and education indicated a negative correlation ($r = -.715$, $p<.01$). For the 121 individuals without a high school education, 119 were in the lower middle and lower classes. Figure 1 provides distributions of these qualitative variables.
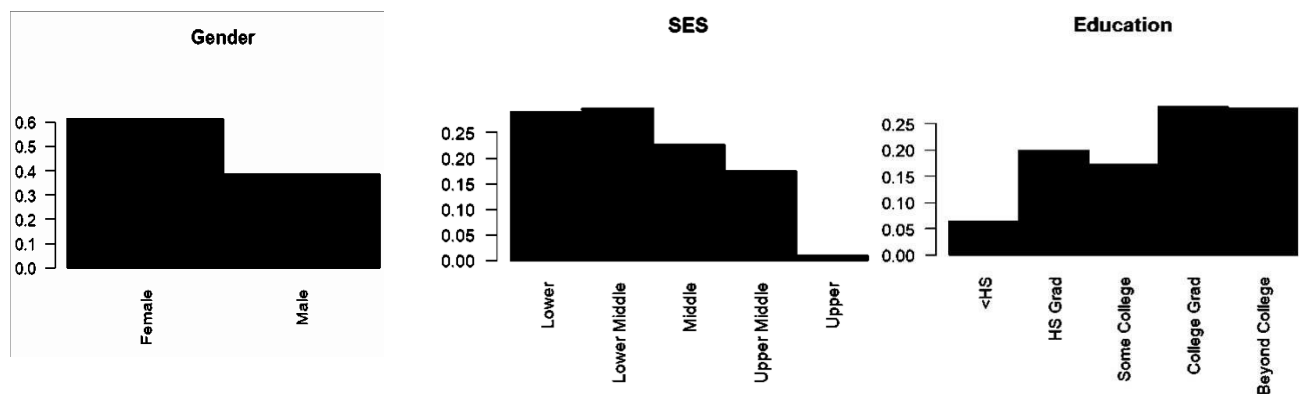

Figure 1. Descriptive Statistics, Qualitative Variables

Correlation between ASF and eTIV is negative and significant ($t414 =-88.7$, $p<.001$) as is the correlation between age and nWBV ($t414 =-36.4$, $p<.001$). The likelihood ratio test (LRT) of all $l = 1$ is rejected

(p<.001), as the optimal power transformation for multivariate normality is {.91, 7.0, .13, -.29, 5.29} for the variables in order of display. MMSE is particularly resistant to transformation.

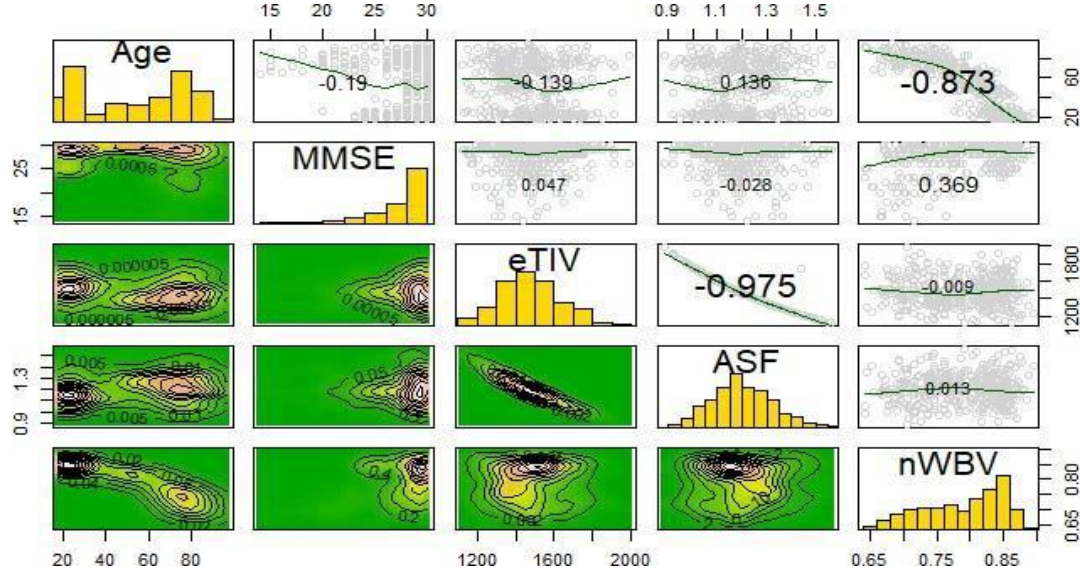Tree methods and deep learning do not require normality, but rather benefit from scaling.

Figure 2. Quantitative pairs

TRANSFORMATION OF MRIs AND EIGENBRAIN DEVELOPMENT

Figure 3 below represents actual slices from an MRI used for analysis. Figure 4 depicts Eigenbrain images derived by Principal Components Analysis where each component is maximized as follows:
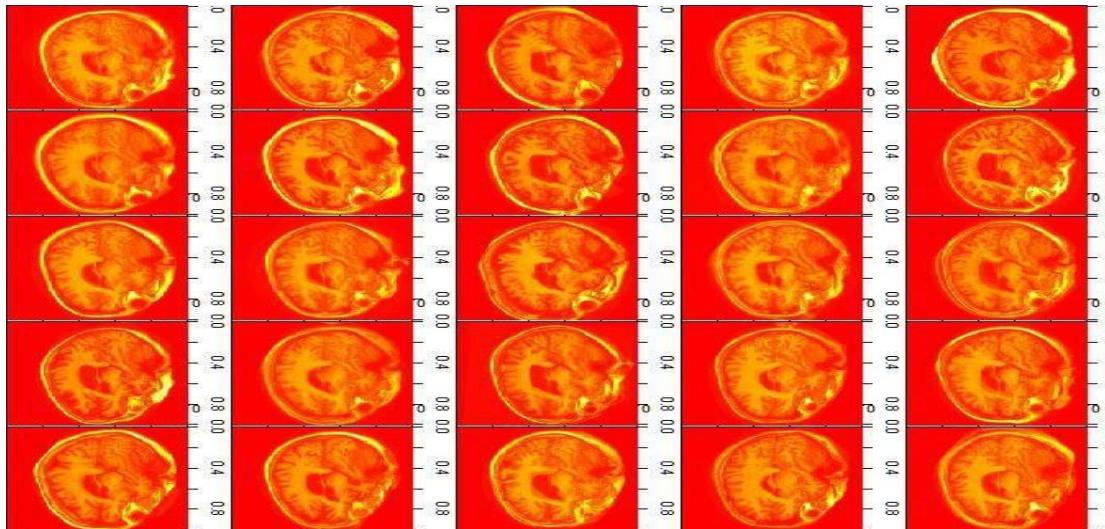

Figure 3. Axial MRI slices from the dataset

Maxa(i) Li = $a^T_i \boldsymbol{R} a i - \Box i(a^T_i a i - 1)$. Vector *a* and scalar $\Box$ are the Eigenspace.
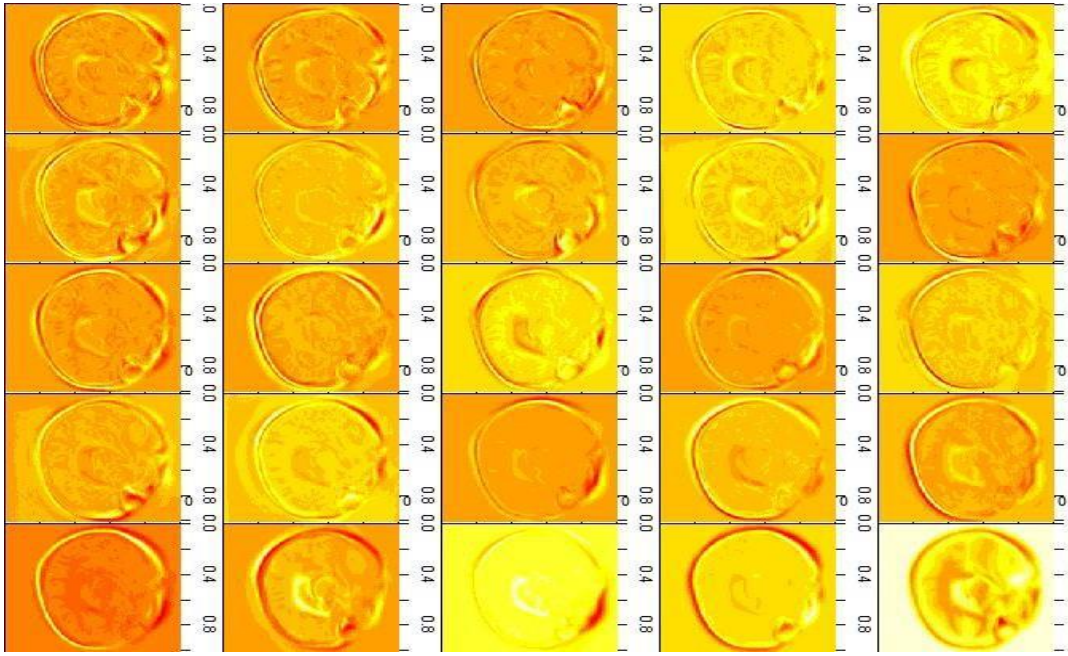
Figure 4. Eigenbrain slices generated through Principal Components Analysis

RESULTS

Gradient Boosting with XGBoost (Chen et al., 2018)

Hyperparameter grid search tuned the random forest. Ten-fold cross-validation provided accuracy metrics. To avoid overfitting, the tree depth was restrained to three. XGBoost classified 93% of the cases correctly with socio-demographic & clinical data. Gradient boosting also classified 92% accurately with only socio-demographic variables & MMSE (PPV=90%, NPV=97%). The following importance (% occurring in trees) for the variables as follows: MMSE (46%), Age (35%), Education (8%), SES (8%), Gender (3%). Figure 5 is an example tree from the analysis.
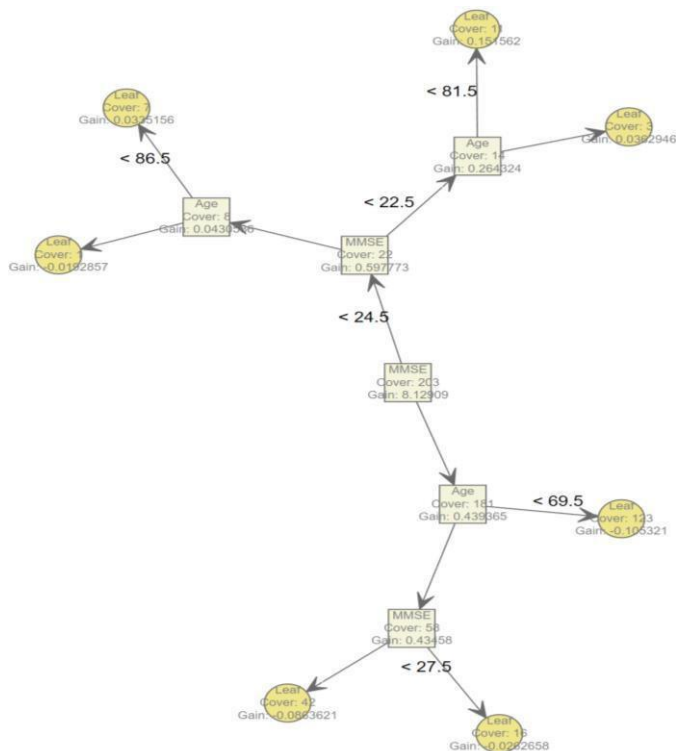
Figure 5. An example tree produced by extreme gradient boosting

Convolutional Neural Networks (Deep Learning) with Keras and Tensorflow (Allaire & Chollet, n.d.)

A Convolutional Neural Network (CNN) is a deep, layered, neural network ideal for working with image data. A picture of a convolutional neural network is shown in Figure 6. A relatively simple three-layer model with {12, 6, 3} nodes and three separate activation functions {linear, hyperbolic tangent, and softmax} applied to all available image data (scaled) predicted a 30% validation set with 93% accuracy after 50 epochs (batch size of 8, categorical hinge loss function, Rmsprop optimizer). The convergence of the model is shown in Figure 7. This result is similar to that of Zhang et al. (2015), although this analysis includes all available data and a multi-level response variable.
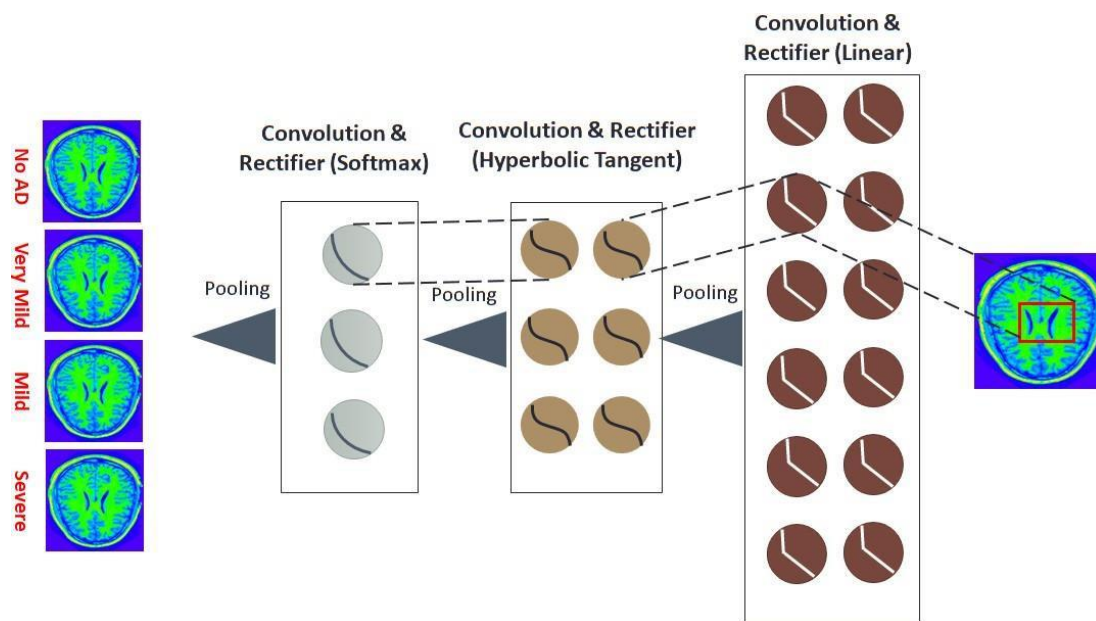
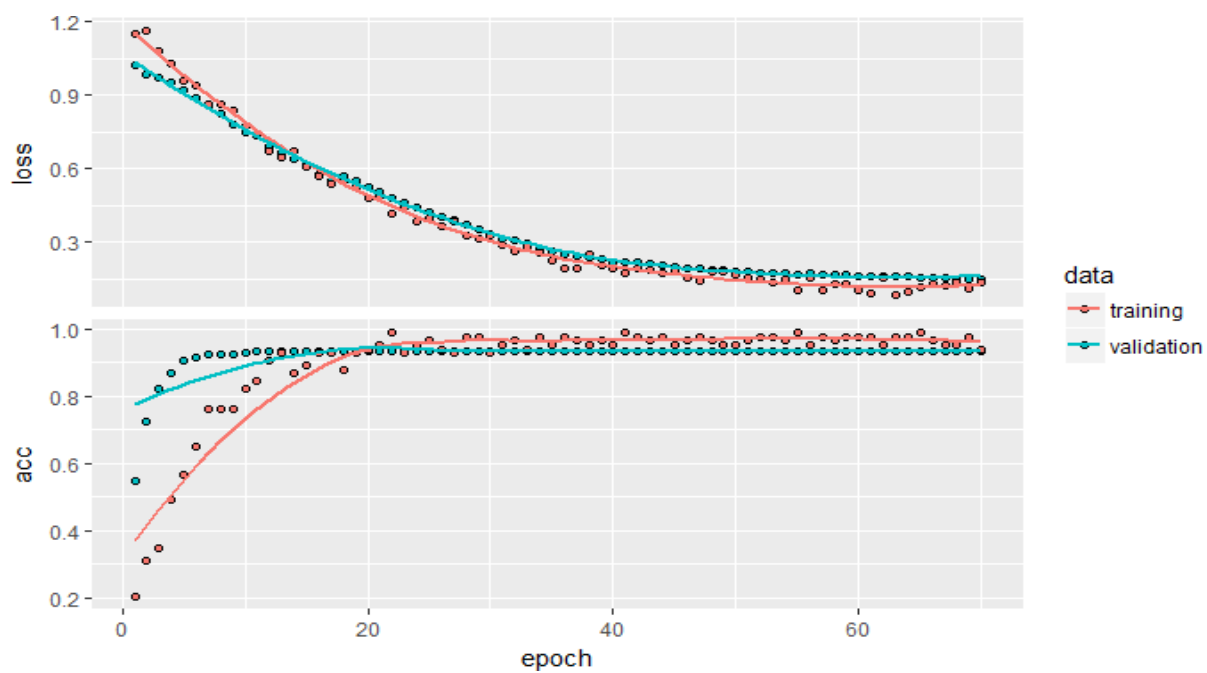Figure 7. An example of the CNN in this study

Figure 8. Convergence of the CNN

CONCLUSIONS

Extreme gradient-boosted tree models provided 93% accuracy in predicting AD and associated severity with clinical data and 92% accuracy with only socio-demographics data. The most important variables in predicting AD with socio-demographic data only included MMSE, Age, Education, SES, and Gender, respectively. With imagery data, CNN accurately identified 93% of the AD by severity with a three-layer model. Machine learning techniques might be used to identify AD in an automated fashion, and it might be possible to develop models with high predictive accuracy that do not require imagery.

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Finding Common Ground: Smart Growth and Affordable Housing

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Abstract

Low and Moderate Income (LMI) housing is an integral part of Smart Growth planning. The same cannot be said of some earlier growth control practices. Growth boundaries, taken alone, can constrain the supply of available land driving up housing costs. In many states, with more integrated growth management plans, these costs are made up for by incentives for more compact and integrated housing within well served, mixed use town and village centers; however, in Rhode Island the absence of real incentives and the slow pace of local reforms to outdated and exclusionary zoning policies have made for a rocky relationship between Smart Growth and LMI housing advocates.

In PART I of this study we developed at a way of measuring the smart growth potential of available land in communities throughout the state with particular attention to those towns outside of the Urban Service Boundary. These are often communities that are not served by municipal water and sewer infrastructure. These outlying areas are also among the fastest growing communities in the state and those with the lowest percentage of LMI Housing counting toward the state mandated 10% goal. Land Use 2025's requirement that all projects in these outlying areas that receive state or federal funding be within identified Growth Centers means that, in some cases, there is a lack of suitable land for the development of the necessary LMI housing. This, coupled with the limited densities and increased costs of providing the needed septic systems, often make the cost of developing LMI housing in these areas prohibitive.

In this study, we will look at the perceived tension between Smart Growth policies, such as those advocated in Land Use 2025 or the soon to be completed RoadMap RI, and Fair Share housing legislation, in order identify possible remedies. Many of these issues are being taken up as part of the "RoadMAP RI" planning process; however, to the extent that part one of this study helped inform and advance the discussion of Growth Center planning in the state, this current effort will help ensure that we are more proactive in addressing important role of more integrated and diverse housing choices for all of the state's inhabitants. This is critical to ensure expanding opportunities for those trapped in the cycle of poverty that has become entrenched in urban areas where concentrations of our nation's most needy populations remain a persistent and costly challenge.

Fair Share Housing Programs

The Fair Housing Act was implemented in 1968 as part of the Civil Rights Act. This laid the groundwork for the Mt. Laurel decision of 1975 and was followed by New Jersey's Fair Housing Act of 1984. This Act established the responsibility of all local municipalities within the state to provide some form of affordable housing under the direction of the Council on Affordable Housing or COAH. [1] Protected Class status was gradually expanded beyond race to also include color, national origin, sex, family status, religion and disability. After the failure of the large scale urban renewal programs of the 1960's and 70's, attention soon turned to strategies that would help families find alternatives to areas of entrenched poverty and that emphasized housing choice such as voucher programs. This all occurred during changes in policy that also began to focus on home ownership as a means of building wealth and increasing the individual's stake in

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[1] U. S. Dept. of Housing and Urban Development, "39 Steps Toward Fair Housing"

the community. At the same time, greater control and responsibility for housing policy and funding was being shifted from the federal government to the states. It did not take long for the states to realize that our 50-year addiction to suburban single family housing left these newly empowered program participants with very limited options.

The comprehensive permit process was established in Massachusetts in 1969 with the enactment of Chapter 40B legislation. In Rhode Island the 1991 Low and Moderate Income Act was introduced to spur the development of LMI housing through the use of a comprehensive permitting process. The "Comprehensive Housing Production and Rehabilitation Act of 2004" (Housing Act of 2004) made significant changes to this measure and followed other similar legislation in Massachusetts, Connecticut and Illinois in establishing clear targets for the production of LMI housing in each community within the state. A 10% target would determine a localities Fair Share contribution to the regions affordable housing needs and would act as a threshold for protection from the comprehensive permit process. Similar legislation also exists in New Jersey, and California; however, these states rely on more complex formulas for determining targets for affordable housing production on a local and regional level. As in California, Rhode Island requires that each community prepare an affordable housing plan that identifies potential sites for affordable housing and the strategies needed to reach stipulated targets.[2] In each case, the primary goal is to combat exclusionary zoning practices and to establish a shared and equitable approach to addressing the need for LMI housing on a statewide basis.

Another valuable tool in promoting the production of LMI and housing and expanding housing choice is Inclusionary Zoning. Montgomery County, Maryland's MPDU or Moderately Priced Dwelling Unit program of 1974 was the first to introduce mandatory inclusionary zoning.[3] This program required a fixed percentage of all new development to be moderately priced in exchange for a density bonus. These programs work particularly well in high growth areas and frequently include a buyout or fee in lieu provision. Connecticut's Incentive Housing Zone (IHZ) takes a more targeted approach that gives local communities more control over the location of new development and uses smart growth criteria to determine local sites. The program is incentive based and includes support at each step in the process.[4]

Barriers to LMI Housing and Smart Growth
To the casual bystander, the prescriptive nature of some of the policies above may seem extreme; however, these measures reflect the entrenched nature of many of the seemingly innocent, but ultimately exclusionary, barriers that advocates of LMI housing confront in trying to find more equitable solutions to the social and economic problems created by entrenched urban poverty. Increasing income segregation has made it increasingly difficult to offer individuals and families of limited means access to the opportunities (educational, economic, social) afforded by greater choice in their housing options. Since 2000 the number of homeowners in the state contributing more than 30% of household expenses toward housing rose from 24.5 to 37.4%. For renters, the percentage jumped from 36.6 to 47.4%.[5]

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[2] Bratt, Rachel, "Overcoming Restrictive Zoning in Five States".

[3] Ibid. Pg. xx

[4] http://www.cga.ct.gov/2011/pub/chap124b.htm

[5] US Census data; ProvPlan, Rhode Island Community Profile

Suburban politics have long been dominated by the individual property owner's desire to do anything and everything to protect the value of their investment in their home. This is complicated by the almost complete reliance on residential zoning dedicated to the production of single family housing on ever increasing lot sizes. Earlier railroad and streetcar suburbs had a greater mix of uses and a more varied housing stock. However, the increasing reliance on the automobile has led to a limiting of our transportation options as well as our housing options.

More established suburban communities such as Barrington, Rhode Island once had a range of housing types and lot sizes. Industrial uses and the accompanying worker housing existed alongside informal summer camps and more stately summer residences. As increasing numbers of farms were platted for residential development after WWII, pressure mounted to increase lot sizes and to eliminate side by sides or duplexes. After the introduction of a town wide sewer system during the 1970's, most undeveloped land was up-zoned to ¼ acre zoning due to fears of overdevelopment. Many fast-growing rural communities in Rhode Island without assess to water and sewer infrastructure rely almost exclusively on 1- 5 acre zoning. Exclusionary zoning practices such as this are often justified by the need to protect private wells and the desire to "protect rural character" yet do nothing to prevent cookie cutter developments from carving up what remains of the agrarian landscape that this zoning purports to protect.

This is where advocates of LMI Housing and Smart Growth can truly find common ground. The mantra of choice and variety are prevalent in both camps, as is the emphasis on increased densities, albeit for different reasons. Housing advocates are trying to bring down housing costs and Smart Growth advocates as trying to preserve open space and natural resources. In both cases, there is a strong recognition that the increasing economic and cultural segregation of our society weakens our sense of community, undermines our sense of shared destiny and limits access to educational opportunities.

Density
Rhode Island is the smallest and the second most densely populated state in the union next to New Jersey); however, with the exception of Central Falls and its older urban cores, it is rarely a place of great density. Since the 1980's we have been consuming out limited land resources at an alarming rate; yet the kinds of densities associated with growth centers, and LMI housing for that matter, strike fear in the hearts some rural residents. Many chose rural locations because they did not want to be able to see another house from their own; yet they think nothing of the long commute or travel to soccer practice or the supermarket. Their children and the elderly, who cannot drive, are completely dependent on others for transportation. Initially the infrastructure is free; however, many communities have resorted to access fees to help defray the mounting costs of maintenance and basic services in such diffusely settled regions.

Many of the rural growth centers in Rhode Island began their lives as Mill Villages that often mixed industrial and agricultural pursuits to create a unique form of community with a rich history. These densely settled rural nodes offer a very positive paradigm for living in harmony with others and with the land. If we are to conserve our rural landscape and the rich agricultural and natural resources that they hold, we must learn to live more densely. Cluster and conservation zoning strategies are some models and cottage housing is another that has great appeal; however, by weaving these and multi-family housing options into integrated mixed-use town and village centers we can provide a very desirable alternative for those who don't want to spend their retirement riding a tractor mower. Very few rural or suburban communities have

zoning that allows for the densities or the housing and transportation choices that are needed to create a vital town or village center.

The Role of the Comprehensive Permit Process
If proper zoning is not in place, and the community has not met its fair share threshold, they are open to Comprehensive Permit proposals. The Comprehensive Permit process usually consists of several components whose desires must be balanced in reaching a final development proposal. This means that the results of this process are often unpredictable and vary widely in their outcomes. In Rhode Island, each community must have a valid housing plan that identifies a clear path toward reaching their stipulated 10% goal. If the local community is not in compliance or has not met their stipulated goal they are subject to comprehensive permit proposals that may be appealed to a regional or statewide housing board. While the purpose of the comprehensive permit is to overcome local barriers to LMI housing, the ultimate goal is to have the local community identify and provide for this need in a proactive manner in order to avoid the process altogether.

In California, the regional need for housing is assessed and complex formulas are used to determine a local community's allocation. The allocation formula includes growth trends, employment and the relationship of both growth and jobs to transit.[6] Communities are charged with identifying suitable sites and removing barriers to LMI housing development. A certified housing plan exempts the community from appeals and makes them eligible for outside funding.[7] In other states such as Rhode Island a certified housing element is required; but does not exempt you from comprehensive permit applications or appeals. However, the housing appeals board (SHAB) must weight conformance with the town's Comprehensive Plan, as well as the community's ongoing need for affordable housing in reaching a final determination.

Massachusetts has gone a step further and given additional weight to environmental and smart growth criteria. They also recognize communities that have shown significant progress by granting them temporary immunity from appeals for a 1-2 year time period. The production of rental housing also includes a special bonus in that all units within the development are counted toward the community's 10 % goal as long as 25 percent of the rental units are affordable. While Massachusetts has made impressive progress across a range of communities under Chapter 40B, many argue that the ends do not justify the means and see it simply as a way to pad developer's wallets. This has led Massachusetts to limit the comprehensive permit process to projects receiving a federal or state subsidy, to non-profit developers or limited dividend organizations.[8] Regardless, given the high cost of housing in many parts of the state, one has to recognize Chapter 40B's important role in helping to spur housing production. Left to their own devices developers will always chose a large lot greenfield (or virgin) site. What all of these measures have done, is to allow communities to hold private developers accountable to their comprehensive plans and to encourage more strategic compact development on grey and brownfield sites and infill development within existing communities.

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[6] Association of Bay Area Governments, Revised Technical Documentation for Regional Housing Needs Allocation Method, August 2007
[7] Bratt, Rachel, "Overcoming Restrictive Zoning in Five States", Pg. xxxiv
[8] Ibid.

Housing and Jobs

The same forces that drove the initial round of suburbanization have also contributed to a phenomenon often referred to as Job Sprawl; yet many low-income families remain in urban areas that have seen a decline in manufacturing and service industry jobs. Although some knowledge industry jobs remain tied to historic urban educational centers, many have migrated outward as seen in the 95/128 corridor around Boston. In Rhode Island our five core cities have lost jobs and we have seen job gains in Urban Ring and Suburban parts of the state. Although it might follow that the decentralization of low income housing would facilitate access to these jobs, the public transportation systems in older east coast cities remain built around edge to center commuting and not the edge to edge commuting prevalent in many contemporary metropolitan regions. This can mean an aided burden for families of limited means that are isolated in suburban communities that often require more than one car. As one might expect, those areas outside of the Urban Service Boundary show between 0-2% use of public transit and 20 to 40% of households have commutes of over 40 minutes. By contrast, over 20% of Providence residents rely on transit to get to work.[9] There is also a mismatch between low wage jobs and communities with low cost housing options. Here again, Smart Growth and LMI Housing policies can find ample common ground.

Smart Growth seeks to turn back fragmented and sprawling development patterns in order to focus development and investments in infrastructure. By increasing densities in outlying communities access to jobs and services can be eased and public transit can function more effectively. This can lessen the isolation and lack of community often associated with suburban living. LMI housing in these areas can be part of more vital and integrated communities rather than the declining and underserved or marginalized suburban settings where LMI housing options are often found. Smart Growth and affordable housing policies can also help to revitalize towns and villages that have been left behind by new development that has leapfrogged these important historic centers.


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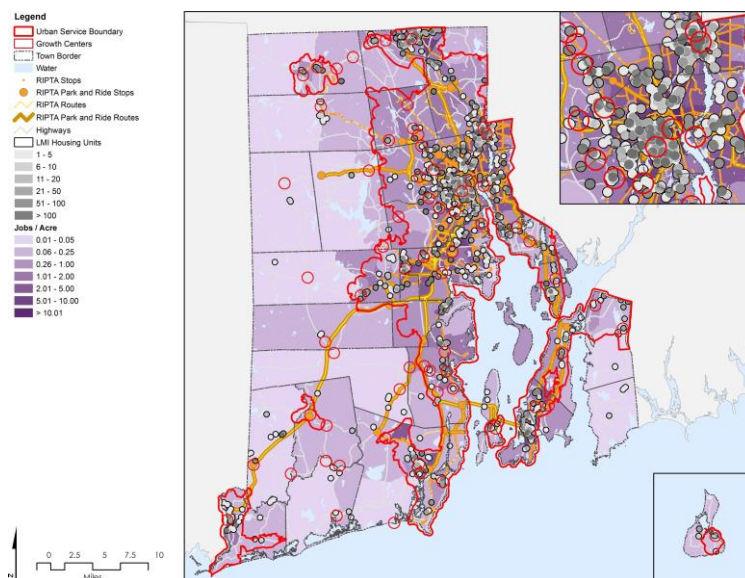
[9] US census data; ProvPlan Rhode Island Community Profiles

Long-term Affordability

GrowSmart RI's "The Costs of Sprawl" graphically documented the costs of wasteful and unregulated sprawl develop to Rhode Island's economy. In trying to better document the financial burdens on working families, the Center for Neighborhood Technology has argued that, since housing and transportation are the two largest items in the family budget, they should be considered together when calculating the "true affordability" of our housing choices. They argue that more "location efficient" urban neighborhoods are often more affordable when the costs of transportation are included. In large part this is due to increased walkability, access to goods and services and access to public transportation. These same settlement patterns have also been linked to healthier living patterns (more walking) and decreased carbon emissions (less driving). Rhode Island has a relatively high percentage of car ownership at 89%; however, that percentage drops to 75% and 77% percent respectively for Central Falls and Providence.[10] Similarly, although only 2.7% of households statewide use public transit to get to work, that percentage jumps to 9 % for families living below the poverty level.[11]

CNT AFFORDABILITY INDEX MAP OF RI

Housing + Transportation Costs % Income

< 24% | 24-36% | 36-45% | 45-54% | 54-66% | 66-78% | 78-87% | 87%+

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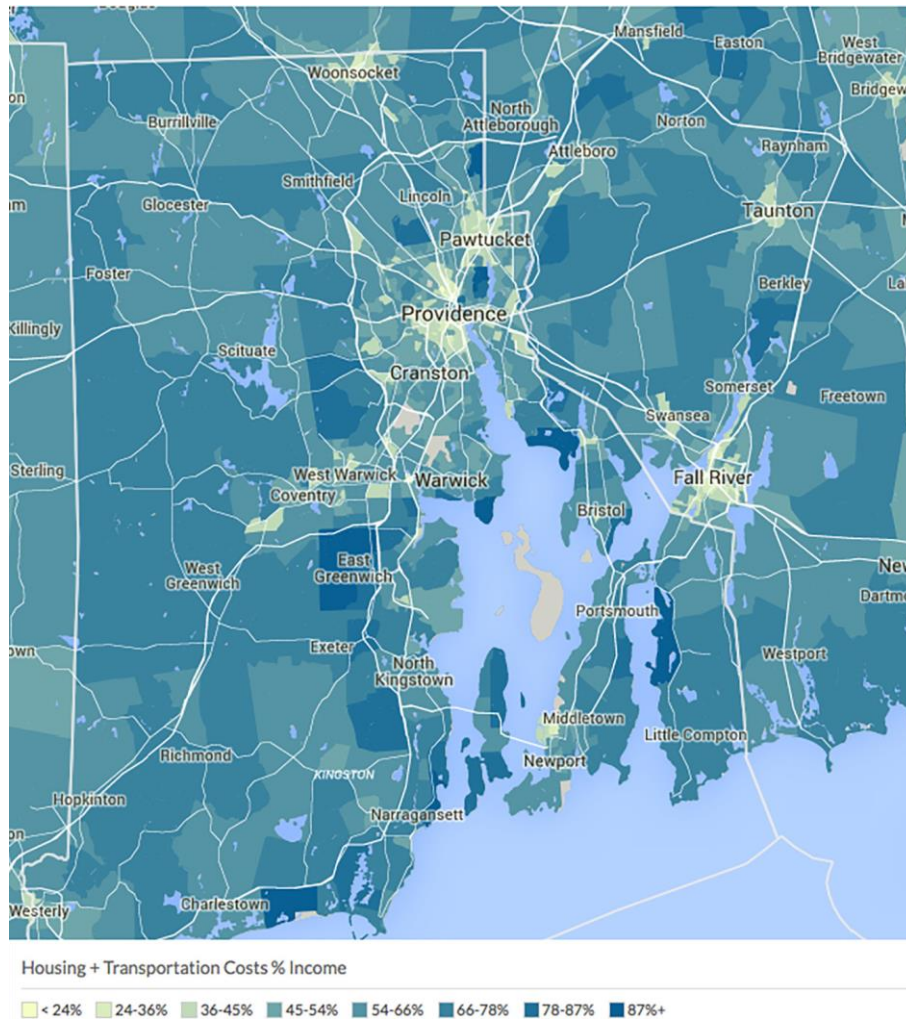
[10] U.S. Census Bureau, ProvPlan Rhode Island Community Profiles 2010
[11] U.S. Census Bureau, 2008-2012 American Community Survey

The Landscape of Opportunity:
At the very same time, the Kirwan Institute at the Ohio State University has been promoting their own mapping exercise, based somewhat on HUDs opportunity index, that focuses on those factors seen as the being the best indicators for identifying areas offering low and moderate income families the greatest opportunities for success. They also weight many of the factors indicating conditions that can be seen as limiting one's chances for success. These include factors common in depressed neighborhoods such as poverty, high unemployment, lower educational achievement, low levels of home ownership and high foreclosure rates. As one might expect, areas that project as having the highest opportunities for success are where the more successful people live. These areas have higher overall levels of education and school performance, fewer children on school lunch programs and are often less transient. Resources like this have been developed to aid mobility and choice and to help those using voucher programs or other forms of subsidy that are more portable make informed choices. These programs are aimed at counteracting the increasing economic and social segregation that has been facilitated by the mobility provided by the car. This has led to increased isolation and puts access to opportunity even further out of reach for many low and moderate-income families.

In a more recent Kirwan Institute study "Equity, Opportunity and Sustainability in the Central Puget Sound Region" conducted as part of the Puget Sound Regional Council's Growing Transit Communities Partnership, these measures we expanded to include access to jobs and transportation. This more detailed study looked at a broader range of issues that illustrate the importance of transit as a tool for building more equitable and sustainable communities and expanding access to opportunity. Here it was revealed that while more prosperous suburban communities may have more access to opportunity, they are also areas with significant numbers of cost burdened households. These findings, when combined with those from The Center for Neighborhood Technology's "True Affordability Index" show some of the potential burdens that may await families seeking opportunity in outlying metropolitan areas. This often forces families to settle for housing in suburban areas that share many of the same plights as their former urban neighborhoods. It also highlights the critical role of public transportation in ensuring access to jobs and educational opportunities. This is why Transit Oriented Development strategies are such a critical smart growth tool and why it is important that we look at a more integrated approach in order to build a more equitable and sustainable metropolitan region.

All of this brings us full circle to the challenges presented by the exclusionary zoning practices that both our current fair share housing legislation and our statewide growth center initiatives are targeting. A recent report by Jonathan Rothwell of the Metropolitan Policy Program at Brookings showed that "large metro areas with the least restrictive zoning have housing cost gaps that are 40 to 63 percentage points lower than metro areas with the most exclusionary zoning". The report also argues "eliminating exclusionary zoning in a metro area would, by reducing the housing cost gap, lower its school test score gap by an estimated 4 to 7 percentiles".[12]

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[12] Rothwell, Jonathan; "Housing Costs, Zoning, and Access to High-Scoring Schools"
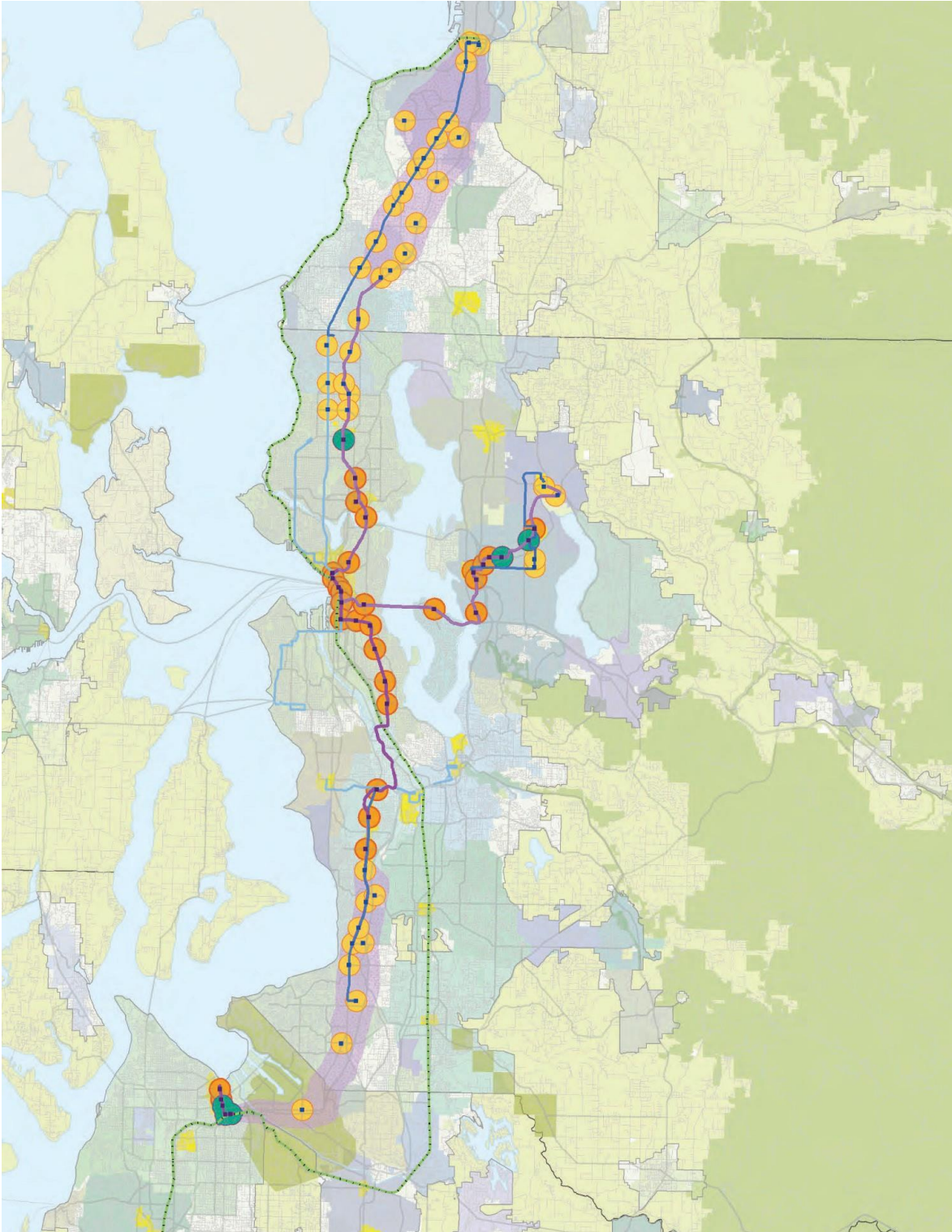
Growth Management Impacts

"Growth Control" programs, such as Portland Oregon's now famous Urban Growth Boundary, that constrain the supply of available land can artificially drive up the cost of the underlying land and in turn, can drive up the cost of housing. On the other hand "Growth Management" programs seek to mitigate this upward price pressure by using incentives such as allowing for increased densities and targeting public support to designated areas. In Portland, investment was focused on supporting vital new transit infrastructure (TOD). Since many Growth Management programs were put in place to combat runaway growth, it is difficult to isolate the root causes of rising housing costs in areas like Portland and Maryland. Smart growth programs like Maryland's that rely on a range of linked programs and incentives are also hard to evaluate due to the range of incentives and programs. In a low growth setting like Rhode Island it is also hard to attribute the lack of development to Land Use 2025 when the underlying economic factors have been so weak. However, the stipulation that all projects receiving state or federal funding must either be located within the USB or within a Growth Center does significantly limit the quantity, location and type of land available for the development of LMI housing in more rural areas.

Making Affordable Housing an Integral Element of Smart Growth

At its core, smart growth uses integrated local and regional policies to promote environmental, social and economic well-being and enhance quality of life. In "Affordable Housing and Smart Growth: Making the Connection", cosponsored by the Smart Growth Network and the National Neighborhood Coalition, Danielle Arigoni asserts that "ensuring an adequate supply, distribution and quality of affordable housing is a litmus test for smart growth". Anthony Downs, in his introduction to Growth Management and Affordable Housing concludes that, "programs encouraging growth management will in fact promote affordable housing only if advocates of both goals work closely together to overcome entrenched resistance to affordable housing". The fact is that both have faced steep battles in gaining acceptance among the general public and in getting major policies in place. Both face entrenched NIMBYism and have been loath to muddy their arguments or distract attention from their core aims by expanding the already daunting task that they face; however, their arguments are so integral that they cannot afford to go it alone.

A major roll back in home prices has already hit suburban landowners, making the specter of declining property values especially difficult to confront. Clearly this is a critical issue and consequently it has been the focus of many studies. Recent academic research into past studies and incorporating new data, suggests that these fears are largely unjustified.[13] Well planned and well integrated projects have been clearly shown to have no negative effects on home values and the new investment in an otherwise declining area can actually raise surrounding home prices. The qualification arises from the predictable consequences of over concentrating affordable housing - a practice that is not currently advocated and that most affordable housing programs expressly seek to combat. The data is slightly more mixed on rental vs. homeownership developments, with high concentrations of rental units being more likely to show negative effects. Smart Growth advocates investing in existing neighborhoods already served by infrastructure and services and it is in these areas that the highest positive effects of

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[13] Downs "Growth Management and Affordable Housing" & Ellen, Schwartz & Schill "Don't Put it Here" both include assessments of broad ranging multi-faceted studies and reach the same conclusion – that there is no net negative impact and that in fact there are often positive impacts.

investments in affordable housing can be found. In neglected neighborhoods throughout Rhode Island, investments in affordable housing have been a proven redevelopment tool. However, this can have the unfortunate impact of raising the desirability of the area and hence the housing costs.

Analysis: The Rhode Island Experience

Background

As we approach the 10-year anniversary of the 2004 Housing Act and the 2006 introduction of Land Use 2025, it is only appropriate that we have a look at these programs and more specifically their relationship to one another. In rural portions of Rhode Island the perceived conflict between LMI Housing and Smart Growth is most pronounced. The Comprehensive Planning and Land Use Act of 1988 gave each local community the responsibility for producing their own Comprehensive Plan meeting specified statewide standards. The Housing Act of 2004 required that they also prepare an Affordable Housing Plan. This plan was ultimately to be incorporated into the Housing element of the Comprehensive Plan. Since the Housing Act of 2004 predated the 2006 growth center provisions of "Land Use 2025", many of the sites initially identified to fulfill the mandated 10% housing goal were not identified with smart growth criteria in mind. This meant that, in rural areas outside of the urban service boundary, these sites often were not within areas ultimately identified as Growth Centers. Since Land Use 2025 stipulates that projects outside of the Urban Service Boundary (USB) that are funded using state or federal assistance must be located with designated Growth Centers, sites for LMI housing in more rural parts of the state were highly constrained. This compounds the already substantial costs associated with building water and sewer infrastructure to support the housing densities required for LMI housing.

A slow economy has meant that many rural communities have made limited progress toward LMI housing goals. There has also been limited pressure on communities to more clearly delineate Growth Centers and to implement the necessary zoning and housing provisions. This slow rollout was largely due to the lack of real incentives to adopt Growth Center designations and policies. Although this left community's vulnerable to Comprehensive Permit projects, many communities preferred to preserve even declining historic village centers rather than see new development.

Most rural villages in Rhode Island began their lives as grits mills or later textile mills. This close relationship to the local waterways and the lack of water and sewer infrastructure make any form of development costly. Some potential Growth Centers like Little Compton have high water tables, while others in Exeter have limited access to water. Historic Villages also have more complex ownership patterns than green-field opportunities outside of more traditional rural centers. While Comprehensive Permits can result in uncoordinated and ultimately unsustainable development of affordable housing often costing municipalities substantial resources for maintenance and services, most projects have been located with some sensitivity to smart growth criteria to the extent that such criteria have been included within local comprehensive plans. However, in a more robust housing market, there is little doubt that greenfield sites would continue to lost to development at a time when local agricultural activity has seen an impressive resurgence. This land, once developed, is lost for good.

Demographic Analysis

As we have already noted in Part I of this study, the western and coastal (Rural) areas of the state are growing at a rate that far outpaces that of the 5 traditional urban core cities and Providence's inner ring suburbs. This is a general trend that is anticipated to accelerate over the next 25 years. While Providence is projected to have modest growth, Woonsocket, Newport and

Warwick are all anticipated to see over 10% declines.[14] This makes it imperative that we plan carefully for these anticipated changes and that we not burden the state with wasteful spending on infrastructure and services. 60% of the state's population is divided equally between the 5 urban cores and their inner ring suburbs. The remaining roughly 40% is divided equally between the outer ring suburbs and the combined coastal and western communities.

Using the more traditional Urban / Suburban / Rural categories, rural populations are climbing; but they still make up only roughly 17% of the state's population, with just under 60% of the population in urban areas. At the same time these communities provide 74% of the affordable housing. Providence alone accounts for 17% of the state's population and holds 28% or its LMI housing. By contrast communities identified as "rural" contain almost the same population as the City of Providence; but contribute only 8.5% or ½ the share of the states LMI housing.[15] This burden is, on many levels, unfair; but perhaps not completely unaccounted for in our historical settlement patterns. Suburban communities likewise need to take on a greater share of the LMI housing since they have more than a quarter of the state's population, but account for less than 17.56% of the LMI housing. All of these communities, unlike the rural communities, have the advantage of access to water and/or sewer infrastructure.

The Cost of Housing in Rhode Island
In addition to the high cost and relative scarcity of land, the overall cost of housing is more expensive in Rhode Island and the availability of low cost housing is significantly less. According to the American Community Survey (2009 data) the median rental is $890 vs. $842 per month nationwide and home ownership costs are significantly above the median values coming in at $1,542 vs. $1,111 nationwide. Median home values paint a more dramatic picture with Rhode Island at $267,100 compared with only $185,200 nationwide. This is primarily driven by the fact that 76.8% of homes in RI are valued at over $200,000 and only 4.1% at under $100,000. This compares with a much more even distribution of 46.3% and 23.3% nationwide, with 30.4% valued between $100, 000 and $199,999. Only 19.2% of the homes in Rhode Island are valued between 100 and $199,999.[16]

If we look at "cost burden" figures for those who own their homes (those families who spend over 30% of their budget toward their housing costs), urban areas have a higher percentage of cost burdened households. Of the state's five traditional urban cores, all have 40% or more of their households ranking as cost burdened and Central Falls tops the list at 63%. Consequently, this area has been particularly hard hit by foreclosures. The gap between cost burdened renters and homeowners is 10% with an average 47% of renters being cost burdened. Here Providence is highest of the five traditional urban cores at 54% joined by suburban communities with constrained rental markets such as East Greenwich and Barrington and at 48 and 52%, while more rural communities such as West Greenwich and Exeter top the list at 64 and 65%.[17] Given that these communities have 2 acre zoning the barriers for families of low to moderate means are substantial and their trailer parks are full to capacity.

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[14] http://www.planning.ri.gov/geodeminfo/data/popprojections.php

[15] The Urban / Suburban / Rural demarcations are particularly tricky since Rhode Island's settlement patterns were well formed prior to the advent of suburbanization. Based on 2010 figures. See appendix.

[16] U.S. Census Bureau, 2009 American Community Survey

[17] U.S. Census Bureau, ProvPlan Rhode Island Community Profiles 2010

Given the low transit usage in these areas (less than 1%), and the fact that 21% of rural commuters have commutes of more 40 minutes, transportation costs will be higher. While 90% of Rhode Island households own a car. The percentage of households without a car in suburban regions (6.9%) is twice that in rural areas (3.4%) and for Providence (at 23%) the figure is almost 7 times as great.[18] The Center for Neighborhood Technology has developed a previously mentioned measure of affordability and location efficiency called the H+T Affordability Index. They use information, such as the census data above, to determine the probable aggregate costs average regional household. By keeping household characteristics the same across a region, we get a more uniform view of relative costs across the metropolitan landscape. Using their "Abogo" application we tabulated the money an average household (from the Providence, Fall River, New Bedford Metropolitan Statistical Area) would spend for transportation for each town in Rhode Island. According the H+T Affordability Index those living in rural segments of the state spend 29% of their income on transportation in contrast with 20% for urban areas. What this information and the corresponding mappings tell us is that with a household income of $55,652 there are a range housing options below the 30% cost burden threshold; however, once the transportation costs are added in options shrink and the five urban cores become the most cost effective places to live.

The Costs of Opportunity

There is a striking inverse correlation between the H+T Affordability Index mappings and the Opportunity mappings of Rhode Island produced by the Kirwan Institute. This is due in large part to the obvious correlation between the cost of housing and the desirability of the location of that housing. It is a well-documented fact that households are willing to pay a significant premium to be in a community with good schools. Similar measures of the security and stability of a neighborhood also contribute to the investment value of a property as well as its desirability. However, there is also a cost to the increased isolation and lack of diversity that suburban flight has caused. Recent studies support the notion that, given access to better schools, underprivileged students do improve their performance.[19] Schools are just one of a range of environmental factors that contribute to a young person's ability to reach their full potential; however it is clear that in more integrated and diverse communities the performance gaps between various racial groups are significantly deceased.[20] These school performance gaps represent one of the most persistent issues impacting Rhode Island's economic competitiveness as a region and our ability to provide economic opportunities to that segment of our population that is least equipped for the service or knowledge based jobs of the future. In light of this research HUD has increasingly supported voucher programs and other initiatives that increase housing choice (options). The principle of housing choice is also a fundamental component of Smart Growth and is critical if these choices are to support the changing economic and social dynamics that characterize a vital metropolitan region.

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17 id.

[19] Rothwell, Jonathan; Op. Cit.

[20] Ibid. pg. 3

Opportunity Mapping Comprehensive Score					
	Inside GCs		Outside GCs		
Low	3,856	11.99%	7,713	23.99%	11,569	35.99%
Medium Low	1,274	3.96%	6,269	19.50%	7,543	23.46%
Medium	873	2.72%	4,498	13.99%	5,371	16.71%
Medium High	357	1.11%	3,478	10.82%	3,835	11.93%
High	738	2.30%	3,093	9.62%	3,831	11.92%
	7,098	22.08%	25,051	77.92%	32,149	100.00%

LMI Housing and Land Use 2025

The Urban Service Boundary (USB) established by Land Use 2025 contains 98% of the state's LMI housing; however, only 22% of that housing is located within the 67 loosely defined Growth Centers identified during the recent RoadMAP RI process. For the purposes of this study we have used a uniform half-mile radius from the location designated by Statewide Planning and RoadMAP RI. Of these 7,018 LMI units, only 80 units (.25%) are located in Growth Centers outside of an USB.[21] Unfortunately, as has been discussed elsewhere, not enough communities have clearly delineated their Growth Centers. While the number of LMI units within Growth Centers is likely to grow once that process is complete, it represents many of the challenges when working within more rural circumstances. A visual survey of the mapping indicates that many of the existing rural LMI units are within striking distance of a growth center or are located in an area that has some access to existing infrastructure and services.

When using criteria developed from the goals of Land Use 2025 to measure the smart growth performance of developed and undeveloped land (see Part I of this report), 75% of LMI housing is found in areas that rank as high performing; and 55% of those housing units were not within a ½ mile radius of the GIS location for the growth center. This is not an exact measure; however, it suggests that, while the Growth Center initiative is still developing, most LMI housing is located with smart growth criteria in mind. Chief among these is access to public transportation. 92% of LMI housing is located within a .5 mile of a RIPTA stop and the number jumps to 97% if we include housing within 5 miles of a RIPTA Park and Ride.

Urban Service Boundary and Growth Centers					
	Inside GCs		Outside GCs		
Inside USB	7,018	21.83%	24,386	75.85%	31,404	97.68%
Outside USB	80	0.25%	665	2.07%	745	2.32%
	7,098	22.08%	25,051	77.92%	32,149	100.00%

Developed Land Use Areas					
	Inside GCs		Outside GCs		
Residential -Low	53	0.16%	26	0.08%	79	0.25%
Res -Medium Low	0	0.00%	38	0.12%	38	0.12%
Res -Medium	136	0.42%	1,693	5.27%	1,829	5.69%
Res -Medium High	516	1.61%	2,529	7.87%	3,045	9.47%
Res -High	2,520	7.84%	13,638	42.42%	16,158	50.26%
Institutional	439	1.37%	371	1.15%	810	2.52%
Industrial	206	0.64%	434	1.35%	640	1.99%
Commercial	3,228	10.04%	6,322	19.66%	9,550	29.71%
	7,098	22.08%	25,051	77.92%	32,149	100.00%

Smart Growth Performance					
	Inside GCs		Outside GCs		
Low	141	0.44%	810	2.52%	951	2.96%
Medium	753	2.34%	6,413	19.95%	7,166	22.29%
High	6,204	19.30%	17,828	55.45%	24,032	74.75%
	7,098	22.08%	25,051	77.92%	32,149	100.00%

Jobs and Housing

Connecting jobs to housing is a key smart growth and affordable housing goal; however only 24% of LMI units are located within medium high - high job areas. These are areas with over 5 jobs per acre. Interestingly, LMI housing located within a Growth Center is twice as likely to be in a "med. high – high" job region. One half of all LMI housing in growth centers is in a commercial or mixed-use zone and 40% are in "High Density" residential regions. Only 26% of LMI housing outside of a growth center is in a commercial or mixed-use zone. Given the coarse nature of the census level Jobs data in low population areas, the Land Use data is perhaps more telling, however, the findings show a clear correlation.

Access to Services

While access to services or social assets can be important for families with limited resources (and limited mobility), proximity to existing services can also reduce the cost burden of new development for local communities and protect the environment. 86.5% of LMI housing within growth centers is within a quarter mile walking distance of a school. This compares with 53% for housing outside of a growth center. Existing LMI housing within a Growth Center is also more than 5 times as likely to be within a quarter mile walking distance of the town hall and 3 times as likely to be within a quarter mile walking distance of a library, police or fire services.

Jobs / Acre							
	Inside GCs		Outside GCs				
Low (< 1 per acre)	1,888	5.87%	6,040	18.79%	7,928	24.66%
Med. Low (1-2 per acre)	1,003	3.12%	6,571	20.44%	7,574	23.56%
Medium (2-5 per acre)	1,329	4.13%	7,678	23.88%	9,007	28.02%
Med. High (5-10 per acre)	1,130	3.51%	3,076	9.57%	4,206	13.08%
High (> 10 per acre)	1,748	5.44%	1,686	5.24%	3,434	10.68%
	7,098	22.08%	25,051	77.92%	32,149	100.00%

RIPTA / Park and Ride Stops						
	Inside GCs		Outside GCs			
RIPTA Stops (1/2 mile)	6,931	21.56%	22,654	70.47%	29,585	92.02%
Park and Ride (5 miles)	6,759	21.02%	24,535	76.32%	31,294	97.34%

Water and Sewer Supply Regions						
	Inside GCs		Outside GCs			
Water Supply	6,906	21.48%	24,210	75.31%	31,116	96.79%
Sewer Supply	6,364	19.80%	22,991	71.51%	29,355	91.31%
Water and Sewer Supply	6,364	19.80%	22,743	70.74%	29,107	90.54%

Social Assets (1/4 Mile Radius)						
	Inside GCs		Outside GCs			
EMS	1,377	4.28%	2,618	8.14%	3,995	12.43%
Fire Station	2,600	8.09%	3,696	11.50%	6,296	19.58%
Police Station	2,017	6.27%	2,806	8.73%	4,823	15.00%
Library	2,186	6.80%	2,546	7.92%	4,732	14.72%
School	4,866	15.14%	13,336	41.48%	18,202	56.62%
Town Hall	1,842	5.73%	922	2.87%	2,764	8.60%

Recommendations

Smart Growth
- Establish County level housing and planning assistance to support the identification and demarcation of Growth Centers and the implementation of LMI housing plans. This county-wide assistance would be coordinated at the state level and work with local officials and planning boards to balance local, county and statewide goals.

- Provide model overlay zoning for each type of growth center to assist in the implementation of required zoning changes.
- Tie Growth Center designation to an analysis of land suitable to meet anticipated housing needs including LMI housing counting toward the community's 10% goal.
- Implement a countywide Transfer of Development Rights policy.

LMI Housing
- Incentivize progress toward LMI Housing goals by granting amnesty from appeals to communities that have met specific performance targets. These targets could be tied to overall housing production levels to account for market conditions.
- In built out communities or in rural communities, tie the identification of LMI housing sites to number and capacity of proposed Growth Centers.
- Incentivize Inclusionary Zoning by raising the required minimum for LMI housing in Comprehensive Permit projects from 25% to "25% or the current inclusionary zoning rate + 10%" to reward communities that have aggressive inclusionary zoning provisions.
- Tie State funding for education to progress toward the State's 10% LMI housing goals.
- Countywide support and coordination efforts can help provide support for underfunded or understaffed municipalities.
- Holding Comprehensive Permits to Smart Growth principles (see MA smart growth principles)
- Avoid arbitrary jurisdictional boundaries. Allow towns to work together to provide affordable housing. Allow communities to invest in affordable housing within a certain distance from their town boarder. Towns that share regional school systems should be allowed to collaborate and share affordable housing assets.
- County wide support and coordination efforts can help provide support for underfunded or understaffed municipalities.

Conclusion

This study has focused on rural Growth Centers due primarily to the rapid growth in these areas and the difficulties in building at a density that is typically needed for the production of affordable housing. Eleven of the 21 Growth Centers identified in Land Use 2025 where outside of the Urban Service Boundary (USB). With RoadMAP RI, the number of designated centers has risen to 67 with 17 of these or 25% outside of a USB. Some of these communities have made significant progress toward their LMI housing goals, albeit from very modest starting points. Rural communities contributed 560 LMI units between 2006 and 2012; however, of the 1,913 total LMI housing units added, 1,342 were in the 3 cities of Providence, Pawtucket and Central Falls (several other urban and suburban communities actually lost housing units as well as population). To achieve their 10% share of the regional LMI housing, rural communities with Growth Centers outside of an USB, would have to more than double their current number of LMI housing units, giving them a significant numerical challenge on top of the obvious physical and planning challenges already discussed. These communities are also projected to grow an average of 16% in population by 2040. A good portion of this growth, along with the needed LMI housing, will need to be accommodated in rural Growth Centers if the state's overall LMI housing and growth management goals are to be met.

In Rhode Island, many of the most impoverished areas are in the former industrial cores of Providence, North Providence, Pawtucket, Central Falls, and Woonsocket. These areas contain

over one half of the states LMI housing and are plagued with high levels of entrenched poverty and unemployment. Urban areas account for 74% of all LMI housing; however, they also have many of the physical characteristics associated with Smart Growth. They are high-density walkable neighborhoods that once had proximity to jobs as well as a host of other amenities and infrastructure; however, they are also anticipated to see declining populations over the next 25-30 years. If we are to maximize our investment in existing infrastructure and resources, we must find a way to make these traditional population and job creation centers vital hubs once again. While this might absorb some of the pressure for outward expansion, we must also ensure that the development of existing town and village centers in more rural areas is prioritized over green field development. This may require additional investments in water and sewer infrastructure as well as incentives or adjustments to the tax structure to make development in Brown or Grey field sites more attractive. This would be in addition to the existing incentives for the preservation of historic structures that have been instrumental in aiding in the restoration of our housing stock and the repurposing our industrial heritage.

Investing in our existing cities, towns and villages means leveraging our existing infrastructure; however, this will only work if these areas also have access to good educational and employment opportunities. Only by developing at increased densities can we create population levels conducive to a more efficient and effective public transit system that can help to break down access to opportunities and lower the cost burdens associated with our high costs of housing and transportation. Existing LMI housing is well located in terms of access to public transit; however, housing located in Growth Centers is significantly more likely to have access to schools, services and commercial areas further reducing car dependency and increasing affordability.

Reducing the levels of entrenched poverty, integrating new levels of immigration from Latin America and educating our workforce for 21st century job in a knowledge-based economy are some of the greatest challenges we face. Housing choice and affordability are critical if we are to improve workforce housing to reduce the jobs / housing mismatch that exists in many suburban communities. This means making urban living more attractive for those the work in the city and increasing access to low cost housing for those working low cost jobs in more outlying areas. In more rural areas it means targeted zoning changes and investments in infrastructure that will facilitate greater mobility and housing choice. Equally entrenched and exclusionary zoning policies in rural areas have also contributed to the slow pace of change in more rural areas. These patterns have traditionally tied to the lack of water and sewer infrastructure. Coordinated regional efforts would allow for the more equitable distribution of LMI Housing and resources to support it. Local governments are not effective means for addressing regional issues. Some form of regional governmental oversight and assistance is required to move these efforts forward. Similarly, Housing (like education) is a critical economic and social policy area, should be funded in a way that supports larger regional and metropolitan goals. There are also many things that can be done to promote housing choice using unsubsidized units. The lack of rental housing in Rhode Island greatly impacts the mobility of our workforce and its ability to meet the demand of a changing economic landscape.

Appendix:

**Growth Trends 1980 – 2010 / 2010 - 2040**
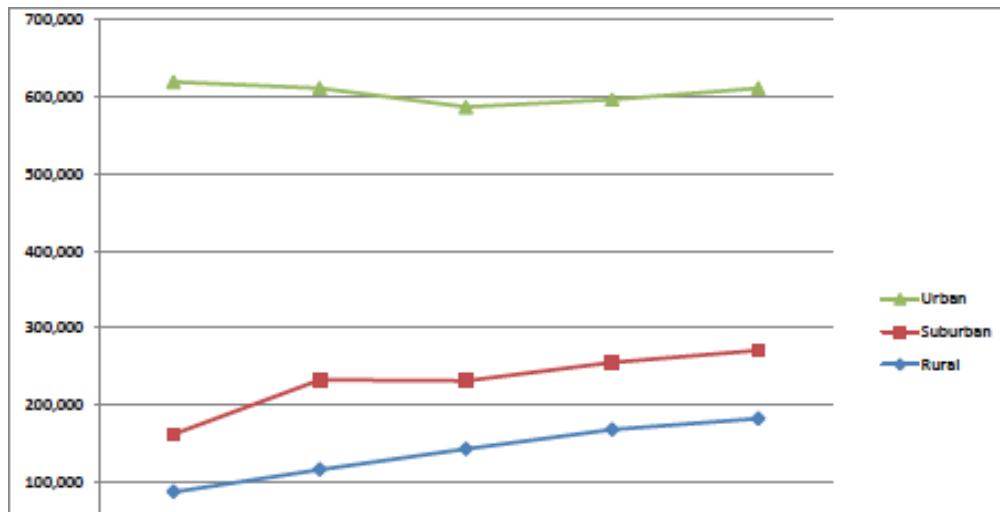
|			1960	1970	1980	1990	2000
South Kingstown	Rural	Coastal	11,942	16,913	20,414	24,631	27,921
New Shoreham	Rural	Coastal	486	489	620	836	1,010
Charlestown	Rural	Coastal	1,966	2,863	4,800	6,478	7,859
Little Compton	Rural	Coastal	1,702	2,385	3,085	3,339	3,593
North Smithfield	Rural	Outer Ring	7,632	9,349	9,972	10,497	10,618
Tiverton	Rural	Outer Ring	9,461	12,559	13,526	14,312	15,260
Scituate	Rural	Western	5,210	7,489	8,405	9,796	10,324
Burrillville	Rural	Western	9,119	10,087	13,164	16,230	15,796
Hopkington	Rural	Western	4,174	5,392	6,406	6,873	7,836
Richmond	Rural	Western	1,986	2,625	4,018	5,351	7,222
Burrillville*	Rural	Western	9,119	10,087	13,164	16,230	15,796
Coventry	Rural	Western	15,432	22,947	27,065	31,083	33,668
Exeter	Rural	Western	2,298	3,245	4,453	5,461	6,045
Foster	Rural	Western	2,097	2,626	3,370	4,316	4,274
Glocester	Rural	Western	3,397	5,160	7,550	9,227	9,948
West Greenwich	Rural	Western	1,169	1,841	2,738	3,492	5,085
			87,190	116,057	142,750	168,152	182,255
Jamestown	Suburban	Coastal	2,267	2,911	4,040	4,999	5,622
Narragansett	Suburban	Coastal	3,444	7,138	12,088	14,985	16,361
Westerly	Suburban	Coastal	14,267	17,248	18,580	21,605	22,966
Johnston	Suburban	Inner Ring	17,160	22,037	24,907	26,542	28,195
Lincoln	Suburban	Inner Ring	13,551	16,182	16,949	18,045	20,898
Middletown	Suburban	Inner Ring	12,675	29,290	17,216	19,460	17,334
Barrington	Suburban	Outer Ring	13,826	17,554	16,174	15,849	16,819
Bristol	Suburban	Outer Ring	14,570	17,860	20,128	21,625	22,469
Cumberland	Suburban	Outer Ring	18,792	26,605	27,069	29,038	31,840
East Greenwich	Suburban	Outer Ring	6,100	9,577	10,211	11,865	12,948
Smithfield	Suburban	Outer Ring	9,442	13,468	16,886	19,163	20,613
Warren	Suburban	Outer Ring	8,750	10,523	10,640	11,385	11,360
North Kingstown	Suburban	Outer Ring	18,977	29,793	21,983	23,786	26,326
Portsmouth	Suburban	Outer Ring	8,251	12,521	14,257	16,857	17,149
			162,072	232,707	231,128	255,204	270,900
Cranston	Urban	Inner Ring	66,766	74,287	71,992	76,060	79,269
East Providence	Urban	Inner Ring	41,955	48,207	50,980	50,380	48,688
North Providence	Urban	Inner Ring	18,220	24,337	29,188	32,090	32,411
Warwick	Urban	Inner Ring	68,504	83,694	87,123	85,427	85,808
Central Falls	Urban	Old Central City	19,858	18,716	16,995	17,637	18,928
Newport	Urban	Old Central City	47,049	34,562	29,259	28,227	26,475
Pawtucket	Urban	Old Central City	81,001	76,984	71,204	72,644	72,958
Providence	Urban	Old Central City	207,498	179,116	156,804	160,728	173,618
Woonsocket	Urban	Old Central City	47,080	46,820	45,914	43,877	43,224
West Warwick	Urban	Outer Ring	21,414	24,323	27,026	29,268	29,581
			619,345	611,046	586,485	596,338	610,960

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MAPPING:

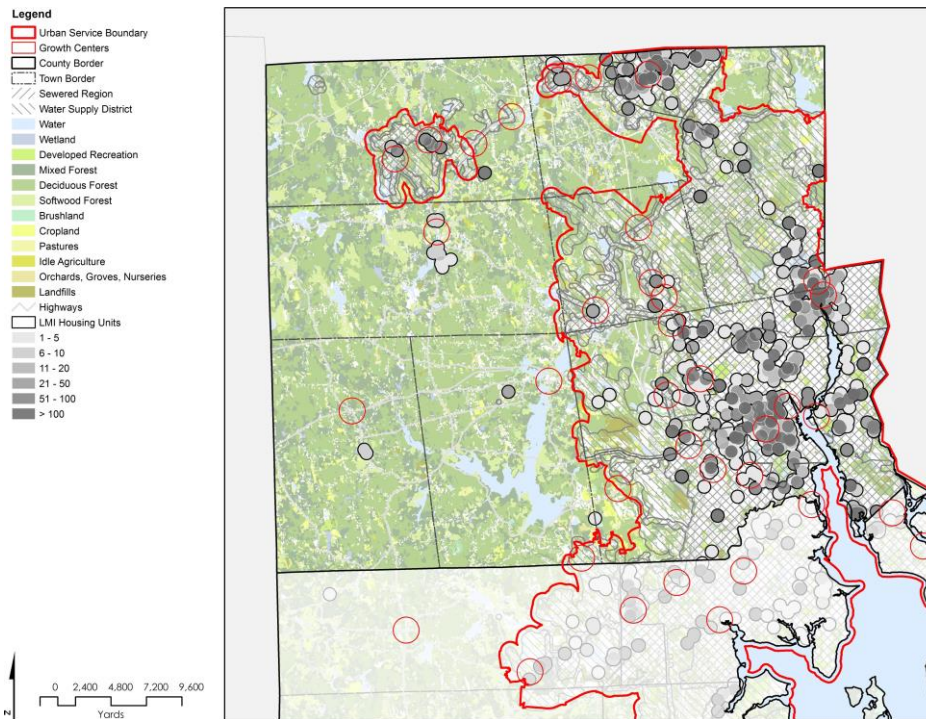**LMI Housing and Growth Centers / USB: Smart Growth Performance**
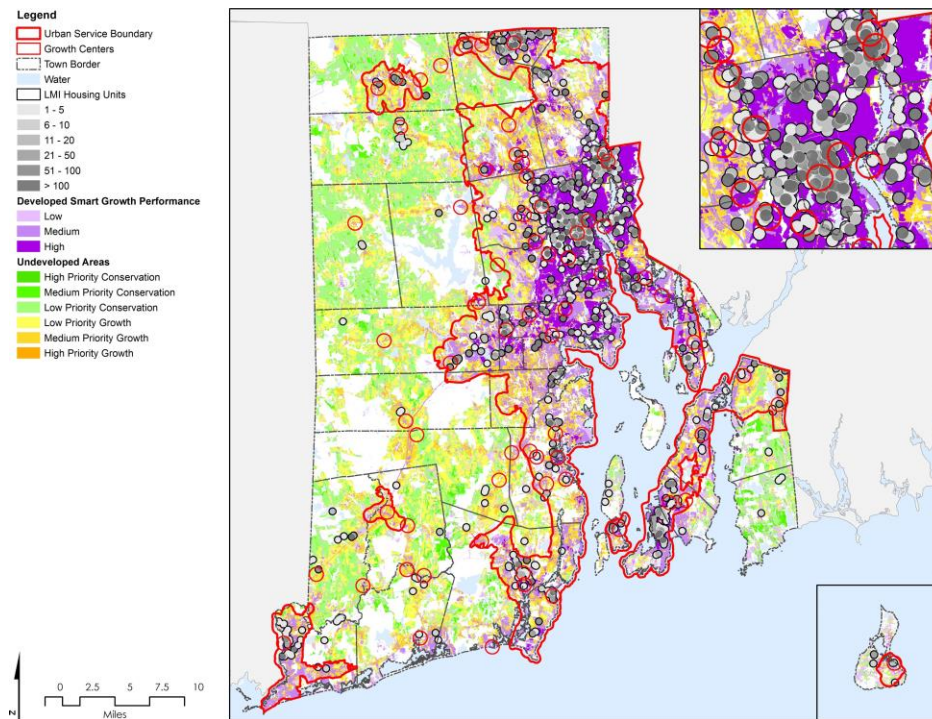
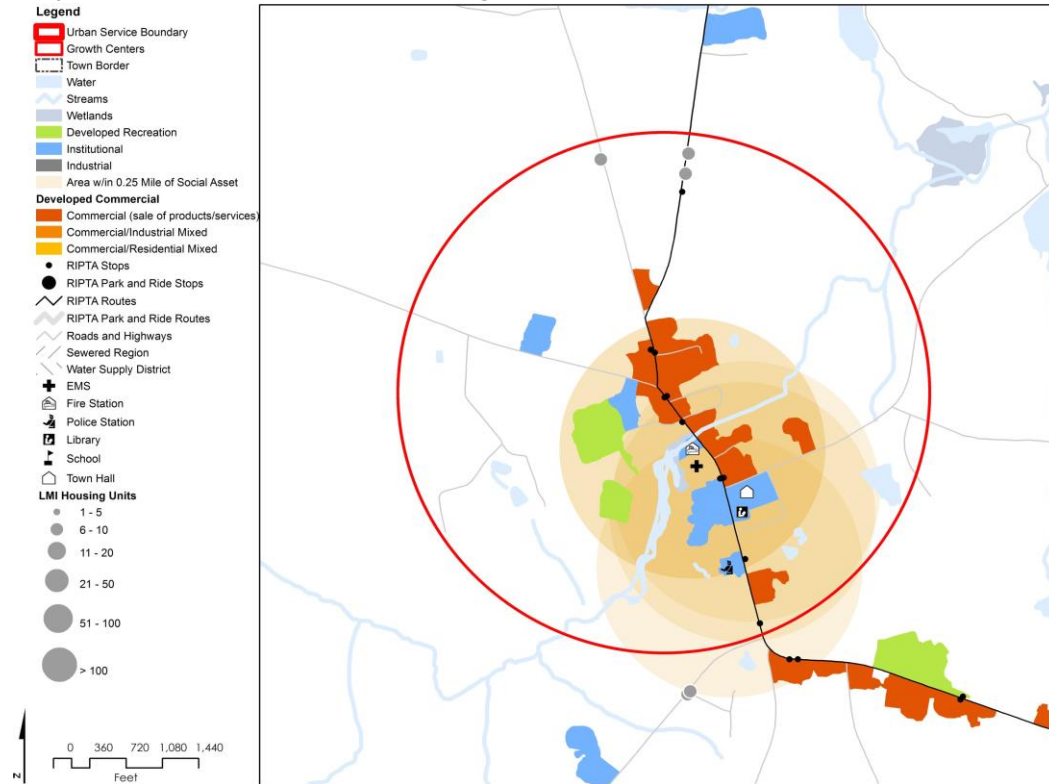**LMI Housing and Opportunity Index: Kirwan Institute**
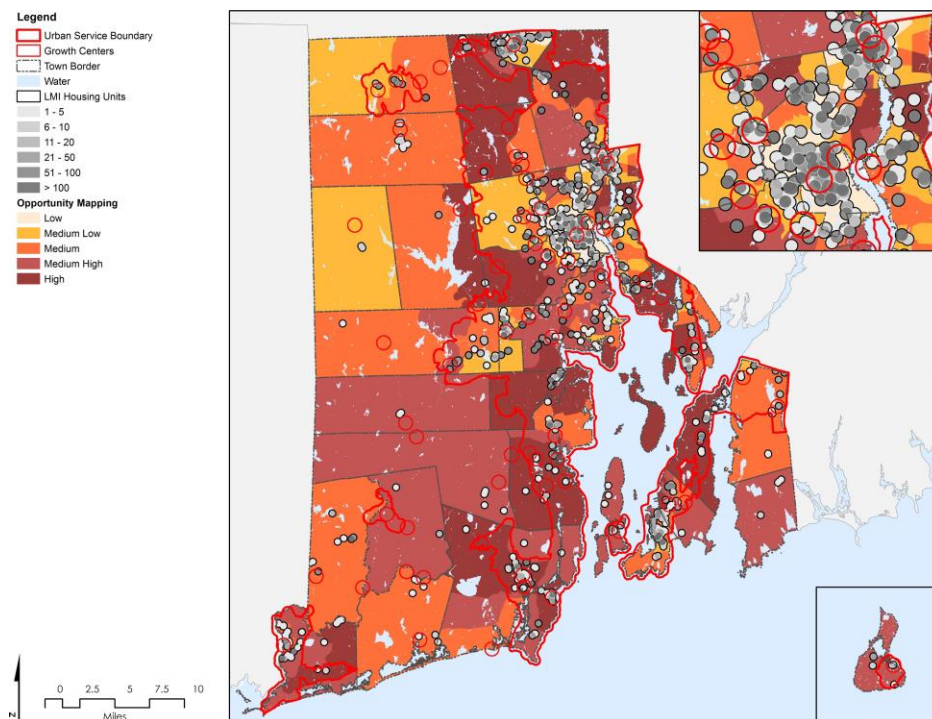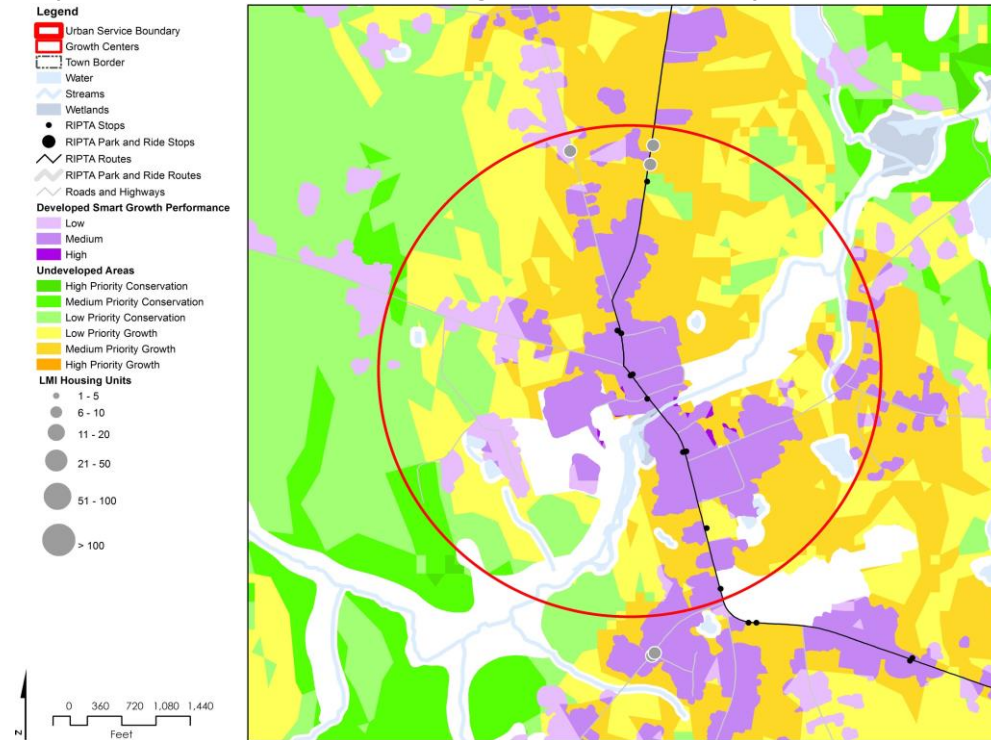
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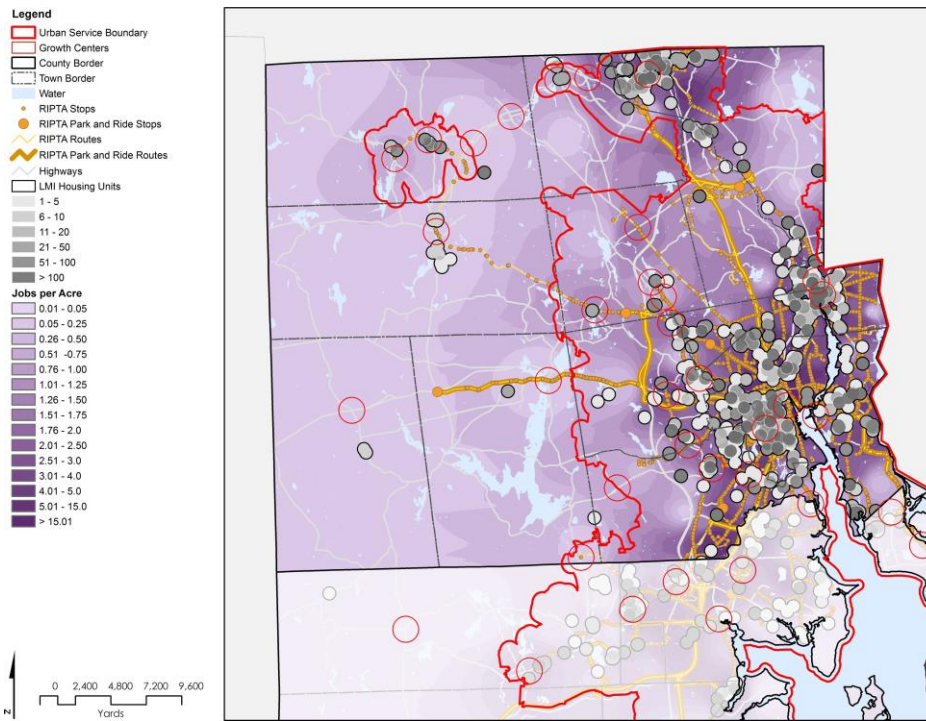
Providence County Environmental Land Use

Chepachet Growth Center: LMI Housing / Social Assets

Chepachet Growth Center: LMI housing / Smart Growth Analysis

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Regulatory Changes: Unexpected Consequences for Non-Accelerated Filers

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Abstract

Regulations implemented by the SEC in 2003 and 2004 simultaneously shortened the financial statement filing deadlines and increased the required preparation time for both the financial statements and the related audit of accelerated filers (AFs). However, there were unintended negative consequences for companies not subject to the regulations, namely non-accelerated filers (NAFs). The new regulations imposed strains on auditor resources requiring them to make resource allocation decisions that negatively affected NAFs. We find that NAFs with an auditor who had a high proportion of AF clients had longer audit delays after the regulations were implemented than NAFs of an auditor with a low proportion of AF clients. Further, we document that NAFs with a high-proportion AF auditor are more likely to change auditors than NAFs with a low-proportion AF auditor. Finally, NAFs changing to a lower-AF proportion auditor experience shorter audit delays after the auditor change.

I. INTRODUCTION

Regulatory reform in the early 2000s has simultaneously increased both the pressure and the difficulty of providing timely financial information. Most notably, effective in 2003, new regulations tightened the 10-K (10-Q) filing deadlines from 90 (45) to 75 (40) days (SEC 2002). One year later, reporting and audit requirements increased, requiring public companies and their auditors to document, test, and report on companies' internal control structure under Section 404 (a) and (b) of the Sarbanes-Oxley Act (further referred to as Section 404) and PCAOB Auditing Standard No. 2. Although wide-reaching, these regulations were not applied across the board for all public companies. Smaller public companies deemed "non-accelerated filers" (NAFs) were never subject to the tightened filing deadlines, and implementation of Section 404 (a) was delayed until fiscal years ending on or after December 15, 2007, allowing more time for smaller companies to prepare. The requirement for auditor attestation (i.e., Section 404 (b) and AS No. 2) on NAFs' internal controls was never implemented and these companies were permanently exempted in June 2010, consistent with regulators' recognition and the public accounting industry's opinion that the costs of implementing such a requirement would be too significant to justify the benefits (Ernst & Young 2005; SEC 2006).

The combination of the regulations has resulted in a heightened concern among regulators, clients, auditors, and academics about financial reporting timeliness (Krishnan and Yang 2009; Bronson, Hogan, Johnson, and Ramesh 2011; Abbott, Parker, and Peter 2012; Whitworth and Lambert 2014; Lambert, Jones, Brazel, and Showalter 2017). Prior studies find that despite the expedited availability of 10-Ks/10-Qs, there was an increase in audit delay for accelerated filers (AFs) around the implementation of these regulations and suggest that it was primarily due to more work for both the company and the auditor (Krishnan and Yang 2009;

Bronson et al. 2011).[1] While these prior studies have limited evidence on how these regulatory changes affect the audit delays of NAFs, none of these studies have considered this impact in the context of auditor resource allocation decisions between AFs and NAFs. We argue that in times of high client demand, which is evidenced in this setting, audit firms find themselves resource-constrained, and have to make resource allocation decisions that may benefit one client over another. We propose that because of auditor resource constraints caused by auditors' needs to meet the new regulations for AF clients, NAFs, who comprise a significant group of market participants (25% across 67 industries based on our analysis), suffered less timely disclosure of information crucial for their investors (Bhushan 1989; Gomes et al. 2006; Krishnan and Yang 2009; and Cabral 2016).

Our focus on audit report timeliness is motivated by recent literature showing that audit report timeliness impacts the quality of SEC filings and earnings announcements. Blankley, Hurtt and MacGregor (2014) document that longer audit delays are associated with a higher likelihood of restatements. While recent findings show that more companies counteract this delay with sooner earnings announcements, research also finds these early earnings announcements are of lower quality. Specifically, earnings announcements made prior to audit completion are more likely to experience earnings revisions in subsequent SEC filings (Bronson et al. 2011), less likely to contain detailed financial statement disclosure (Schroeder 2016), experience an attenuated reaction by the stock market (Marshall, Schroeder, Yohn 2016), and are associated with higher audit fee, lower financial reporting quality, and a higher likelihood of subsequent auditor turnover (Bronson, Masli and Schroeder 2014). Therefore, timeliness of the audit report is important for reporting quality.

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[1] We use the term "accelerated filers" throughout the paper for both accelerated filers and the eventually designated subset "large accelerated filers".

Using a sample of audit reports over the period 2000 to 2006, we find that NAFs experienced a significant increase (i.e., over nine days) in the average length of time between the fiscal year-end and the audit report date ("audit delay") after the SEC mandated Section 404 and tightened filing deadlines (further referred to as combined regulations) for AFs. While this increase in audit delay is likely partially due to heightened regulatory and investor scrutiny across all filers in the post-SOX era, our contention is that this increase is also a result of auditors making resource allocation decisions that were to the detriment of NAFs. The additional workload and compressed reporting timeline for AFs apply further pressure on auditors to put their first efforts toward meeting those needs, relegating NAFs to a lower priority and resulting in longer audit delays after 2003. Specifically, we hypothesize that auditors with a high proportion of AFs experienced an increase in resource constraints, due to the enactment of the combined regulations, and the increase in audit report delays is greater for NAFs with these auditors than for those with low AF-proportion auditors

We further conjecture that NAFs with auditors who have a high proportion of AFs may become more dissatisfied with their auditors or these auditors may decide to resign from their NAF clients because of the constrained resources. For NAFs whose auditors have a high proportion of AF clients, we find consistent evidence that auditor changes are more likely after the combined regulations took effect for AFs. In addition, the increase in the likelihood of changing auditors after the combined regulations is greater for NAFs with a high AF-proportion auditor than NAFs with a low AF-proportion auditor. Finally, we examine whether the auditor change strategy was successful and find that NAFs changing to a lower AF-proportion auditor experience an improvement in audit report delay after the auditor change. Moreover, these NAFs

experience a larger improvement in audit report delays after the auditor change compared with NAFs changing to a higher AF-proportion auditor.

Our results are important for a number of reasons. While prior research has investigated the timeliness implication of these regulations, they do not focus on the timeliness implication on NAFs and specifically consider the effects of auditor resource allocations. Although NAFs are smaller, they make up a reasonably large portion of all public companies (PCAOB 2015) and are significant enough for various regulators to establish offices and committees to address the needs of these smaller firms.[2] Thus any negative effects on these companies can be wide-reaching. In addition, significantly less analyst following and media coverage for smaller firms, especially in the post-Regulation Fair Disclosure era, (Bhushan 1989; Gomes et al 2006; and Cabral 2016) increases the importance of timely financial reporting (Krishnan and Yang 2009) as these other information channels are more limited for these smaller firms. Moreover, as discussed by Leuz and Wysocki (2016), there is a "paucity of evidence on market-wide effects from regulation, especially on externalities," (p. 529). We expand the knowledge base; while regulators were attempting to improve information of large companies (i.e., AFs) and save reporting costs for small companies (i.e., NAFs), they perhaps did not fully consider the unexpected costs on smaller companies and their investors. The reduced auditor attention and increased reporting delays of NAFs should be examined in evaluating the success of the combined regulations. Finally, while others have researched auditor resource constraints/allocation, this is the first study to investigate regulatory-induced auditor resource constraints. As such, we have a data

[2] These offices and committees include SEC's Office of Small Business Policy (http://www.sec.gov/info/smallbus/reachsec.htm), PCAOB's Forum on Auditing in the Small Business Environment (http://pcaobus.org/Featured/Pages/SmallBusinessForums.aspx), and FASB's Small Business Advisory Committee (http://www.fasb.org/jsp/FASB/Page/SectionPage&cid=1218220151740) (Bills, Cunningham and Myers 2016).

environment where the changes in the impact of the AF-proportion on audit delays over time is induced by regulatory changes, which are considered exogenous shocks.

The remainder of the paper proceeds as follows. The next section discusses the hypothesis development, followed by a discussion of the data. We follow this with development of the models used and the results. The final section contains our conclusion.

II. HYPOTHESIS DEVELOPMENT

Regulatory Changes

Prior to 2003, all public companies were required to submit their 10-K filings within 90 days of the company's fiscal year-end.[3] On September 26, 2002, the SEC issued SEC Release No. 33-8128 phasing in shortened filing delays over three years, 2002 through 2004. For fiscal years ending on or after December 15, 2003, companies deemed accelerated filers (AFs) were required to submit their 10-K (10-Q) filings within 75 (40) days of fiscal year-end.[4, 5]

From 2002 through 2004, additional reporting requirements for public companies were proposed, approved, and implemented. First mentioned in Section 404 of the Sarbanes-Oxley Act of 2002[6], the SEC required both accelerated filers and their auditors to document, test, and report on internal controls starting in fiscal years ending on or after November 15, 2004 (SEC

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[3] Available at https://www.sec.gov/rules/final/33-8128.htm; last accessed on March 16, 2017.

[4] Accelerated filers are generally defined as companies meeting the following criteria (SEC release No. 33-8128): its common equity public float was $75 million or more as of the last business day of its most recently completed second fiscal quarter; the company has been subject to the reporting requirements of Section 13(a) or 15(d) of the Exchange Act for a period of at least 12 calendar months; the company has previously filed at least one annual report pursuant to Section 13(a) or 15(d) of the Exchange Act; and the company is not eligible to use Forms 10-KSB and 10-QSB.

[5] The rule further shortened the 10-K filing delay to 60 days for fiscal years ending on or after December 15, 2006 for large accelerated filers (SEC Release No. 33-8644).

[6] Also known as Public Law 107-204, issued on July 30, 2002; available at https://www.sec.gov/about/laws/soa2002.pdf; last accessed on March 16, 2017.

Release No. 33-8392). In addition, the Public Company Accounting Oversight Board (PCAOB) issued AS No. 2 in 2004 to help auditors implement Section 404 (b).

We focus on the effect of these specific regulations because they were significant and were implemented differently for AFs and NAFs. The SEC recognized the potential undue burden that additional regulation could have on smaller public companies, establishing the SEC Advisory Committee on Smaller Public Companies to specifically consider regulation for these smaller companies. The requirement for NAFs to report on internal controls was delayed until fiscal years ending on or after December 15, 2007, allowing more time for smaller companies to prepare. Big 4 auditor Ernst & Young agreed with delayed implementation for NAFs suggesting that NAFs' audit fees will be "disproportionately higher" than that for accelerated filers (AFs) if complying with Section 404 (b), given the related audit work is "the same irrespective of size and complexity" (Ernst & Young 2005). In addition, consistent with the Committee's concern "that the current costs of the requirement for an external audit of the effectiveness of internal control over financial reporting are disproportionate to the benefits," (p. 6)[7], the requirement for auditor attestation on NAFs' internal controls was never implemented and NAFs were permanently exempted in June 2010.

We acknowledge that there are additional regulatory changes during the period of our study as included in Krishnan and Yang (2009) (pages 269-270). With the exception of the regulations studied in this paper, all remaining regulations were implemented across both AFs and NAFs, and therefore would be less likely to affect the inferences of our test results.[8]

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[7] "Final Report of the Advisory Committee on Smaller Public Companies to the United States Securities and Exchange Commission", Issued April 23, 2006; available at https://www.sec.gov/info/smallbus/acspc/acspc-finalreport.pdf; last accessed on April 4, 2017.

[8] For example, AS No. 3 (Audit Documentation) which affects both AFs and NAFs, took effect on November 15, 2004. It is conceivable that given the relative importance of AF clients, auditors might finish documentation first for these clients and then turn to NAF clients, resulting in longer audit delays for NAFs. However, this possibility is still

We considered the audit report delays from 2000-2013 during the time of these regulatory changes and provide our findings in Figure 1. Given the significant increase in company and auditor workload due to Section 404 implementation for AFs in 2004, the increase in audit report delays evidenced in Figure 1 is not surprising. However, Figure 1 also shows a similar steady increase in audit report delays for NAFs from 2003 to 2007. The increase from 2006 to 2007 can be explained by the implementation of Section 404 (a) for these companies; the increase prior to 2006 cannot. We propose that the audit timeliness of NAFs was negatively affected by the combined regulations implemented for AFs because of auditor-related issues, specifically resource allocation decisions made by auditors[9].

Insert Figure 1 here

Auditor Resource Allocation

At a particular point in time, an individual audit firm office has a relatively fixed level of resources available to conduct audits. Over time, an audit firm office can increase capacity or even borrow resources across audit firm offices, to meet client needs. Despite this, in times of high client demand, audit firms may still find themselves resource-constrained. Ernst & Young confirms the concerns, stating "The new auditing requirements and obligations have created a

consistent with our argument that auditors allocate resources in face of increased regulatory pressure. Further, because AS No. 3 affects all public companies, we believe auditor resource allocation decisions are less likely to be affected by this rule than Section 404, AS No, 2, and tightened filing deadlines.

[9] We acknowledge a non-competing explanation that the increase in audit report delays for both AFs and NAFs can reflect a change in conservatism in the auditing industry in the post-Enron era. That is, a more conservative auditor is more risk averse and thus takes longer to complete the audits. Prior literature shows some support for this explanation as auditors became more likely to issue going-concern opinions shortly after the collapse of Enron (Geiger, Raghunandan and Rama 2005). However, recent studies show that the increased conservatism post-Enron is short-lived and provide no evidence that auditors continue to be more conservative after 2003 (Feldmann and Read 2010 and Kao, Li and Zhang 2014).

huge strain on our firm's resources, despite the fact that we have greatly increased our hiring of experienced professionals and new college graduates," (Ernst & Young 2005, p. 7).

Resource constraints can affect all clients, and has been shown to affect fees and audit quality. Audit fee research routinely controls for busy season audits, finding generally increased fees during high demand times (for example, Hogan and Wilkins 2008; Fung et al. 2012; Eshleman and Lawson 2017). In addition, researchers have found higher discretionary accruals for companies with December fiscal year-ends compared to companies with non-December year-ends, and more earnings management and a lower propensity or lower accuracy of going concern opinions, for partners who have more clients, especially when audit firm partners' client portfolios are being rebalanced (Lopez and Peters 2012; Goodwin and Wu 2016; Gul et al. 2017). In addition, Nash (2017) finds non-restating clients of restating auditors pay abnormally lower fees and are more likely to have subsequent material misstatements, providing support for Irani, et al.'s (2015) argument that a "…restating auditor may need to realign resources to the restating clients as those issues are resolved, thus providing lower-quality service to non-restating clients…" (p. 846).

The Section 404 requirements for AFs resulted in significant increases in the workload for both companies and their auditors. At the same time, these companies and their auditors were under pressure to get the reports completed and submitted more quickly. Further, AFs are presumably the largest clients in an audit firm's office and may also present the highest litigation risk to an audit firm office given the nature of the users of the financial statements. The additional regulatory requirements, shortened reporting deadlines, size of the clients, and increased risk all combine to likely increase the importance of these clients to the individual audit firm office.

We propose that auditors react to this increased importance by altering how many resources or the timing of the allocation of resources, with more/more timely allocation to the more important clients and less/less timely resources to their other clients. Specifically, we expect that NAFs will receive less attention, or less timely attention, resulting in increased delays in the issuance of their audited financial statements in the post-regulatory period. We expect these delays to be longer for NAFs whose auditors have more AFs as a percentage of their total client base.[10] Formally stated, we hypothesize:

> **H1**: The increase in audit report delays post-regulation is greater for NAFs with a high AF-proportion auditor than NAFs with a low AF-proportion auditor, ceteris paribus.

Audit Office Change

Auditor changes can occur for any number of reasons: change in corporate ownership or structure (Haskins and Williams, 1990); search for lower fees (Hartwell et al, 2001; Ettredge et al, 2007; Lopez and Peters, 2011); search for auditor expertise (Williams, 1988; Haskins and Williams, 1990); change in financial condition (Schwartz and Menon, 1985; Haskins and Williams, 1990; Lopez and Peters, 2011); and need for new services related to IPOs (Haskins and Williams, 1990) or mergers/acquisitions (Krishnan et al, 1996). Changes may also occur because of dissatisfaction with the relationship between the auditor and the client. Prior research finds dissatisfaction with the audit opinion (Chow and Rice, 1982; Krishnan et al, 1996; Ettredge et al, 2007; Hartwell et al, 2001; Lopez and Peters, 2011;), dissatisfaction with the auditor conservatism in the form of lower discretionary accruals (DeFond and Subramanyam 1998), and concerns over audit quality (Haskins and Williams, 1990; Irani et al., 2015) are all positively

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[10] In contrast to prior research using the number of clients as the proxy for auditor resource constraints, we use the proportion of AFs in a given audit office to measure the resource constraints affecting NAFs as we propose that NAFs bear the consequences of the disproportionate allocation of audit resources to large clients at the cost of smaller clients.

associated with auditor changes. Lopez and Peters (2011) further investigate clients' concerns

over the auditor-client relationship and hypothesize that high auditor workload compression has

a damaging effect on this relationship resulting in more auditor changes. Using the percentage of

audit fees for all clients with an individual client's year-end as a percent of total office audit fees,

Lopez and Peters (2011) find higher percentages are associated with higher likelihoods to change

auditors.

Specific to our setting and consistent with the prior research, we expect as auditors

allocate more internal resources to their AF clients, the relationship between NAFs and their

auditors will become more strained resulting in more auditor changes. We expect the

dissatisfaction to increase in the post-regulation period, especially for NAFs whose auditor has a

high percentage of AF clients. This dissatisfaction can either lead to auditors being dismissed by

their clients or auditors resigning from their clients. Formally stated, we hypothesize:

> **H2a**: NAFs with a high AF-proportion auditor are more likely to change
> auditors in the *post-regulation* period than in the *pre-regulation* period, ceteris
> paribus.

> **H2b**: The increased likelihood of changing auditors in the post-regulation
> period is higher for NAFs with a *high* AF-proportion auditor than for NAFs
> with a *low* AF-proportion auditor, ceteris paribus.

Success of Strategy

If auditor changes are due to the concerns of lengthened audit delays and companies

select new auditors strategically, we would expect the new auditor to resolve the concerns the

company had. Results from previous research is somewhat mixed. Chow and Rice (1982) find

that companies are more likely to change auditors after receiving a qualified opinion, but they

don't find that change-companies are more likely to receive unqualified opinions in future years

than non-change companies. [11] In contrast, DeFond and Subramanyam (1998) find results

consistent with public companies changing auditors they found to be too conservative. Further,

they find discretionary accruals with the new auditor, while still negative, were of a lower

magnitude than those with the predecessor auditor, suggesting the change strategy was

successful.

We investigate the success of NAFs strategy in changing auditors by analyzing changes

on future audit report delays. We consider the mixed prior results, but expect NAFs making a

strategic auditor change will experience improved audit report delays compared to NAFs not

making a *strategic* auditor change. We believe Chow and Rice's "non-results" are caused by the

continuing troubled firm characteristics of their sample. Our decision to focus on the post period

will be explained in the Data section. Formally stated:

> **H3a**: NAFs changing to a *lower* AF-proportion auditor in the post period
> experience a decrease in audit report delays after the auditor change, ceteris
> paribus.

> **H3b**: NAFs changing to a *lower* AF-proportion auditor in the post period
> experience a larger improvement in audit report delays after the auditor change
> compared with NAFs changing to a *higher* AF-proportion auditor, ceteris paribus.

III.

We obtain our initial sample of 44,254 client-years with non-missing CIK from

COMPUSTAT and with non-missing audit report dates from Audit Analytics between 2000 and

2006. This sample period provides us adequate data before implementation of the regulations

discussed above. It ends on December 31, 2006 to include the effects of Section 404 (a and b), AS

No. 2, and all of the SEC shortened filing deadlines, including the further acceleration of filing

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[11] This was further replicated by Krishnan et al. (1996). However, Haskins and Williams (1990) do not find intra-
Big N auditor changes are more likely after a qualified opinion.

deadlines for large accelerated filers which took effect for fiscal years ending on or after December 15, 2006.[12] In addition, we end our sample in 2006 to eliminate the implementation of Section 404 (a) for NAFs, effective on December 15, 2007. We exclude this implementation as it is likely to increase financial statement and audit preparation time for NAFs, thereby likely increasing audit delay which could confound our analyses on auditor resource allocation. Table 1 Panel A details the data requirements that result in our sample for the audit delay analysis to run Model (1) and test H1. To eliminate the effect of extreme delays or potential data errors, we delete 711 observations with negative audit delays (i.e., audit report date is earlier than fiscal year end) and audit delays greater than 105 days, which includes the 15-day grace period to file annual reports allowed by SEC. We cannot use the filer status information from Audit Analytics because our goal is to analyze the change in audit delays from the pre- to post-regulation period and the filer status information is only available in the post-regulation period from Audit Analytics per SEC's regulatory change. Instead, we identify potential accelerated filers as those with market value of $75 million or above at the end of the second quarter in a given fiscal year, those that filed an annual report at least once, and those that had 10-Ks, not 10-KSBs.[13] We identify any client which does not meet the above requirements as non-accelerated filers. The requirement to compute filer status and control variables in Model (1) further reduces the sample by 23,315 observations. Because our study focuses on NAFs, we delete all accelerated filers. We further delete 51 NAFs adopting Section 404 earlier than the required timeline because our goal is to test the pressure of

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[12] Since large accelerated filers face an even tighter filing deadline starting December 15, 2006 and are perhaps most important to their auditors, these auditors would further prioritize the audit of these large clients, thus increasing the audit delays of NAFs even more.

[13] In addition, an AF remains at its filing status unless the public float becomes less than $50 million as of the last business day of the most recent second fiscal quarter.

these regulatory changes on NAFs and including these observations can potentially confound the inferences of our results.

To confirm the validity of our classification of filer status, in the post-regulation period, we compare the filer status information available on Audit Analytics to our classification. In order to present a clean sample, we delete 164 client firms years (i.e., 64 unique clients) from the entire sample period because those clients are classified as NAFs based on our calculation but are identified as AFs or Large AFs in Audit Analytics (i.e., misclassified NAFs) in our post period.[14] The final sample of Model (1) consists of 4,989 firm-years.

We detail the data selection process for the audit office change analysis (Model 2) in Table 1 Panel B. The sample period starts in year 2001 because the auditor change decision is made in the year subsequent to the year measured in the independent variables, i.e., auditor- or client-characteristics. Following Landsman et al. (2009), we exclude the financial industry (two SIC codes of 60-69).[15] We further delete all auditor changes from Arthur Anderson. Other data selection requirements are similar to those reported in Panel A. The sample to test H2a and H2b yields 7,250 from the years of 2001-2006.

To investigate the impact of audit office change on subsequent audit delays, we only include audit office changes occurred in 2004 and 2005. We exclude audit office changes in 2006 as the implementation of Section 404 (a) for NAFs took effect in 2007 and therefore we cannot have a clean sample testing for the effects of the audit office change in the year after the change. In addition, we exclude audit office changes in 2002 and 2003 because the potential effect on audit

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[14] The most common reason of the mismatch is data collection errors by Audit Analytics. In some cases, firms identify themselves as accelerated filers even though their public float is below the $75 million or $50 million threshold as stated in footnotes 3 and 12.

[15] In the audit delay analysis (Model 1), we include the financial industry to follow prior literature (Krishnan and Yang 2009). The tenor of our results doesn't change if we exclude the financial industry in the sample of Model (1).

delay crosses both the pre- and post-regulation periods and again, we cannot cleanly test the effect of the audit office change. With 2001 being the only year remaining in the pre-regulation period, the validity to compare between the pre- and post-regulation periods is limited. Thus, we use only audit office changes occurring in 2004 and 2005, both in the post-regulation period. Table 1 Panel C outlines the data selection process for Model (3). We start with 4,989 observations from the sample of Model (1). We then delete 2,946 observations from the pre-regulation period as our analysis focuses on the post period. We lose 625 observations in order to compute change in *AF_RATIO* from two consecutive years. Also, we delete audit office changes which occurred in 2003 and 2006 to ensure that only audit office changes in 2004 and 2005 are included in the analysis. In addition, we delete 31 firms in 2003 (2006) if these firms experience audit office changes in 2005 (2004) so that these observations would not be included in the base group which consists of clients not experiencing any audit office changes from December 15, 2003 to the end of 2006. Lastly, we delete 6 firms years of two clients experiencing audit office changes in both 2004 and 2005 and arrive at the final sample with 1,208 observations.

Insert Table 1 here

IV. ELS

Audit Delay Model

To test our first hypothesis (H1), we use the following empirical model, incorporating models from Whitworth and Lambert (2014) and Son and Crabtree (2011)[16]. This model is

---

[16] While Son and Crabtree (2011) investigate the determinants of earnings announcements timeliness, we include their variables in our audit delay analyses because these variables capture factors influencing the overall timeliness of financial information.

estimated using ordinary least squares (OLS) and clustering standard errors by firms, with control for heteroscedasticity.

$$
\begin{aligned}
AUDIT\_DELAY_{it} = {}& \beta_0 + \beta_1 POST_{it} + \beta_2 AF\_RATIO\_HIGH_{it} + \beta_3 \left(POST_{it} \right. \\
& \left. \times AF\_RATIO\_HIGH_{it} \right) + \beta_4 PERIOD_{it} + \beta_5 MIADDADDITODD_{it} \\
& + \beta_6 AMMRRAA\_OOHHAAIIHHDD + \beta_7 BMHHII_{it} + \beta_8 PASSD_{it} + \beta_9 DEEAARR_{it} + \beta_{10} IIAAAA_{it} \\
& + \beta_{11} AAPPPPMII_{it} + \beta_{12} AARR_{it} + \beta_{13} DDDIIAA_{jit} + \beta_{14} BII_{it} + \beta_{15} DPPPPPP_{it} \\
& + \beta_{16} DAAAMIIAA_{it} + \beta_{17} BAA_{it} + \beta_{18} AOO_{it} + \beta_{19} DLHH_{it} + \beta_{20} APDD_{it} + \beta_{21} LPDD_{it} \\
& + \beta_{22} POOPPII_{it} + \beta_{23} MOOPPII_{it} + \beta_{24} OOAAAII_{it} + iiiiii + \varepsilon_{it}
\end{aligned} \tag{1}
$$

where for client i in year t, all variables are as defined below and/or in Appendix A.

AUDIT_DELAY is defined as the number of calendar days from fiscal year-end to the audit report date.[17] We define *POST* as one if client i's fiscal year end in year t is on or after December 15, 2003, and zero otherwise, indicating whether a client-year is in the post-regulation period. We define the start of the post-regulation period to be December 15, 2003 because the shortened filing deadline for AFs took effect on that date and the compressed reporting timeliness exerts pressure on auditors, potentially forcing them to prioritize AF clients to the detriment of NAF clients. Subsequently, the SEC's mandate of AFs adopting Section 404 (a) and (b), effective on November 15, 2004, puts further pressure on auditors' resources.

AF_RATIO_HIGH equals one if a client is audited by an audit office whose *AF_RATIO* is higher than the median *AF_RATIO*, and zero otherwise. *AF_RATIO* is defined as the number of accelerated filer clients divided by total number of clients in a given audit office each year. When *AF_RATIO_HIGH* is one, it indicates that a client-year is audited by an audit office with a high proportion of accelerated filer clients and thus is more resource constrained. The interaction term of *POST* and *AF_RATIO_HIGH* tests our H1. A significant and positive β_3 supports H1, suggesting

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[17]Our results remain unchanged if we define audit delay using log of calendar days from fiscal year-end to the audit report date.

that the increase in audit delay in the post-regulation period is greater for NAFs with a high *AF_RATIO* auditor than those with a low *AF_RATIO* auditor.

Following Whitworth and Lambert (2014) and Son and Crabtree (2011), we include controls for auditor characteristics, accounting and audit complexity, financial health, litigation risk, and investor demands among other factors that are expected to correlate with audit delay. Auditor characteristics likely to affect audit report delay include audit office size (*OFFICE*), client importance (*INFLUENCE*), whether there is an auditor change (*AUDITFIRM_CHANGE*), and whether it is a Big4/5 auditor (*BIGN*). For accounting and audit complexity, we include measures of client size (*SIZE*), whether clients have extraordinary items (*EXTR*), the number of business segments (*NUM*), whether they receive a non-clean standard qualified opinion (*AOPIN*), levels of receivables (*AR*), whether clients have December fiscal year-end (*YEND*). For financial health, we include negative unexpected earnings (*BN*), and negative earnings (*LOSS*). Litigation risk is expected to decrease the audit delay, and so we include measures of the likelihood of litigation in the client's industry (*LITIND*), book to market ratio (*BM*), Zmijewski's financial condition (*FC*), and leverage ratio (*LVG*). We include number of analyst forecasts (*FOL*), trading volume (*VOL*), and ownership concentration (*OCON*) to proxy for investors' demand for timely information because investors' demand is likely to reduce audit delay. We include industry concentration (*ICON*) and capital investment (*CAIN*) to measure the degree of proprietary cost as Son and Crabtree (2011) suggest that the lower the proprietary cost, the more timely the financial information. Finally, we include industry fixed effects.[18]

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[18] Our study does not include year fixed effects in Models (1) and (2) because one of our test variables is *POST*, indicating whether a client-year is in the post-regulation period. This research design has been used in prior literature (Landsman, Nelson and Rountree 2009).

Audit Office Change Model

We use the following logit model to test the audit office change decision (H2).

$$
\begin{aligned}
AUDITOFFICE\_CHANGE_{it} =\ & \beta_0 + \beta_1 POST_{it} + \beta_2 AF\_RATIO\_HIGH_{it-1} + \beta_3 \left(POST_{it} \right. \\
& \left. \times AF\_RATIO\_HIGH_{it-1} \right) + \beta_4 PAUDITOOD_{it-1} + \beta_5 BMHII_{it-1} + \beta_6 DEEPPDDRRM_{it-1} \\
& + \beta_7 AAADDIIAARRDD_{it-1} + \beta_8 PPAASSDD_{it-1} + \beta_9 IIAAAA_{it-1} + \beta_{10} AARRHHII_{it-1} \\
& + \beta_{11} AAAA_{it-1} + \beta_{12} AAPPPPMII_{it-1} + \beta_{13} HHOO_{it-1} + \beta_{14} HHRRPPGGAAHH_{it-1} + \beta_{15} AAAA_{it-1} \\
& + \beta_{16} RRDDPPAAAAAADD_{it-1} + \beta_{17} MIILLRRDDOO_{it-1} + \beta_{18} DDPPPPPP_{it-1} + \beta_{19} DDLLHH_{it-1} \\
& + \beta_{20} RRPPAA_{it-1} + \beta_{21} OOAAPPHH_{it-1} + iiiiiiiiiiiiii + \varepsilon_{it} \qquad (2)
\end{aligned}
$$

where for client *i* in year *t*, all variables are as defined below and/or in Appendix A.

AUDITOFFICE_CHANGE is equal to one if a client changes their audit office in year *t*, and zero otherwise. The coefficient estimate of *POST*, β_1, shows the likelihood of audit office change in the post-regulation period, compared to the pre-regulation period, for clients in a low *AF_RATIO* office. The coefficient estimate of *AF_RATIO_HIGH*, β_2, shows the likelihood of audit office change for clients in a high *AF_RATIO* office, compared to those in a low *AF_RATIO* office, in the pre-regulation period. Similarly, the sum of the coefficient estimates $(\beta_1 + \beta_2 + \beta_3)$ shows the likelihood of audit office change for clients in a high *AF_RATIO* office in the post-regulation period, compared to those in a low *AF_RATIO* office in the pre-regulation period. To test H2a, we compare $(\beta_1 + \beta_2 + \beta_3)$ to β_2. A significant and positive $(\beta_1 + \beta_3)$ would suggest that NAFs with a high *AF_RATIO* auditor are more likely to change audit offices in the post-regulation period than in the pre-regulation period. A significant and positive β_3 would support H2b that the increased likelihood of NAFs to change audit offices in the post-regulation period is greater for clients with a high *AF_RATIO* auditor than for those with a low *AF_RATIO* auditor.

Following prior literature (Landsman et al. 2009; Hennes, Leone and Miller 2014), we include four categories of control variables.[19] We include auditor characteristics such as audit office size (*OFFICE*), Big 4/5 auditors (*BIGN*), industry expert (*EXPERT*), and auditor tenure (*ATENURE*). To control for accounting and audit complexity, we include client size (*SIZE*), number of business segments (*NUM*), whether a client has foreign operation (*FRGN*), and whether a client had a recent merger and acquisition (*MA*), the type of auditor opinion (*AOPIN*), going-concern opinion (*GC*), sales growth rate (*GROWTH*), discretionary accruals (*DA*), the announcement of financial statement restatements (*RESATE*), and the sum of inventory and receivables (*INVREC*). The higher the level of accounting and audit complexity, the more likely it is that a company will change audit offices. In addition, we control for client financial condition by including loss (*LOSS*), leverage (*LVG*), financial performance (*ROA*) and the amount of cash (*CASH*). We expect an increased likelihood of auditor change with a higher level of audit risk and client financial risk. Lastly, we include industry fixed effects.

Model of Audit Office Change on Subsequent Audit Delay

To test whether an auditor change, especially change to an audit office with a lower *AF_RATIO*, has mitigated the increase in audit delay or reduced audit delay (H3a and H3b), we use the following empirical model which is estimated using ordinary least squares (OLS) and clustering standard errors by firms, with control for heteroscedasticity. Following Ke, Huddart and Petroni (2003) and Wilson (2008), the following event-study regression model measures audit delays over a three-year period surrounding the event of auditor changes:

---

[19] Although we include slightly different sets of controls in Models (1) and (2), they capture the same underlying economic substance. We follow the prior literature in determining which controls to include in the audit report delay and audit office change analyses, respectively.

$$AUDIT\_DELAY_{it}$$
$$= \beta_0 + \beta_1 BEFORE\_CHANGE\_LOWER_{it} + \beta_2 CHANGE\_LOWER_{it}$$
$$+ \beta_3 AFTER\_CHANGE\_LOWER_{it} + \beta_4 BEFORE\_CHANGE\_HIGHER_{it}$$
$$+ \beta_5 CHANGE\_HIGHER_{it} + \beta_6 AFTER\_CHANGE\_HIGHER_{it}$$
$$+ \sum_{k=7}^{27} \beta_k CONTROLS_{it} + industry + year + \varepsilon_{it} \qquad (3)$$

where for client *i* in year *t*, all variables are as defined below and/or in Appendix A.

BEFORE_CHANGE_LOWER (*BEFORE_CHANGE_HIGHER*) equals one if year *t* is one year before client *i* changes to an audit office with lower (higher) *AF_RATIO*, and zero otherwise. *CHANGE_LOWER (CHANGE_HIGHER)* equals one if year *t* is the year of client *i* changing to an audit office with lower (higher) *AF_RATIO*, and zero otherwise. *AFTER_CHANGE_LOWER* (*AFTER _CHANGE_HIGHER*) equals one if year *t* is one year after client *i* changes to an audit office with lower (higher) *AF_RATIO*, and zero otherwise. Note that the above-mentioned variables are based on *AF_RATIO*, a continuous variable, different from *AF_RATIO_HIGH,* a dummy variable used in Models (1) and (2). All control variables have been defined in Model (1). As mentioned previously, this analysis uses the post-regulation period and only audit office changes occurring in 2004 and 2005 are included. The base group consists of those clients who didn't experience any audit office changes during the post period (December 15, 2003 – December 31, 2006).

To test H3a, we calculate the change in audit delays from the year before the audit office change to the year of the audit office change for clients switching to an audit office with a lower *AF_RATIO*. A significant and negative (β_2 - β_1) would support H3a in that clients changing to an audit office with a lower *AF_RATIO* would experience a decrease in audit delay after the change. Similarly, (β_5 - β_4) measures the change in audit delay for clients changing to an audit office with a higher *AF_RATIO*. To test H3b, we compare (β_2 - β_1) to (β_5 - β_4). If (β_2 - β_1) is more negative

than (β_5 - β_4), it would support H3b in that compared to clients changing to an audit office with a higher *AF_RATIO*, clients changing to an audit office with a lower *AF_RATIO* experience a larger improvement in audit delay after the change. Because it is uncertain whether the reduction in audit delay occurs during the year of the change or the year after the change, we also compare β_3 to β_1 and a negative (β_3 - β_1) supports H3a. The result of (β_3 - β_1) being more negative than (β_6 - β_4) would support H3b.

V. EMPIRICAL RESULTS

Descriptive Statistics

Table 2 Panel A presents descriptive statistics and univariate tests related to *AUDIT_DELAY* in the pre- and post-regulation periods for NAFs with a low *AF_RATIO* audit office (*AF_RATIO_HIGH*=0) and those with a high *AF_RATIO* audit office (*AF_RATIO_HIGH*=1). *AUDIT_DELAY* has increased in the post-regulation period, regardless of whether a client is with a low or high *AF_RATIO* audit office. This is consistent with the notion that the increased regulatory requirements and the audit industry's reaction by becoming more risk averse, in the post-SOX era has reduced the timeliness of audit reports. What is more pertinent to our study is that this increase in *AUDIT_DELAY* is greater for clients with a high *AF_RATIO* audit office than for those with a low *AF_RATIO* office. When comparing the increase in *AUDIT_DELAY* of NAFs from the pre- to post-regulation period, it takes a high *AF_RATIO* auditor a mean (median) of three (eight) more days than a low *AF_RATIO* auditor to issue an audit report. This descriptive evidence supports our conjecture that the number of AF clients in a given audit office affects the timeliness of audit reports of NAFs, especially in the post-regulation period.

Table 2 Panel B provides descriptive data on *AUDITOFFICE_CHANGE.* It shows the

percentage increase in audit office change is greater for clients with a high *AF_RATIO* audit

office (i.e., 9.5%) than for those with a low *AF_RATIO* audit office (i.e., 6.2%). This provides

preliminary support that clients with a high *AF_RATIO* audit office are more likely to experience

audit office changes in the post-regulation period.

Table 2 Panel C provides descriptive statistics for all the variables included in each of our

empirical models. Using the sample of Model (1), *AUDIT_DELAY* of NAFs is, on average, 62

days. About 41% of the observations draw from the post-regulation period (*POST*=0.41) and by

construction, 50% of the observations are in a high-proportion audit office (*AF_RATIO_HIGH*).

On average, audit office annual audit fees is $4.4 million (*OFFICE*=15.29). The audit fee of a

given client represents about 13% of total audit fee of an audit office (*INFLUENCE*=0.13). The

average total assets of a client is $35 million (*SIZE*=3.56). About 70% of the sample clients

receive unqualified audit opinion (*AOPIN*=0.30). The statistics of some other variables (i.e.,

AUDITFIRM_CHANGE, *LOSS*, *BM*, *BIGN*, *FOL*, *NUM,* and *CON)* reflect the nature of the

sample clients, i.e., NAFs. In comparison to the same descriptive statistics in previous literature

which includes AFs in their sample (Son and Crabtree 2011; and Whitworth and Lambert 2014),

our sample firms are smaller, more likely to experience auditor change at the audit firm level,

more likely to experience a loss, with a higher book to market ratio, less likely to use a *Big N*

auditor, and have less analyst attention, fewer business segments, and lower ownership

concentration.

Table 2 Panel C also provides the descriptive statistics of additional variables used in

Model (2). About 19% of NAF client-years experienced an audit office change

(*AUDITOFFICE_CHANGE*=0.19). About 7% of the NAF clients announce a financial statement

restatement (*RESTATE*=0.07). Compared to prior studies which include AFs in the sample (Landsman et al. 2009 and Hennes et al. 2014), the statistics of these variables, i.e. *EXPERT*, *GC, ATENURE, ROA,* and *MA*, show that the NAF sample clients are less likely to employ an industry expert as their auditor, are more likely to receive a going concern opinion, have shorter auditor tenure, are less profitable, and are less likely to have prior M&A activities.

Insert Table 2 here

For brevity, we do not present the correlation matrix. All Pearson correlation coefficients of the variables used in Models (1) and (2) are under 0.5 except for the following. In Model (1), the correlation between *FC* and *LVG* is 0.72, between *INFLUENCE* and *OFFICE* is -0.73, between *BIGN* and *OFFICE* is 0.67, and between *BIGN* and *AF_RATIO_HIGH* is 0.53. In Model (2), the correlation between *LVG* and *ROA* is -0.69, between *AOPIN* and *GC* is 0.66, between *OFFICE* and *AF_RATIO_HIGH* is 0.62, and between *SIZE* and *ROA* is 0.54. In addition, the variance inflation factors for all variables included in Models (1), (2) and (3) are less than 2, much lower than 10, the conventional benchmark for evaluating the severity of multicollinearity. Also, our sample spans sixty-seven industries with two industries representing more than 10% of the sample. These two industries are Business Services (two-digit SIC of 73 with 17% of the sample) and Electronic and other Electrical Equipment and Components (two-digit SIC of 36 with 10% of the sample).

Audit Delay Analysis

Table 3 Panel A presents the results of the multivariate regression of Model (1) addressing the impact of auditor resource allocation on audit delays. The positive and significant β_3 (=3.345) supports H1; the increase in audit report delays post-regulation is about three days

greater for NAFs with a more resource-constrained auditor than NAFs with a less resource-constrained auditor. Panel B presents a more detailed interpretation of the regression results on the variables of interest. As shown in this panel, the increase in audit delays from the pre- to post-regulation period for clients with a low *AF_RATIO* audit office is 8.306 days (β_1), while this increase for clients with a high *AF_RATIO* audit office is 11.381 days ($\beta_1 + \beta_3$). The difference in these increases is significant ($\beta_3 = 3.345$). We acknowledge that in the pre period, NAFs with a high AF-ratio audit office have more timely audit reports than those with a low AF-ratio audit office. However, the focus of our study is to examine the impact of regulatory changes on the change in audit delay from the pre- to post- period, and hence the variable of interest is β_3. All the significant coefficient estimates of control variables have directions consistent with expectations.

Insert Table 3 here

Audit Office Change Analysis

Table 4 Panel A presents the results of the multivariate regression of Model (2), which investigates whether auditor resource constraint affects the likelihood of audit office changes and Panel B presents the detailed calculations and interpretation of these regression results. As discussed above, we test H2a by comparing ($\beta_1 + \beta_2 + \beta_3$) to β_2 and a significant and positive β_3 will support H2b.

As detailed in Panel B, for clients with a high *AF_RATIO* audit office, the likelihood of changing audit offices increased from the pre period to the post period ($\beta_2 < (\beta_1 + \beta_2 + \beta_3)$). The increase in this likelihood is significant ($\beta_1 + \beta_3 = 0.652$, p-value<0.01, supporting H2a. Further, consistent with our prediction of H2b, the increase in the likelihood of auditor change is

significantly greater for clients with a high *AF_RATIO* audit office (β_3=0.488).[20] Because the

dependent variable in a logit regression is the log of the odds ratio, to interpret the economic

significance of the coefficient estimates, we convert the test variables' effect from odds to

probabilities. For a client with a low (high) *AF_RATIO* audit office, the likelihood of audit office

change increases by 9% (14%) from the pre- to post-regulation period, while holding all other

independent variables at their mean values. This suggests that post regulation, the percent

increase in the likelihood of audit office changes is 56% [(14%-9%)/9%] more when clients are

with a high *AF_RATIO* audit office, compared to those with a low *AF_RATIO* audit office. All

the significant coefficient estimates of control variables have directions consistent with

expectations.

Insert Table 4 here

To provide some deeper understanding of the audit office change decisions made by

NAFs, we present the frequency of Big 4/Non-Big 4 audit office changes for clients with a low

or high *AF_RATIO* audit office in the pre- and post-regulation periods in Table 5. For clients

with a high *AF_RATIO* audit office, the majority of auditor changes are from Big 4 to non-Big 4

in the post-regulation period (63.08%) and the frequency of this auditor change is higher than

that in the pre-regulation period (63.08% vs. 48.99%). While the lateral Big 4 auditor changes

become less dominant from 40.91% in the pre-period to 15.82% in the post-period, the lateral

non-Big 4 auditor changes become more prevalent from 7.58% to 20.46% during the same time

window. Although not direct tests on H2a or H2b, these results are consistent with our

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[20] We also eliminate observations where a client changes to another audit office within the same auditor firm. The inferences from the results of H2a and H2b do not change.

hypotheses that since Big 4 auditors are likely to audit more AF clients, clients with a high

AF_RATIO audit office are concerned with the increasingly constrained resources faced by these

Big 4 auditors and thus become less (more) likely to switch to a Big 4 (Non-Big 4) auditor in the

post-regulation period. [21]

Insert Table 5 here

Impact of Audit Office Change on Subsequent Audit Delay Analysis

Figure 2, Panel A plots the mean audit delay around auditor changes for NAFs changing

to a lower *AF_RATIO* audit office in 2004 and 2005. We observe a sharp decrease in audit delays

from the year before to the year of auditor changes. In addition, audit delays of NAFs changing

to a lower *AF_RATIO* audit office in 2004 remain steady for the year after auditor change and

NAFs with such an auditor change in 2005 experience a slight increase in audit delays in the year

after an auditor change, likely due to preparation for the implementation of Section 404 (a)

required in 2007. In contrast, for NAFs changing to a higher *AF_RATIO* audit office, Figure 2,

Panel B shows an increase in audit delays from the year before to the year of auditor changes,

especially for auditor changes in 2004. These provide descriptive support that NAFs changing to

a lower *AF_RATIO* audit office experience an improvement in audit delays, and audit reports for

NAFs changing to a higher *AF_RATIO* audit office are further delayed.

Insert Figure 2 here
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[21] The Pearson (Spearman) correlation between Big4 and *AF_RATIO*, a continuous variable, is 0.59 (0.60), significant at 1%. The Pearson (Spearman) correlation between Big4 and *AF_RATIO_HIGH*, a dummy variable, is 0.53 (0.53), significant at 1%. In addition, among the top 100 most resource-constrained audit offices (i.e. with the highest *AF_RATIO*), 93 are Big 4 audit offices. In contrast, only nine of the 100 least resource-constrained audit offices are Big 4 audit offices.

Table 6 presents the multivariate results of the variables of interest of Model (3) on the impact of audit office changes on audit delays[22]. We find that consistent with H3a, clients switching to a lower *AF_RATIO* audit office experience a significant reduction in audit delays, a reduction of over 7 days from the year before the change to the year of the change (β_2- β_1=-7.054 and significant at 5%). There is a reduction of over 6 days from the year before the change to the year after the change (β_3- β_1=-6.653 and significant at 10%) However, β_3 is not significantly different from β_2, suggesting that the reduction in audit delays occurs during the year of the auditor change. In contrast, clients switching to a higher *AF_RATIO* audit office experience a significant increase in audit delays in the year of the auditor change (β_5 - β_4 = 7.594); however, the increase in audit delay seems short-lived and *AUDIT_DELAY* in the year after the auditor change is substantially reduced (β_6 - β_4 = 0.691). In support of H3b, we find ($\beta\beta_2 - \beta\beta_1$)-($\beta\beta_5 - \beta\beta_4$) is significantly negative. However, ($\beta\beta_3 - \beta\beta_1$)- ($\beta\beta_6 - \beta\beta_4$) is insignificant. Altogether, these results suggest that compared to NAFs changing to a higher *AF_RATIO* auditor, those changing to a lower *AF_RATIO* auditor experience a much larger improvement in audit delays during the year of auditor change, supporting H3b.

Insert Table 6 here

VI. ADDITIONAL ANALYSIS

Big 4 vs. Non-Big 4 Auditors

As an additional analysis, we examine if the documented main results differ for Big 4 vs. Non-Big 4 auditors. On the one hand, Big 4 auditors may have better resources to deal with

[22] We omit the presentation of the controls to present a parsimonious table.

constraints caused by the regulatory changes. Therefore, NAF clients with Big 4 auditors may be less likely to experience audit delays and auditor changes. On the other hand, Big 4 auditors have disproportionally more AF clients than Non-Big 4 auditors. Thus, NAF clients with Big 4 auditors may have less attention from their auditor, resulting in audit delays and auditor changes. For the testing of H1 (H2a and H2b), there are 62% (48%) of the sample clients who employ Big 4 auditors in the current (previous) year. Our documented results hold only for NAF clients with Big 4 auditors. None of the test variables is significant for NAF clients with non-Big 4 auditors. Overall, this suggests that the documented results concentrate on NAFs with Big 4 auditors, who have disproportionally more AF clients than Non-Big 4 auditors and therefore are more constrained.[23]

Auditor Dismissal and Resignation

We also test the auditor change hypotheses (H2a and H2b) with auditors' realignment of their client portfolio (auditor resignations) and clients' decision to change auditors (auditor dismissals), separately. Our results for both samples and both hypotheses are supported at the 1% level.

Robustness Tests

In tests of H1, H2a, and H2b, we consider alternative definitions of *AF_RATIO_HIGH*[24]. We define *AF_RATIO_HIGH* =1 if a client is audited by an audit office whose *AF_RATIO* is higher than the median *AF_RATIO*, where the median is determined annually. As another

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[23] Inferences from testing H3a and H3b are difficult to make given the small sample size for these tests.
[24] We do not consider additional measures for H3 as this hypothesis requires the use of a continuous measure.

robustness test, we include *AF_RATIO,* a continuous variable, instead of *AF_RATIO_HIGH*, in the regression models. The tenor of the results remains the same[25].

We also consider an alternative specification of *AF_RATIO* using audit fees. This ratio is calculated as audit fees of accelerated filer clients divided by total audit fees in a given audit office. Our results for H1, H2a, and H2b are robust to this different measure of auditor resource constraint. Although directionally consistent with our hypotheses, the results for H3a and H3b are insignificant (*p*-value=0.15 for H3a and *p-value*= 0.21 for H3b).

In addition, in order to reduce the effect of firm characteristics on the comparison between the pre- and post-regulation periods, we delete client firms which do not have at least one year of data in both the pre- and post- period. Since H3a and H3b are tested only post-regulation, this robustness check is performed on H1, H2a, and H2b. Our results continue to hold with the exception that the result of H1 is marginally significant (*p*-value=0.11). When we use *AF_RATIO,* a continuous variable, instead of *AF_RATIO_HIGH*, in our regression models by similarly requiring client firms to have at least one year of data in both the pre- and post-period, all of the hypotheses are supported at 5% level.

Lastly, we consider the effect of audit market dynamics in a given city on audit delays. In cities with more (fewer) auditors, NAFs may be less (more) limited in their choice of auditor and, as a result, NAFs may be less (more) willing to accept delayed audit reports, leading to shorter (longer) audit delays. We measure audit market dynamics by dividing total number of auditors by total number of companies in a given city and include this measure in Model (1). Our results show that this measure is not significant and H1 continues to be supported.

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[25] Because H2a can only be tested with a categorical variable of *AF_RATIO*, we did not perform a robustness test using the continuous variable, *AF_RATIO*, to test H2a.

VII. CONCLUSION

New regulations implemented by the SEC effective in 2003 and 2004 were intended to improve financial reporting quality and timeliness. While these goals may have been met for accelerated filers (the companies subject to the regulations), there were unintended consequences for non-accelerated filers, companies not subject to the regulations. We hypothesize that the new regulations put pressure on auditors' resources, requiring them to give more attention to accelerated filers at the expense of their other clients. Specifically, we look at the audit report delays of NAFs after the implementation of the new regulations and find NAFs with an auditor who has a high proportion of AF clients have longer audit report delays than NAFs with an auditor who has a low proportion of AF clients. We then find that NAFs react strategically to the auditor resource allocation decisions. NAFs with a high-AF proportion auditor are more likely to change audit offices after the regulations were implemented, and are more likely to change audit offices than NAFs with a low-AF proportion auditor. Finally, we provide evidence that the strategic audit office changes were successful. NAFs changing to a lower-AF proportion audit office in the post-regulation period experience a decrease in audit report delays in the year of the auditor change, and they experience a larger improvement in audit report delays in the year of the auditor change as compared to those changing to a higher-AF proportion audit office.

While prior studies have investigated the effects of auditor resource constraints on aspects of audit quality, we are the first to consider reporting timeliness, especially important for smaller public companies' investors given the reduced analyst following and media coverage as compared to larger public companies. In addition, we are able to investigate the effects of regulatory-induced resource constraints, which eliminate concerns of client- or auditor-characteristic endogeneity in the models. Finally, and perhaps most importantly, we provide

strong evidence that there are unintended negative consequences of regulations even to parties not subject to the regulations, adding to the currently sparse research on the externalities of regulation. While the SEC did not want to overburden NAFs with increased regulation, the application of the regulations to large publicly traded companies forced auditors to direct more resources toward meeting the new regulations for their AF clients, thereby reducing their attention to NAFs resulting in longer audit report delays.

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APPENDIX A
Variable Definitions and Measurements

AUDIT_DELAY	=	number of calendar days from fiscal year-end to audit report date;
POST	=	one if the fiscal year end is on or after December 15, 2003, and zero otherwise;
AF_RATIO	=	number of accelerated filer clients divided by total number of clients in a given audit office;
AF_RATIO_HIGH	=	one if a client is audited by an audit office whose *AF_RATIO* is higher than the median *AF_RATIO*, and zero otherwise;
OFFICE	=	natural log of aggregated client audit fees of an audit office;
INFLUENCE	=	a given client's total fees (audit fees plus nonaudit fees) as a percentage of total fees collected by its audit office;
SIZE	=	natural log of total assets;
EXTR	=	one if a client reports extraordinary items, and zero otherwise;
AOPIN	=	one if the auditor's opinion is not standard unqualified, and zero otherwise;
AUDITFIRM_CHANGE	=	one if a client changes its auditor firm, and zero otherwise;
AR	=	accounts receivables as a percentage of total assets;
BN	=	one if a client's actual 4th-quarter earnings in year t is less than the earnings of the same quarter of year $t-1$ (bad news), and zero otherwise;
LOSS	=	one if a client reports negative earnings, and zero otherwise;
BM	=	ratio of the book value of equity to market value;
LVG	=	total liabilities divided by total assets;
YEND	=	one if a client has December fiscal year-end, and zero otherwise;
BIGN	=	one if an auditor is one of the Big 5/4, and zero otherwise;
NUM	=	natural log of the number of business segments. We set *NUM* to be zero if segment data is missing;
LITIND	=	one if a client operates in a high-litigation industry, zero otherwise. High-litigation industries are industries with Standard Industrial Classification (SIC) codes of 2833-2836, 3570-3577, 3600-3674, 5200-5961, and 7370-7374;
FC	=	Zmijewski's (1984) financial condition index,

		where *FC*= -4.336 – 4.513*ROA + 5.679*FINL + 0.004*LIQ. *ROA* is net income to total assets, *FINL* is total debt to total assets, and *LIQ* is current assets to current liability. The higher the *FC* index value, the higher expected probability of financial failure.
FOL	=	number of analysts' forecasts over the 4th fiscal quarter of a client compiled by I/B/E/S. If a firm is not covered by I/B/E/S, we set *FOL* to be zero;
VOL	=	annual trading volume divided by the number of shares outstanding;
OCON	=	ownership concentration measured as the natural log of shares outstanding divided by the number of shareholders;
ICON	=	industry concentration measured as the percentage of revenue controlled by the top five companies for each two-digit industry;
CAIN	=	gross property, plant, and equipment expressed as a percentage of total assets;
Additional variables for Model (2)		
AUDITOFFICE_CHANGE	=	one if a client changes their audit office in year t, and zero otherwise;
EXPERT	=	one if an auditor has the largest annual market share in an industry defined by 2-digit SICs, and if its annual market share is at least 10 percentage points greater than its closest competitor in a national audit market, and zero otherwise;
GC	=	one if a client receives going-concern opinion, and zero otherwise;
ATENURE	=	auditor tenure in number of years;
GROWTH	=	percentage change in sales from year t-1 to year t;
DA	=	performance-matched discretionary accruals (Kothari et al. 2005);
RESTATE	=	one if a client announces a restatement of its financial statements, and zero otherwise;
INVREC	=	inventory plus receivables, divided by total assets;
ROA	=	net income divided by average assets;
CASH	=	cash divided by total assets;
FRGN	=	one if a client reports foreign exchange income (loss) in COMPUSTAT, and zero otherwise;
MA	=	one if a client had a merger or acquisition in the previous two years, and zero otherwise.

Additional variables for Model (3)		
CHANGE_LOWER	=	one if a client changes to a lower ratio (*AF_RATIO*) audit office in year t than in year t-1, and zero otherwise;
BEFORE_CHANGE_ LOWER	=	one if year t is one year before a client changes to a lower ratio (*AF_RATIO*) audit office, and zero otherwise;
AFTER_CHANGE_LOWER	=	one if year t is one year after a client changes to a lower ratio (*AF_RATIO*) audit office, and zero otherwise;
CHANGE_HIGHER	=	one if a client changes to a higher ratio (*AF_RATIO*) audit office in year t than in year t-1, and zero otherwise;
BEFORE_CHANGE_ HIGHER	=	one if year t is one year before a client changes to a higher ratio (*AF_RATIO*) audit office, and zero otherwise;
AFTER_CHANGE_ HIGHER	=	one if year t is one year after a client changes to a higher ratio (*AF_RATIO*) audit office, and zero otherwise;

FIGURE 1
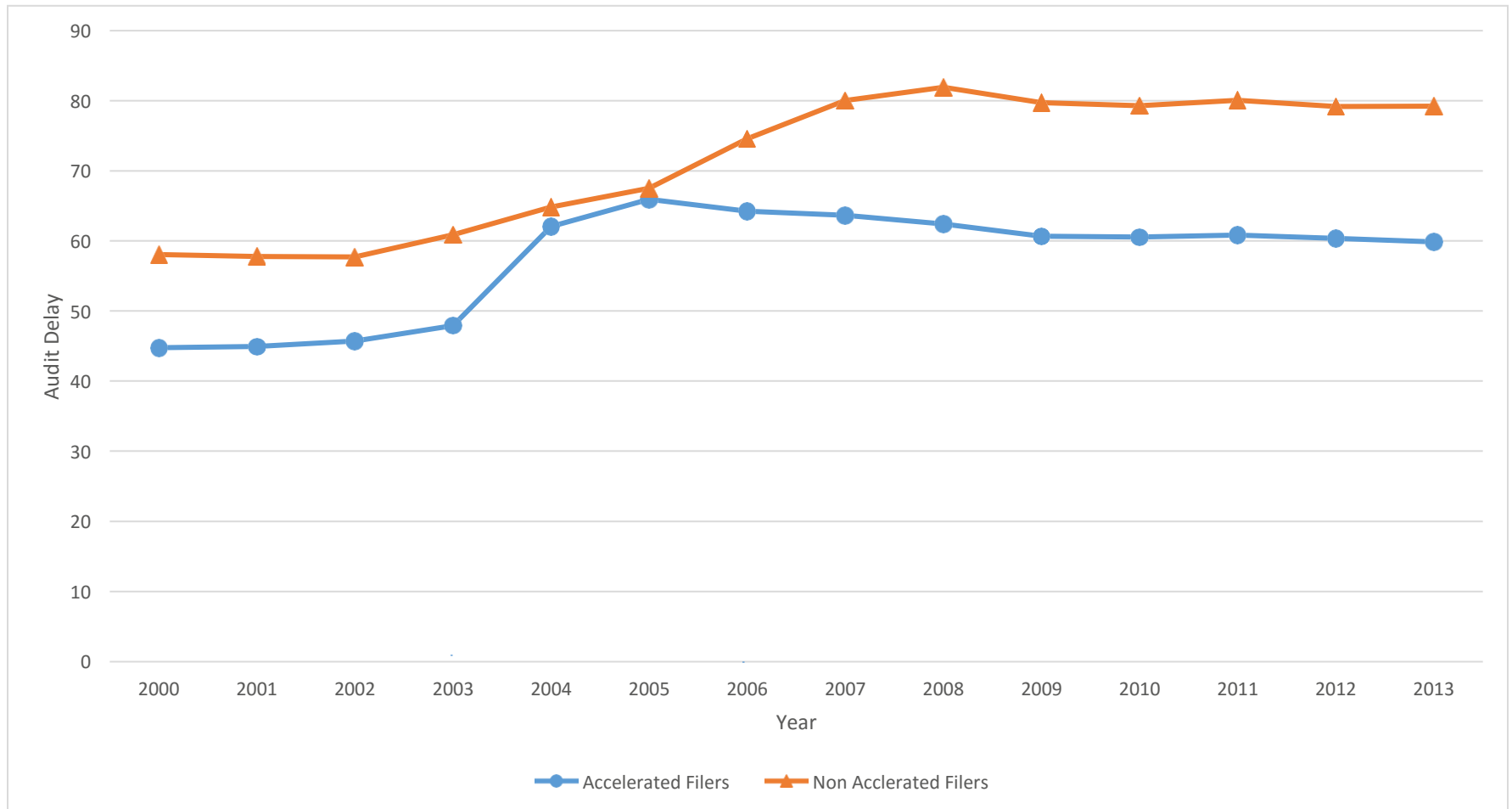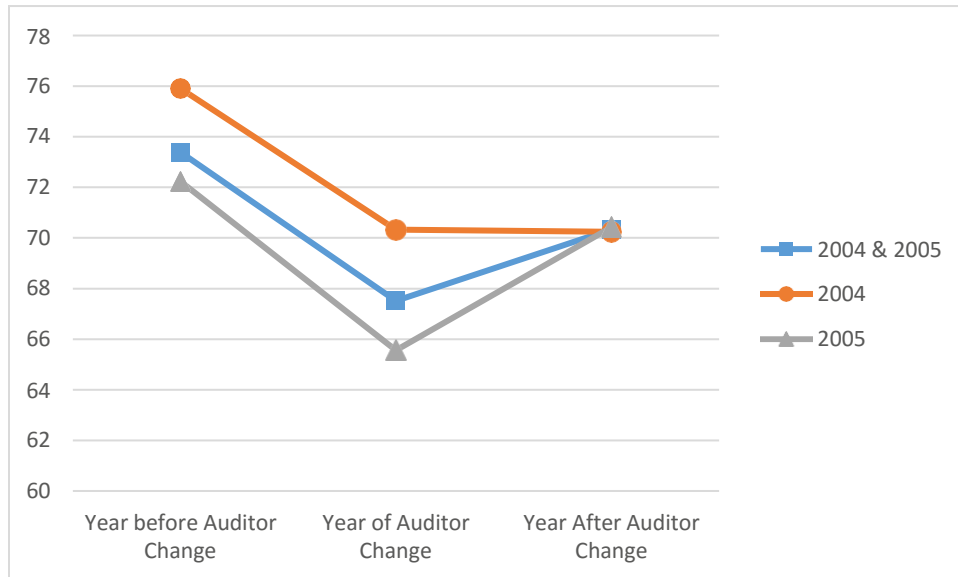
Mean Audit Delay by Filer Status

FIGURE 2

Mean Audit Delay around Auditor Change for NAFs

Panel A: Changing to a Lower AF-proportion (*AF_RATIO*) Audit Office

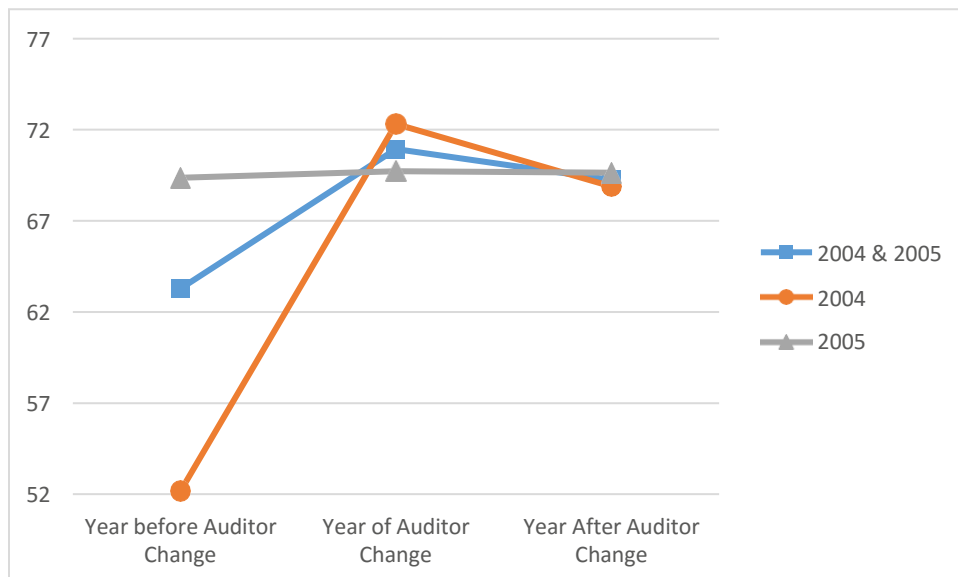**Panel B: Changing to a Higher AF-proportion (*AF_RATIO*) Audit Office**

TABLE 1
Sample Selection

Panel A: Audit Delay Analysis - Model (1)

Sample	# of obs
Client-years with non-missing CIK from COMPUSTAT between years 2000 and 2006	60,281
Less: Missing audit report dates from Audit Analytics	16,027
Observations with extremes in audit delay (i.e., negative audit delay or audit delay of greater than 105)	711
Observations without necessary data to compute filer status or controls from COMPUSTAT and Audit Analytics	23,315
Accelerated filers	15,024
Non-accelerated filers being early adopters of Section 404	51
Misclassified non-accelerated filers	<u>164</u>
Sample for Model (1)	4,989

Panel B: Audit Office Change Analysis – Model (2)

Sample	# of obs
Client-years in COMPUSTAT with non-missing CIK code between years 2001 and 2006	50,964
Less: Financial Industry (two-digit SICs 60-69)	13,313
Auditor switches from Arthur Anderson	1,013
Observations without necessary data to compute filer status or controls	16,937
Accelerated filers	12,389
Non-accelerated filers being early adopters of Section 404	39
Misclassified non-accelerated filers	<u>23</u>
Sample for Model (2)	7,250

Panel C: Analysis of the Impact of Audit Office Change on Subsequent Audit Delay – Model (3)

Sample	# of obs
Sample for Model (1)	4,989
Less: Observations before 12/15/2003 (i.e., the pre-regulation period)	2,946
Observations without two consecutive years' AF-ratios	625
Audit office changes occurring in 2003 or 2006	173
Additional year for audit office changers	31
Clients change audit office in both 2004 and 2005	<u>6</u>
Sample for Model (3)	1,208

TABLE 2
Descriptive Statistics

Panel A: Descriptive Statistics of *AUDIT_DELAY* (n=4,989)

	Pre-Regulation Period		Post-Regulation Period		Diff. btw. Pre- and Post- Periods	
	AF _RATIO _HIGH=0	AF _RATIO _HIGH=1	AF _RATIO _HIGH=0	AF _RATIO _HIGH=1	AF _RATIO _HIGH=0	AF _RATIO _HIGH=1
AUDIT_ DELAY	(N=1,370)	(N=1,576)	(N=1,131)	(N=912)		
Mean	59.30	57.22	66.71	68.01	7.41***	10.79***
Median	58	55	69	74	11***	19***

Panel B: Descriptive Statistics of *AUDITOFFICE_CHANGE* (n=7,250)

	Pre-Regulation Period		Post-Regulation Period		Diff. btw. Pre- and Post- Periods	
	AF _RATIO _HIGH=0	AF _RATIO _HIGH=1	AF _RATIO _HIGH=0	AF _RATIO _HIGH=1	AF _RATIO _HIGH=0	AF _RATIO _HIGH=1
	(N=1,117)	(N=1,498)	(N=2,546)	(N=2,089)		
# of auditor changes	173	198	553	474		
% of obs	15.5%	13.2%	21.7%	22.7%	6.2%	9.5%

Panel C: Descriptive Statistics

	Mean	Std. Dev.	25%	Median	75%
Model (1): n=4,989					
AUDIT_DELAY	61.92	21.42	45.00	63.00	81.00
POST	0.41	0.49	0.00	0.00	1.00
AF_RATIO_HIGH	0.50	0.50	0.00	0.00	1.00
OFFICE	15.29	2.01	13.86	15.46	16.88
INFLUENCE	0.13	0.25	0.01	0.02	0.11
SIZE	3.56	1.11	2.80	3.55	4.29
EXTR	0.02	0.14	0.00	0.00	0.00
AOPIN	0.30	0.46	0.00	0.00	1.00
AUDITFIRM_CHANGE	0.10	0.31	0.00	0.00	0.00
AR	0.18	0.14	0.07	0.16	0.26
BN	0.40	0.49	0.00	0.00	1.00
LOSS	0.53	0.50	0.00	1.00	1.00
BM	0.82	1.26	0.28	0.63	1.20
LVG	0.48	0.31	0.25	0.43	0.64
YEND	0.62	0.49	0.00	1.00	1.00
BIGN	0.62	0.48	0.00	1.00	1.00
NUM	0.46	0.61	0.00	0.00	1.10
LITIND	0.37	0.48	0.00	0.00	1.00
FC	-0.72	3.32	-2.64	-1.38	0.08
FOL	2.31	7.10	0.00	0.00	0.00
VOL	0.97	1.58	0.25	0.49	0.99
OCON	2.53	1.56	1.30	2.23	3.74
ICON	0.46	0.15	0.36	0.40	0.51
CAIN	0.51	0.41	0.19	0.40	0.73
Additional Variables from Model (2): n=7,250					
AUDITOFFICE_CHANGE	0.19	0.39	0.00	0.00	0.00
EXPERT	0.07	0.25	0.00	0.00	0.00
GC	0.22	0.41	0.00	0.00	0.00
ATENURE	2.80	1.47	2.00	3.00	4.00
GROWTH	0.27	1.12	-0.13	0.04	0.25
DA	0.01	0.45	-0.12	0.02	0.17
RESTATE	0.07	0.26	0.00	0.00	0.00
INVREC	0.32	0.23	0.11	0.29	0.50
ROA	-0.46	1.14	-0.41	-0.05	0.04
CASH	0.21	0.24	0.03	0.11	0.32
FRGN	0.10	0.29	0.00	0.00	0.00
MA	0.09	0.28	0.00	0.00	0.00

TABLE 3
Impact of Auditor Resource Allocation Ratio on Audit Delay

$$
\begin{aligned}
AUDIT\_DELAY_{it} ={}& \beta_0 + \beta_1 POST_{it} + \beta_2 AF\_RATIO\_HIGH_{it} + \beta_3\,(POST_{it} \\
& \times AF\_RATIO\_HIGH_{it}) + \beta_4 PERIOD_{it} + \beta_5 MEDIATION_{it} \\
& + \beta_6 AUDITFIRM\_CHANGE_{it} + \beta_7 BIGN_{it} + \beta_8 SIZE_{it} + \beta_9 EXTR_{it} + \beta_{10} NUM_{it} \\
& + \beta_{11} AOPIN_{it} + \beta_{12} AR_{it} + \beta_{13} YEND_{it} + \beta_{14} BN_{it} + \beta_{15} LOSS_{it} \\
& + \beta_{16} LITIND_{it} + \beta_{17} BM_{it} + \beta_{18} FC_{it} + \beta_{19} LVG_{it} + \beta_{20} FOL_{it} + \beta_{21} VOL_{it} \\
& + \beta_{22} OCON_{it} + \beta_{23} ICON_{it} + \beta_{24} CAIN_{it} + industry + \varepsilon_{it} \qquad (1)
\end{aligned}
$$

Panel A: Regression Results

Independent Variables	Coefficient Estimates	Predicted Sign	Estimate	
Constant		?	44.049	***
POST	β_1	+	8.306	***
AF _RATIO_HIGH	β_2	?	-2.647	***
POST × AF_ RATIO_HIGH	β_3	+	3.345	***
OFFICE		+	1.404	***
INFLUENCE		+	8.282	***
AUDITFIRM_CHANGE		+	0.393	
BIGN		-	0.061	
SIZE		-	-0.954	**
EXTR		+	1.347	
NUM		+	2.079	***
AOPIN		+	6.140	***
AR		+	3.299	
YEND		?	-0.102	
BN		+	1.876	***
LOSS		+	4.685	***
LITIND		-	-6.690	***
BM		?	1.909	***
FC		-	0.374	
LVG		?	13.011	***
FOL		-	-0.089	**
VOL		-	-0.051	
OCON		+	0.012	
ICON		-	-10.127	
CAIN		-	-8.055	***
N			4,989	
Adjusted R^2			0.197	

Panel B: Interpretation of Regression Results on Audit Delay

	Sum of Estimates: POST=0		Sum of Estimates: POST=1		Diff btw. Pre- and Post-Regulation Periods	
AF_RATIO_HIGH=0	Base Group		β_1	8.306 ***	β_1	8.306 ***
AF_RATIO_HIGH=1	β_2	-2.647 ***	$\beta_1 + \beta_2 + \beta_3$	8.734 ***	$\beta_1 + \beta_3$	11.381 ***
Diff btw. Low and High AF_RATIO	β_2	-2.647 ***	$\beta_2 + \beta_3$	0.428	β_3	3.345 ***

Notes to Table 3:

*, **, *** Significant at 0.1, 0.05, and 0.01 levels, respectively. The statistical tests are one-tailed (two-tailed) if there are (are not) directional predictions.

Industry dummies are also included as additional controls. All the continuous independent variables are winsorized at top and bottom 1% to control for outliers.

All variables are as defined in Appendix A.

TABLE 4

Impact of Auditor Resource Allocation Ratio on Audit Office Change

$$AUDIT\_OFFICE\_CHANGE_{it}$$
$$= \beta_0 + \beta_1 POST_{it} + \beta_2 AF\_RATIO\_HIGH_{it-1} + \beta_3 (POST_{it}$$
$$\times AF\_RATIO\_HIGH_{it-1}) + \beta_4 OFFICE_{it-1} + \beta_5 BIGN_{it-1} + \beta_6 EXPERT_{it-1}$$
$$+ \beta_7 ATENURE_{it-1} + \beta_8 SIZE_{it-1} + \beta_9 NUM_{it-1} + \beta_{10} FRGN_{it-1}$$
$$+ \beta_{11} MA_{it-1} + \beta_{12} AOPIN_{it-1} + \beta_{13} GC_{it-1} + \beta_{14} GROWTH_{it-1} + \beta_{15} DA_{it-1}$$
$$+ \beta_{16} RESTATE_{it-1} + \beta_{17} INVREC_{it-1} + \beta_{18} LOSS_{it-1} + \beta_{19} LVG_{it-1}$$
$$+ \beta_{20} ROA_{it-1} + \beta_{21} CASH_{it-1} + industry + \varepsilon_{it} \tag{2}$$

Panel A: Regression Results

Independent Variables	Coefficient Estimates	Predicted Sign	Estimate	
Constant		?	-1.070	
POST	β_1	+	0.164	*
AF _RATIO_HIGH	β_2	?	-0.242	**
POST × *AF_ RATIO_HIGH*	β_3	+	0.488	***
OFFICE		?	-0.054	**
BIGN		?	0.597	***
EXPERT		-	0.160	
ATENURE		+	0.077	***
SIZE		-	-0.203	***
NUM		+	0.102	**
FRGN		+	0.225	**
MA		+	0.161	*
AOPIN		+	0.129	*
GC		+	0.364	***
GROWTH		+	0.045	**
DA		-	-0.226	***
RESTATE		+	0.231	**
INVREC		+	0.162	
LOSS		+	0.143	**
LVG		+	-0.054	*
ROA		-	-0.047	
CASH		-	-0.199	
N			7,250	
Pseudo R^2			0.049	

Panel B: Interpretation of Regression Results on Audit Office Change

	Sum of Estimates: *POST*=0		Sum of Estimates: *POST*=1		Diff btw. Pre- and Post-Regulation Periods	
AF_RATIO_HIGH=0	Base Group		β_1	0.164 *	β_1	0.164 *
AF_RATIO_HIGH=1	β_2	-0.242 **	$\beta_1 + \beta_2 + \beta_3$	0.410 ***	$\beta_1 + \beta_3$	0.652 ***
Diff btw. Low and High AF_RATIO	β_2	-0.242 **	$\beta_2 + \beta_3$	0.246 **	β_3	0.488 ***

Notes to Table 4:
*, **, *** Significant at 0.1, 0.05, and 0.01 levels, respectively. The statistical tests are one-tailed (two-tailed) if there are (are not) directional predictions.

Industry dummies are also included as additional controls. All the continuous independent variables are winsorized at top and bottom 1% to control for outliers.

All variables are as defined in Appendix A.

TABLE 5

Audit Office Changes in the Pre- and Post-Regulation Periods

| Direction of Change | Pre-Regulation Period | | | | Post-Regulation Period | | | |
| | (*AF_RATIO_HIGH* =0) | | (*AF_RATIO_HIGH* =1) | | (*AF_RATIO_HIGH* =0) | | (*AF_RATIO_HIGH* =1) | |
	N	Freq. (%)	N	Freq. (%)	N	Freq. (%)	N	Freq. (%)
Non-Big 4 to Big 4	19	10.98%	5	2.53%	13	2.34%	3	0.63%
Big 4 to Non-Big 4	21	12.14%	97	48.99%	43	7.73%	299	63.08%
Lateral Big 4	27	15.61%	81	40.91%	13	2.34%	75	15.82%
Lateral Non-Big 4	106	61.27%	15	7.58%	487	87.59%	97	20.46%
Total	173	100%	198	100%	556	100%	474	100%

TABLE 6
Multivariate Analyses: Impact of Audit Office Change on Subsequent Audit Delays for NAFs

$$AUDIT\_DELAY_{it} = \beta_0 + \beta_1 BEFORE\_CHANGE\_DPGDR_{it} + \beta_2 OF\_CHANGE\_DPGDR_{it} + \beta_3 AFTER\_CHANGE\_DPGDR_{it}$$
$$+ \beta_4 BEFORE\_CHANGE\_HMHHDR_{it} + \beta_5 OF\_CHANGE\_HMHHDR_{it} + \beta_6 AFTER\_CHANGE\_HMHHDR_{it}$$
$$+ \sum_{kk=7}^{27} \beta_k CONTROL_{it} + industry + year_i + \varepsilon_{it} \qquad (3)$$

Auditor Change	Year *bef.* Auditor Change Coeff.	Year *of* Auditor Change Coeff.	Year *After* Auditor Change Coeff.	(Year of Auditor Change – Year before Auditor Change) Coeff.	Pred. Sign		(Year after Auditor Change – Year before Auditor Change) Coeff.	Pred. Sign	
To Lower *AF_RATIO* Office	β_1=10.270	β_2=3.216	β_3=3.617	$\beta_2-\beta_1$	-	-7.054 **	$\beta_3-\beta_1$	-	-6.653 *
To Higher *AF_RATIO* Office	β_4=1.453	β_5=9.012	β_6=2.144	$\beta_5-\beta_4$	?	7.599 *	$\beta_6-\beta_4$	?	0.691
Difference				$(\beta_2-\beta_1)-(\beta_5-\beta_4)$	-	-14.653 **	$(\beta_3-\beta_1)-(\beta_6-\beta_4)$	-	-5.962

(N=1,208 Adjusted R^2=0.259)

Notes to Table 6:
*, **, *** Significant at 0.1, 0.05, and 0.01 levels, respectively. The statistical tests are one-tailed (two-tailed) if there are (are not) directional predictions.

Industry and year dummies are also included as additional controls. All the continuous independent variables are winsorized at top and bottom 1% to control for outliers. All variables are as defined in Appendix A.

Is Mixed Reality a Viable Educational Technology for Higher Education or Is It Just another Form of Edutainment?

Prof. Russell Beauchemin, Roger Williams University

There has been consistent conversation happening across all forms of modern media concerning the future of higher education in the United States. The overall sentiment seems to be that traditional models of higher education could be in jeopardy due to rising costs, shifting political landscapes, and overall concerns relating to ROI and the value of a traditional degree. Additionally, there have been numerous advancements in educational technologies that bring classroom content directly to students on-demand irrespective of location or modality—in some cases, for free. Though not exactly free, a group of newer technologies might hold promising results to help deliver this content in a more personalized and interactive way as higher education continues to evolve and transform to address these nascent problems.

Mixed Reality (MR) began its roots with augmented reality (AR) back in the early 1960's when Morton Heilig was trying to understand what future cinematic sensory experiences might be like. From this first AR device, a sort of private viewing station that sprayed scents towards the participant in an effort to enhance the viewer's sensory experience, to Google Glass, an AR device developed by Google in 2013 and used to augment (read: enhance) information perceived from the natural environment with static information superimposed onto it through a small monocle-type device, AR has been struggling to gain more practical and wide-spread adoption in the education sector. In fact, as of now, most of AR's educational benefits have been theoretical or, at most, minimal in their educational impact.

Mixed Reality (MR) is a form of interactive AR where virtual dynamic objects and information overlay the natural environment which a user can interact with, unlike the static AR precursor. Due to the dynamic nature of this technology, it's easy to see the potential impact the application of this technology has for the entertainment and creative industries, but what about education?

This paper will explore existing research and the potential of using MR-based delivery of educational content to determine whether it is a viable educational technology or just another technology that will over-promise and under-deliver in a higher-education setting.

Hands-on with Mixed Reality: A Workshop on Microsoft HoloLens
Mr. Russell Beauchemin, Roger Williams University

Mixed Reality (MR) began its roots with augmented reality (AR) back in the early 1960's when Morton Heilig was trying to understand what future cinematic sensory experiences might be like. From this first AR device, a sort of private viewing station that sprayed scents towards the participant in an effort to enhance the viewer's sensory experience, to Google Glass, an AR device developed by Google in 2013 and used to augment (read: enhance) information perceived from the natural environment with static information superimposed onto it through a small monocle-type device, AR has been struggling to gain more practical and wide-spread adoption in the education sector. In fact, as of now, most of AR's educational benefits have been theoretical or, at most, minimal in their educational impact.

Mixed Reality (MR) is a form of interactive AR where virtual dynamic objects and information overlay the natural environment which a user can interact with, unlike the static AR precursor. Due to the dynamic nature of this technology, it's easy to see the potential impact the application of this technology has for the entertainment and creative industries.

This workshop will provide attendees a hands-on demo of this technology, through Microsoft HoloLens, along with use-cases and potential applications across a multitude of industry sectors from education to manufacturing.

Coastal Resilience: Re-grounding the Newport Waterfront

Prof. Edgar G. Adams Jr., Roger Williams University

Abstract

The site where land meets water has increasingly become a scene of violent confrontation between the extreme weather being unleashed by climate change and man's ambition for permanence and mastery over the dynamic and unpredictable forces of nature. Ian McHarg's 1967 book entitled "Design with Nature" offered a prescient glimpse at a new and radically different way of looking at man's relationship to nature. Urban responses to extreme weather and sea level rise can take three fundamental forms: hardening, retreat, and working with and learning from nature to develop a more dynamic, flexible and resilient means of dealing with the changes that confront us. Each strategy has a role to play; however, we need to come to terms with the fact that the more we ignore the functioning of the natural systems that we rely on, the more we seem to be at their mercy.

Once a major colonial port, the City of Newport Rhode Island has never truly recovered from the British occupation during the War for Independence. Passed over by the forces of industrialization, the city found itself caught between those who would see it become a museum and playground for the wealthy and those that see it as a diverse and vibrant year-round urban community. The path to a resilient future lies in the purposeful integration of these seemingly divergent paths. 100% of Newport Rhode Island's Central Waterfront below Thames Street now lies within the 100-year flood plain. This area, which is critical to the city's tourism industry and supports its world class yachting community, will increasingly be impacted by rising tides and extreme weather. This presentation is an exposition of work of a graduate architectural design studio that examined the creation of a more resilient Central Waterfront and identified key sites for intervention within the physical and cultural infrastructure that allows the city to serve the throngs of visitors that regularly fill its streets. This presentation and the community partnership studio and that inspired it consider whether this transient flow of people could be brought into greater harmony with the city's past, its vulnerable natural setting and its unique coastal ecology? We drew inspiration from Newport's own "Resilient Newport" and "Keeping History Above Water" initiatives and international responses to climate change. We also used historical mapping to uncover fact from historical fiction and allow for a fuller understanding of the city's complex, but hidden, evolution.

Organizational Capability Assessment and Knowledge Management Planning for Development of Organizational Capability
(Study Case: N219 Program)

How Capability Define, Asses, and Knowledge Adapted and Utilized for Supporting
Certification Process

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Abstract:
As a struggling high-tech industry suffered from declining market share, lack of capital, and potential massive knowledge loss, PTDI tries to restate its presence in the market while accelerating its young human capital capability through new product development program called the N219. This program become interesting since if succeeded, it would be the first time in over three decades PTDI able to independently complete a whole areophane development and certification cycle. This research then focused on the N219 program organization to assess the capability gap between organization's current level of maturity and the ideal level of maturity required to successfully complete its purposes. The ideal core capabilities used here to define each level of maturity was derived from various reference and tailored to the organization's need. Data collection primarily performed through interview and questioner to few pre-selected experts with high-level responsibility on the program. Assessment results then presented and analyzed. It was found that N219 organization is currently at 40% of its ideal core capabilities. With so much room for improvement, it was also found that most immediate capability to pursue is on managerial system, which includes extensive knowledge management system implementation within the organization. A set of recommendation on how to increase the maturity level of the organization through pilot project, along with five-year implementation timeline was proposed.

Keywords: Areophane Development, Organizational Capability, Aerospace Industry, Knowledge Management

Introduction

PT Dirgantara Indonesia is a State-Owned Enterprise that focuses on making transportation modes and aircraft components. PTDI is also the largest aircraft manufacturing company in Southeast Asia. Since was established in 1976, PTDI has core competence in designing and producing aircraft. In addition, PTDI has the ability to develop aircraft, including developing aircraft structures, aircraft assembly, and aircraft maintenance both for civil and military aircraft. For almost 41 years developing aircraft business, PTDI has become very important role in the development of the aviation industry in Indonesia. The journey taken in developing aircraft products requires a long process. One of them PTDI can prove the capability of transfer technology on fix wing aircraft. PTDI build C212, CN235, N250. But PTDI was Fail to get the type certificate. It become long financial crisis and loss of knowledge.

After experiencing financial crisis and several cases in court back in 2003, PTDI underwent human capital exodus and have not recruit new talent for almost 10 years. During that time PTDI experienced a lot of loss of knowledge, and fading good corporate culture. This went on until 2012, where in that year PTDI was almost declared bankrupt by the Jakarta district court. Luckily, PTDI was saved through the road of restructuring.

During this phase of restructuring, PTDI carried out some business transformation like improvement of investment infrastructure in human capital and pursuing development of new product. At the same time, government trust is increasing, it is marked by the addition of orders into the PTDI. The Indonesian government also invests in PTDI through PMN funds (State investment). This PMN fund is used for Human Resource competency improvement program and improvement of production facilities, such as machine replacement and SAP implementation. In addition to continuing the development of new products, PTDI is partnering with LAPAN (the national aviation and space agency) to co-develop a new aircraft product N219 since 2014. But PTDI facing the problem about gap generation and have high potentials for loss of knowledge. PTDI should accelerate organizational capability to fulfil knowledge gap.
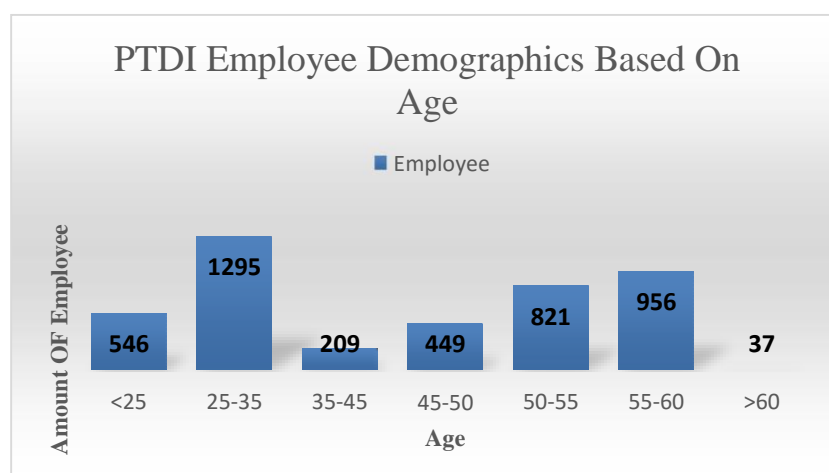
Figure 1 PTDI Employee Demographics Based On Age

Based on business issue, Finishing N219 program is one important factor in improving sustainability of PTDI. Finishing N219 program needed set of resources from tangible assets and intangible assets. Because N219 is a wide project that required various disciplines of knowledge and technical competence, adequate knowledge management, and required cooperation from various parties. All these capabilities are the capabilities that an organization must have to achieve its business objectives. N219

should be first flight in 2015, but the realization occurred in 2017. So that to reach time to market in 2019, then in 2018, N219 should finish its certification process. Certification will ensure that the aircraft is feasible to operating by customer. In this case PTDI must know the current position of organizational capability and which is expected achieve to target of finishing N219 program certification. Based on the business situation currently happening at PTDI especially in N219 Programme along with the designed conceptual framework in Chapter II, this study has following objectives:

1. To identify organizational capability expected to support certification of N219 in Technology and Development Directorate
2. To measure organizational capability gap in certification process N219 Aircraft at 2018
   To propose how roles and strategy of knowledge management can support certification process N219 Aircraft at 2018

Theoretical Overview: **Organizational Capability**

Organizational capability is a set of differentiated skills, knowledge complementary assets, and routines *(Teece et al,1997; Barton, 1992; Winter, 2000)* to establish internal structures and processes *(Ulrich, 1990)* that distinguishes and provides a competitive advantage and sustainable future. Helfat &Peteraf (2003) describes organizational capability as the ability to perform a coordinated set of tasks and utilizing organizational resources to achieve organization purpose.

Further, Barton (1990) identify three organizational capability aspects:

1. Core Capability: Constitute an upper hand for a firm; they have been developed after some time and can't be effortlessly imitated.
2. Enabling Capability: "imperative to an organization as a base reason for rivalry in the business yet that, without anyone else, pass on no specific upper hand"
3. Supplemental Capability: "nice to have but unessential"

Core capabilities of an organization must be something that is difficult to replicate by competitors and drives the organization to continuously improve their competitiveness. Hamel dan Prahalad (1990) add "relevance" to describe core organizational capability. Relevance is the ability to influence or to provide added value to the customer to buy an organization's product instead of competitor's product.

McKenzey (2011), conduct a survey which found that implementation of organizational capability improvement will be more effective if the top level executive was involved in the process. It will enable the organization to be more adaptive and effective in executing its predefined business strategy, which is important to attain better organization performance.

Recently, an organization is said to be developed not because it utilizes a certain set of management approach, but rather because it can easily adapt and innovate to meet dynamic needs of customers. Organizational capability represents a group of workers with required sets of skills, illustrates how an organization direct its human capital to achieve its targets, and how well the organization manage their intangible assets (Ulrich and Smallwood; 2004). This author further identifies the capability to be adjusted into the organizational capability required to complete the N219 certification program. It is also found that the capability can be mapped into the maturity model to assess the capability gap through the level of processes that occur within the organization. The following capabilities have been selected and adjusted to be the assessment criteria in this study: Knowledge & Skill, Technical System, Managerial System, Value and Norm, Leadership, Collaborative, Strategy unity, Decision Making and Conformity to regulation. Then the define capability will assessing the maturity level with Capability maturity model Integration and APO KM maturity framework. Capability maturity model Integration is a framework that provides ways to measure the process of improvement undertaken by the

organization. The CMMI helps an organization clarify the roadmap to achieve higher organizational capability levels. CMMI consists of initial level, manage, defined, quantitatively manage, optimizing.

3. Method

Cresswell (2003), explains there are 3 approaches to doing research; a quantitative approach, a qualitative approach and a combined approach of quantitative and qualitative. This study used a mixed approach to the problem, affixed assessment model and to strengthen the results of the interview. Because the author believes that using these two approaches will be obtained a more comprehensive analysis of the problem of research (Cresswell & Plano Clark, 2011). In case of data the author uses primary data and secondary data. Primary data obtained from personal interviews, focus group discussion, observation, and questionnaire. Secondary data obtained from literature review from several related sources.

In the questionnaire development phase, the authors conducted a study of the literature and problems that occurred in the field by way of personal interview and focus group discussion along with project leaders, chief engineer and senior expertise program N219. Based on the process, the model of questionnaire organizational capability is approaching according to the problems faced in the field.

Then, interviews were conducted at the beginning of the research for business issue exploration, development of the questionnaire at the time of data collection. At the time of data retrieval, an expert who is very understand the context of the problems in the program N219. Valenzuela and Pallavi (2014) suggested that an interviewer must be Knowledgeable, Structuring, Clear, Gentle, Steering, Remembering and Interpreting.

This author chose Mr. Ir. Andi Alisjahbana as former Director of Technology and Development who currently also serves as Expert Staff and Advisor to the new Director of Technology and Development, as the interviewee. Mr Ir. Andi Alisjahbana, is the originator of the idea made N219 aircraft. He also has experience in aircraft design at Boeing Company. At the time of data collection is done the weighting of each question and the reason of the selected scale

PTDI Capability Maturity Model of IAe

Before developing questionnaire, based on literature review and field observation results, PTDI authors need to establish a Capability Maturity Model to simplify the assessment process. Then the Capability Maturity Model Integration and APO KM maturity model were chosen to be the materials to develop PTDI Capability Maturity Model. CMMI is used to assess the level of capability in each process, while the APO KM maturity model assesses the maturity of the implementation of knowledge management activities to support the transfer of knowledge. This model is then verified by the project leader N219.

Table 1. Capability Maturity Model

Level	Definition
Initial (71-148)	Unpredictable and reactive : work gets completed but is often delayed and over budget. KM activity has been run but not systematic and unstructured, KM activity without direction or without clear target and its activity very rare
Managed (149-203)	Managed on the project level: Projects are planned, performed, measure and controlled. Organization have standard operating KM as a reference, but the implementation has not been consistent in every activity

Level	Definition
Defined (204-254)	Proactive. Rather than reactive: Organization-wide standards provide guidance across project, programs and portfolios. Organizations already have KM standards, clear direction and good job sharing
Quantitatively managed (255-274)	Measured and controlled: Organization is data-driven with quantitative performance improvement objective that are predictable and align to meet the needs of internal and external stakeholders. The organization has a monitoring and measuring system of efficiency and effectiveness of KM activities, with continuous improvement process but not yet synergistic
Optimizing <274	stable and flexible : Organization is focused on continuous improvement and is built to pivot and respond to opportunity and change. The organization's stability provides a platform for agility and innovation. Have a quantitative monitoring and assessment system and the organization continues to make improvements and improvements in accordance with business goals and external factor developments.

Result and Discussion

□ **Value and norm**

The value and norm category will evaluate the required capabilities. Value and norm capability is defined as the company's ability to maintain a rewarding tradition of maintaining a nurturing individual and potentially producing knowledge that can improve the company's competitive advantage and influence new product development programs in every business line. As a company that does business airplanes, this should be done. Because after all, keeping the tradition of rewarding the people who have the potential to produce competitive advantage will make the employee feel at home and will have more value. But this process must also be associated with the revenue earned. Based on the assessment results it is known that the value and norm capability has a total score of 30 for the expected capability.

The lowest score obtained educational background indicator because it does not provide specific awards for employees with formal education that supports core competency PTDI eg from aviation, electro, civil engineering. Because the qualification system in PTDI is not only determined by the level of education but rather the experience. Experience is what makes PTDI employees more effective in carrying out design work on the Directorate of Technology and Development. Although the educational background, for example, employees with educational backgrounds still provide impact to core competency PTDI.

The existence of N219 Program gives a positive impact that is a sense of pride in the increasing motivation of employees, especially millennial PTDI. However, PTDI Management must still think about how this award program can be implemented in a comprehensive study. Because if not, PTDI will face the knowledge loss due to people potentially leaving the company.

□ **Technical system**

Technical system is defined as the accumulation of knowledge and experience owned by the company from the previous time and can be accessed and used by Professional N219 easily. Based on the results of the assessment, the Technical system used by PTDI in general is sufficient to help the project N219. Previous knowledge databases are stored in engineering data management. However, for the availability of sources of knowledge that contain a specific set of activities that are run in a standard way, not all are able to answer the company's challenges. Because basically need to be updated regularly through the appropriate studies. For technical procedures that govern the way daily work already exists.

But it still needs to be developed accordingly to answer business challenges. The technical system in PTDI has not been fully integrated, and is limited to access.

☐ **Strategy unity**

Strategy unity is defined as the ability of companies to articulate and share a comprehensive understanding of the various things that affect the direction of the company. The N219 engineer understands N219's strategic plan every year. So many N219 Engineers feel get the big picture through the strategy submitted by the directors. N219 is the company's strategy to enter the civil market. Where previously most of PTDI's customers were TNI. This opens up new hope for PTDI employees in improving their welfare. Employees have also invested their time and thoughts to build the N219. It is inevitable that in its journey, in designing N219 there are several iterations to realize the certification process, including the success of first flight. It has never escaped the support of the Board of Directors in collaboration with employees to realize the success of this program. The Board of Director often goes to the hangar or enters the task force meeting to listen to the problems that occur and formulate solutions that can be done. That way, the journey of this project becomes more lancer than ever. So it can be summed up for this capability is a very important capability for the certification process and PTDI already has it.

☐ **Managerial system**

Managerial system is defined as the ability and willingness of the company to encourage the accumulation of organizational knowledge and manage it either through formal or informal means continuously. One indicator in the managerial system is the implementation of knowledge management, because in it there SECI process. As a technology-based and project-based company, this is a very important capability. Because SECI process that will encourage PTDI to continue to manage knowledge and accelerate the transfer of knowledge in accordance with cases that occur in PTDI. Where gap generation becomes one of the main problem points encountered. Existing, the SECI process takes place in PTDI. But the application is still not consistent. And in gaining new knowledge the employees involved in the N219 program did not cooperate with foreign technical assistant like the previous project, N250. They get pure knowledge of the knowledge that is still stored in the company and the experience of senior engineers who also had experience in the design process of N250 aircraft. As for the training provided is not a special package in the form of training N219 aircraft design. Because the junior engineer get the experience through job shadowing and mentoring with senior engineer. Education and training parties provide only general and basic training such as understanding Basic Aircraft, Reading engineering drawings, and English. As for specific training that can only be obtained from certain institutions, PTDI provides training but because of the limited funds and the approval process of PMN funds, not everyone has the same opportunity at one time. However, PTDI Management provides learning facilities for the N219 program by purchasing a Kodiak airplane that is used as a model for engineers to learn. In the course of the N219 project, the reward system has not been enforced maximally. The current incentive system is still valid up to manager level. This is because the new PTDI developed a performance management system that has never existed before. The new system is tested and the overall implementation of this system will be done in 2018. In conclusion, PTDI capability in managing knowledge and human capital should still be improved, not only for N219 project but for future projects.

Leadership

Leadership is defined as the ability to lead a group or organization. Leadership will be very useful for the project. Indicators assessed in leadership capability consist of set direction, motivate people, and develop people. Based on the assessment, the size for this leadership is enough. This indicator is enough from the result that the first flight process runs smoothly. However, should the leadership capability required is level 5. This is because PTDI for almost 15 years soft leadership competence of employees the development process is minimal. Leadership training has not been evenly distributed and the involvement of provider training from outside PTDI is still very minimal. This is because the limited funds owned by PTDI after the crisis is very minimal. Training leadership conducted with new providers is done in 2015 after the cost of PMN is available. Based on the internal review of PTDI, the current leadership is not as expected.

 Knowledge and skill

Knowledge and skill is defined as the employee's capabilities that include the understanding and expertise of the technical and scientific specifications owned by the employee. It consists of Mastery of Knowledge, Problem solving, Culture, Influence skill, Availability expert, Learning habitat creation. The indicator results according to the assessment is quite good. But for problem solving and corporate habits of bringing in experts outside the company is still very less. Engineer N219 does not always result in innovation to speed up the process of programming. This is evident from the delay of programming. This is related to the learning process experienced by employees. Due to lack of experience, it takes time to process iterations. While the capability to design aircraft, engineer PTDI every year always audited knowledge and skill by the regulator to get the design of approval. When PTDI obtains DOA, PTDI has the authority to design the aircraft itself.

Although indeed skills and skills to get DOA already obtained PTDI still require acceleration for junior engineer. Due to being an experienced engineer, at least 5 years of experience in the field of design and flight test aircraft. The current dominating composition is the number of existing young engineer engineers who have not had more than 5 years of experience. So the overall capability is not maximal. This is correlated with the managerial system that when fulfilled will be able to help the N219 program in menyseikan the process of timely identification. In addition PTDI also still need people with T shape skill. T shape skill that will help PTDI more in the technical process and management of the management. People who have T shape skills not only understand or have deep skills but also have a wide skill. It means able to think holistically in addition to the detail.

 Decision Making

Decision is increasingly the process of setting what to do and how to do. Based on the literature study used, decision making is important for an organization. Because the organization is not always faced with a condition that is always stable. There will always be changes and dynamics.
However, in the process of decision making is required knowledge and skill capabilities are strong. Without knowledge and skill the resulting decisions may be incorrect. Capability of decision making is also highly correlated with leadership capability. Because when a project leader has good leadership, then he will be easier to convince others. Indicator contained in this capability that consists of ability of a leader able to see big picture, situational appraisal, decision analysis, and persuasive communication. Besides the decision making, requires need emotional intelligence. The better the three, then the ability of the decision is also good. So need input and need know how process too. The most important in this decision making needs to be called integrative thinking skills, the ability to

overcome paradoxes and reduce tension will be important for organizational goals. Leaders with integrative thinking skills and the ability to cope with paradox and tension will be essential for effective decisions about the organizational purpose (McKenzie et al., 2009).

All indicators based on the assessment are quite good. However, persuasive communication is lacking. This is because PTDI has never previously trained employees to communicate properly. And this is evident when dealing with DGCA, project leader still looks less convincing. Though the project leader has good knowledge and skills. So the process to meet the regulatory requirements several times revised and iterated. This is also one of the causes of the delay of the N219 project. Persuasive communication ability must be owned by all project leader N219, considering the project leader is working on different fields.

☐ **Compliance to regulation**

Compliance to regulation is defined as the Ability to Comply with the national and / or international flight regulation applicable to the organization. The technology directorate has the authority to ensure designated aircraft meet the required security indicator. The results of the assessment indicate that for the capability of compliance to regulator, PTDI has an understanding of the knowledge needed to achieve the requirement well. Because if it does not meet, the N219 aircraft will not get a fly license for the first flight. This capability also relates to knowledge and skill capabilities. Because this regulation will work properly if the N219 engineer has the knowledge and skills required by the regulation.

☐ **Collaboration**

Collaboration is defined as the ability to work productively with other people or parties. From the assessment results show the results of this collaboration is good enough. This can be proved by the achievement of the first flight of the prototype N219. The existence of N219 program able to build synergy between organizations. Not only the internal Directorate of Technology, but the Directorate of Technology in cooperation with the Directorate of production, Finance, Human Resources and Commerce to jointly realize the program N219. Each individual performs their respective roles. However, to achieve the N219 certification program is still needed a long journey and this collaboration needs to be improved. This collaboration capability is closely related to the capability of the unity strategy. Because by having a clear purpose and communicated to an individual level, collaboration can be a power to attach performance. This collaboration also enabled PTDI to perform better than before.

Gap Analysis

Gap analysis is used to understand the relative ratios between factors so that the priority is found, and the comparison of which factors are the most dominant. The most dominant capability represents the effort required to reduce the capability gap. So we get two mutually reinforcing information to determine which capabilities need attention to management.

• **Comparison of factors relative**

To get a relative comparison between factors, how to measure the gap, obtained from the difference of total score of each sum of the expected capability value:

Gap Value Relative = Total score existing capability - Total score expected capability

This is the result of the gap value between the existing capability score and the expected capability score.

Table 2. Gap value on organization capabilities.

Organizational capability	Collaboration	Compliance with	Decision making	Knowledge and skill	Leadership	Managerial System	Strategy Unity	Technical System	Value & Norm	Total
Score capability existing	15	14	13	19	9	54	18	30	23	195
Score capability expected	20	15	20	35	15	80	20	40	30	275
Gap	5	1	7	16	6	26	2	10	7	80

Then the number is standardized in percentage by:

% gap value relative = (each gap value / total gap value) x 100%

To get the percentage of gap value and give a rank for each capability to get the biggest gap value as below:

Table 3. Gap value on organization capabilities, in percentage.

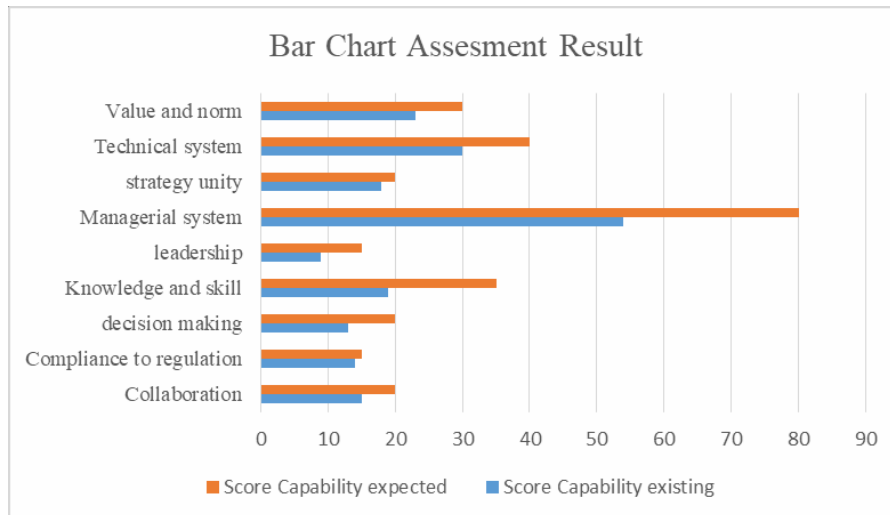| Organizational capability	Collaboration	Compliance with	Decision making	Knowledge and skill	Leadership	Managerial System	Strategy Unity	Technical System	Value & Norm	Total
Score capability existing	8%	7%	7%	10%	5%	28%	9%	15%	12%	100%
Score capability expected	7%	5%	7%	13%	5%	29%	7%	15%	11%	100%
Gap	6%	1%	9%	20%	8%	33%	3%	13%	9%	100%
Priority	7th	9th	5th	2nd	6th	1st	8th	3rd	4th	

Figure 2. Bar Chart Assessment Result.

The analysis shows that the managerial system is a capability that has the highest gap among other capabilities. This is in accordance with the needs of PTDI to minimize the gap generation that occurs. The managerial system is one of the indicators in which there is the implementation of the SECI process. Followed by knowledge and skill, technical system and value and norm. The indicator with the smallest gap is the "unity strategy"**.**

Based on the assessment, it was found that the total score of organizational capability in the N219 program was 195, which was interpreted as the managed level. "Manage" level has an interpretation that Projects are planned, performed, measure and controlled. The organization has standard operating KM as a reference, but the implementation has not been consistent in every activity.

☐ **Comparison of dominant factors**

To describe the most dominant factor of each variable; which variable is the most dominant variable and the most lagging variable. The way to find out is by using the following formula:

> **3. Standard final score existing level =**
>
> **(Total Score existing capability1*standardize)/maximum score capability1)**

> **2. Standardize calculation = maximum expected level / 100%**

> **1. Gap Value Dominant = Standard final score existing level – Standard Maximum expected level**

Here is a calculation for comparison of domain level which also mapped the existing level gap and expected level.

Table 4. Comparison of dominant factors calculation.

Capability	Existing (a)	Maximum level expected (b)	amount question [c]	Max score expected (D) = [b]*[c]	Std % [E]	Domination [f] = [D]/[e]	std final score existing level [g]= [a]*[e]/[f]	std maximum expected level [h]
Compliance to regulation	14	5	3	15	100	6.7	93%	100%
strategy unity	18	5	4	20	100	5	90%	100%
Value and norm	23	5	6	30	100	3.3	77%	100%
Collaboration	15	5	4	20	100	5	75%	100%
Technical system	30	5	8	40	100	2.5	75%	100%
Managerial system	54	5	16	80	100	1.3	68%	100%
decision making	13	5	4	20	100	5	65%	100%
leadership	9	5	3	15	100	6.7	60%	100%
Knowledge and skill	19	5	7	35	100	2.9	54%	100%
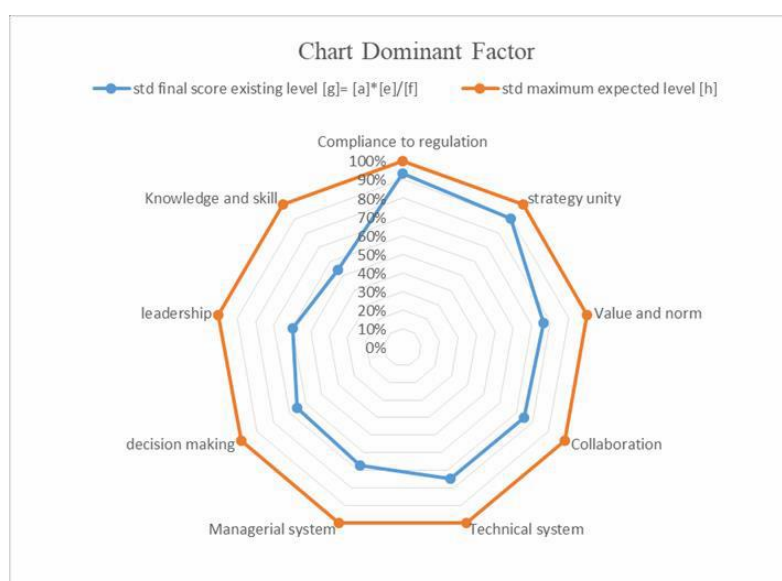
Figure 3. Chart Dominant Factor

Based on the dominant gap mapping, it was found that compliance to regulation occupied the highest number of 93%. Then followed by strategy unity. This is in accordance with the primary requirements that must be fulfilled by the program N219. That to get the type certificate, the N219 program must always meet the qualifications of human resources, the design process in accordance with the regulations and facilities / technologies that support. In addition, unity strategy is also a dominant factor that becomes the success factor of the N219 program. Due to the articulation process and the sharing of a comprehensive understanding of the various directions affecting the company, employees will find it

easier to understand the importance of executing the company's strategic plan, and the parties facilitate cooperation between management and employees.

    • Level of importance

After obtaining the value of each gaps, the relative comparison between factors and the relative dominant comparison, the level of importance for each capability can then be determined. The way to calculate the importance level is:

Level of importance: Standard final score existing level x Gap Value relative

Table 5. Calculation of level of importance.

Capability	std final score existing level [g]=	std maximum expected level [h]	Rank [i]	Capability [j]	Gap Value relative [k]	rank [L]	score total [M]	Level of Importance [n]=[g]*[k]
Compliance to regulation	93%	100%	1	Compliance to regulation	1%	9	9	0.93%
strategy unity	90%	100%	2	strategy unity	3%	8	16	2.70%
Value and norm	77%	100%	3	Value and norm	19%	4	12	14.57%
Collaboration	75%	100%	4	Collaboration	6%	7	28	4.50%
Technical system	75%	100%	5	Technical system	13%	3	15	9.75%
Managerial system	68%	100%	6	Managerial system	33%	1	6	22.28%
decision making	65%	100%	7	decision making	9%	5	35	5.85%
leadership	60%	100%	8	leadership	8%	6	48	4.80%
Knowledge and skill	54%	100%	9	Knowledge and skill	20%	2	18	10.86%

From the result of the level of importance, it is found that managerial system is a capability factor that becomes important to be handled immediately. Because based on the calculation, the managerial system gets the highest score. The dominant factor, the managerial level is not dominant, but the managerial system has the highest priority gap.

4. Organisational Capability Maturity Model Analysis

    Based on the total score of existing capability which is at 195, placing PTDI at the category "managed". This maturity level indicates that the organization has implemented the project by planning, controlling, and measuring its performance. Existing project N219 also on that level. But for the implementation of KM process has not been continuous. Stakeholders involved in the N219 project really understand KM is important and some KM activities such as knowledge sharing, and knowledge documentation have been done. However, the implementation has not been evenly distributed and not yet consistent. So to get to a higher level N219 program requires knowledge and higher-level capability.

Business Solution

Based on the calculation of existing capability, Program N219 is still in manageable level. By the definition of manageable level can be explained as in the table 2.5 in chapter 2. Level manage has the meaning that "Managed on the project level: Projects are planned, performed, measure and controlled. Organizations have standard operating KM as a reference, but the implementation has not been consistent with every activity". If PTDI wants to increase to define level, then in accordance with its definition, PTDI must achieve proactive organizational capability. Rather than reactive: Organizations-wide standards provide guidance across projects, programs, and portfolios. Organizations have KM standards, clear direction and good job sharing. Although the expected level is the optimizing level but, in its accomplishment, PTDI requires step by step. To determine the priority of the capabilities of concern, Pareto principle is used with the highest gap capability. Such as managerial system, knowledge and skills, technical system and value and norm.

☐ **Managerial System**

In this case the managerial system discusses how the ability of the company is able and willing to encourage the accumulation of organizational knowledge and manage it either through formal or informal means continuously. Companies should be able to increase the managerial capability of the system to achieve the define level. In this case required the consistency of the implementation of knowledge management. Here is an activity that can be done in managerial system at define level based on appendix D is community of practice, implementing performance management system, Increasing role of human capital strategic partner, continuously knowledge management implementation.

☐ **Knowledge and Skill**

To improve capability at the define level, in managing project people in organization must be more proactive than reactive. Because at the level of define a project has reached the organization wide standards provide guidance across projects, programs, and portfolios. Work on the project will not work without adequate knowledge and skill. The following is an activity that can be done to improve knowledge and skills and Increase the superiority of dominance discipline of knowledge. This activity is job shadowing, and capturing tacit knowledge fom expert.

☐ **Technical System**

In technical system needed to increase the effectiveness in developing technical system based on accumulative experience of PTDI employee that able to give more advantages in new product development compared to competitor. The human capital division also needs to collaborate with the IT division to build KM technology that can access knowledge and store the knowledge needed by the organization in an integrative manner. It is should be update continuously. This will make it easier for PTDI employees to be involved in the KM process. Currently, PTDI is conducting business process transformation into the digital phase. This can be a right moment to start defining the business process requirement needed to build KM technology.

☐ **Value and Norm**

To moving on the define level, Value and norm is also an organizational capability that must be improved. Because this is a basic need in every employee to get an award if the employee is an individual who maintains and has the potential to generate knowledge that can improve the competitive advantage of the company and influence the new product development program in every business line.

Here is a solution that PTDI can do to retain potential individuals with Implementation Talent Management.

Analysis of Alternatives

Based on the result of business alternative solution, it was found that the managerial system was chosen as the main priority. Because PTDI currently requires accelerated transfer of knowledge continuously integrated with human capital management system. In the alternative business solution for the managerial system, there are 4 initiatives that can be done. It is community of practice, implementation of performance management, increasing role of human capital strategic partner, consistency in knowledge management implementation. Community of practice performed at PTDI but inconsistent. For implementation performance management system in 2018, PTDI starting to implement integrated performance management system until individual level. However, for the implementation of consistency knowledge management and integrated with the role of human capital management is still not fully feasible. Because there are challenges and fundamental leadership that must be met in facing these challenges.

Conclusion

Organizational capability needs to be done to identify the core capability needed to improve the organization's business result. In this study, the business result is the achievement of the process of certification N219 certification in 2018. The results obtained that the organizational capability that still need attention is the managerial system. Where managerial system should be done to improve the acceleration of knowledge transfer organization. As for organizational capability assessment results, N219 program is still at manage level. Where there are still 3 more levels that must be passed for the organization to enter the level of optimizing. To increase to optimizing level N219 needs to increase its capability for the managerial system. Where managerial system in it contains indicator to implement knowledge management.

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Improving the Financial Well Being of College Students: A Design Thinking Approach

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College life is stressful. Students have to meet academic demands, manage social relationships, and plan for their careers. Financial concerns add to these stresses. In a national survey of college students and recent graduates, Trombitas (2012) found that one   third of participants reported that financial stress had a negative impact on their academic performance or progress and students who worked more than 20 hours per week during school year were significantly more likely to reduce course load due to financial stress. Robb (2017) reported similar findings. His sample showed that students who reported higher financial   stress were also more likely to report difficulty staying in school or maintaining number of enrolled credit hours. Not surprisingly students who did not complete their degrees were significantly more likely to default on their student loans (Brookings 2018). Britt et al (2016) investigated factors contributing to financial stress on college students. They classified factors into resources and perceptions. Resources included objective and subjective financial knowledge, income, savings, credit card debt, student loan debt, perceived net worth, and activities to earn additional cash, ranging from working more hours to skipping meals, pawning belongings, stealing. Perceptions included peer financial comparison, self-accessed financial sufficiency, and self-mastery. They found that objective financial knowledge, savings, student loan, perceived net worth, extra cash activities, peer comparison, financial sufficiency and mastery contributed to financial stress in expected directions. For example, higher income correlated with lower financial stress and higher loan balance correlated with higher stress.
They concluded that students coped with financial stress by engaging in risky behaviors to   earn extra cash. Walsemann, et al (2015) found that student loans, even when not in default, were associated with poorer psychological functioning and Sweet et al (2013) found that higher debt ratios were associated with higher perceived stress and depression, worse self-reported general health, and higher diastolic blood pressure. Therefore there are a lot of good reasons for students to manage and reduce their financial stress.

In addition to improving personal overall well-being, society will also benefit if reducing financial stress helps students stay in school and graduate, improving their ability to pay off student loans. Concerns over high student loan balance in the US resulted in numerous articles with "student loan crisis" in their headlines, from the Huffington Post (2014), to the Washington Post (2018), and the Brookings Institute (2018). According to a 2017 report by College Board, increases in college costs have outpaced inflation by more than 3% per year continuously for the past 3 decades. In 2017-18, the average tuition and fees were $25,620 for public in-state 4-year institutions and $34,740 for private non-profit 4-year institutions. Room and board added $10-$12,000 annually. Paying for college became a significant financial burden for many families and more and more of them have turned to loans to finance college education. Student loans increased dramatically over the past decade, from $516 billions in 2007 to $1,367 billions in 2017. The number of borrowers increased from 28.3 millions to 42.6 millions over the same time period. (Data source: National Student Loan Data System)   Student loans now accounted for 11% of total consumer credit, larger than auto loan (9%) and credit card (6%). (Data source: New York Fed Consumer Credit Panel) The Brookings report

(2018) estimated student loan default rate of borrowers from for-profit institutions to be 46.5% and those from public and non-profit institutions to be 11.89% and 13.2%. In comparison, the highest mortgage default rate during the 2008 recession was 11.53%. (Data source: Federal Reserve Bank of St. Louis) High student loan defaults will negatively impact the economy.

Helping students manage and reduce financial stress can contribute positively to combat this national crisis.

Financial education was the most common tool chosen to address this issue. The assumption is that if students have more financial knowledge, they will make better financial decisions to begin with, avoiding stressful situations (including defaulting on their student loans) later in their lives. Serido et al (2013) posited a decision making model that integrates financial knowledge, financial self-beliefs, financial behavior, and well-being. In their model, improvement in subjective and objective financial knowledge will initiate changes in attitudes and beliefs, which will improve financial behaviors, promoting overall well-being. Low financial literacy is a problem not just for college students. The federal government established the Financial Literacy and Education Commission (FLEC) under the Fair and Accurate Credit Transactions Act of 2003 to combat financial illiteracy in the US. FLEC has a special website for students, youth.gov, which provides money management tools such as a financial savings calculator, weekly budget worksheets, college preparation checklist, etc. There are also many non-government efforts to improve youth financial literacy. The most well known is perhaps the Jump$tart Coalition, which was founded in 1995 with the mission to advance financial literacy in preschool through college-age youth. Vitt et al (2000) reported that many institutions (e.g. community organizations, cooperative extension services, community colleges) offered financial education programs targeting specific populations (e.g. women, welfare recipients, low-income families, adolescents, college students, and persons of color). Despite these efforts, a national exam conducted in 2012-2013 by the National Financial Education Council found that the average financial literacy score was 58% among 1309 participants aged 15-18. FINRA conducted a National Financial Capability Study in 2016 and found that 64% of the 27,564 adult Americans surveyed could not answer 3 of 5 basic finance questions. These findings are disheartening and indicate that much more work remains.

Results from research on the efficacy of financial education are mixed. Reich and Berman (2015) found that a financial literacy course for low-income individuals was effective in improving financial knowledge and behavior for participants that completed the program, but the attrition rate was high, 46%. Therefore the overall success rate of the program was indeterminate. The demographic variables for those who left were similar to those who completed the course. Reich and Berman did not provide reasons for attrition. Seyedian and Yi (2011) found that using finance courses improved financial knowledge of college students. They also found that job experiences, financial background, attitude, class participation and motivation affected the amount of their learning. Since these students were mostly business students the population of the Seyedian and Yi study may be subject to self-selection bias.

Postmus el al (2015) conducted a longitudinal study focusing on survivors of domestic violence and found that financial education improved subjective financial knowledge, financial intentions, and financial behavior and decreased financial strain. Mandell and Klein (2009) studied the impact of a personal finance course on 79 high school students 1 to 4 years after completion. They found that students who took the course were no more financially literate

and did not appear to have better financial behavior than those who had not taken the course. Fernandes et al (2014) conducted a meta-analysis of 168 papers covering 201 prior studies. They found correlational studies of financial literacy and financial behavior showed strong results but financial education decayed over time and effects were negligible 20 months or more from the time of intervention. They also found that the partial effects of financial literacy diminished dramatically once controlled for psychological traits omitted in prior studies. What remained unclear was why educational interventions they investigated had been unsuccessful. Collins and Holden (2014) discussed the difficulties in assessing the relationships between financial education and financial capability, and between these to financial outcomes.

Challenges include lack of standards in financial literacy program and their delivery, limited measures of behavior, sampling problems, and few research designs that controlled for confounding influences. They suggested future programs should develop 'an explicit theory of change and include a role for peers in influencing learning and behavior. The social and institutional context of learners and programs is also critical to consider in order to develop approaches that are engaging, motivating, and impactful.'

Most traditional financial education programs focus on content delivery. Some recent studies proposed incorporating findings from behavioral economics into the programs. Smith et al (2016) argued that the readiness of participants to learn the curriculum was not considered in past programs and proposed applying mindfulness techniques and gradually introducing educational tasks. Fernandes et al (2014) suggested 'just-in-time' financial education tied to specific behaviors it intends to help. They also suggested using nudges based on behavioral economics such as 'smart defaults' that requires consumers to opt out of savings plans. Shim el al (2013) examined socialization factors and financial capabilities. Using factors including interactive parental influence, explicit parental influence, and active self-learning, they grouped participants into three clusters, labeling them 'followers', who had strong socializing influence from their parents' financial style; 'pathfinders', who took a more active and engaged approach to develop a personal financial style; and 'drifters', who did not commit to accept their parents' financial style or to form their own. They found that 'pathfinders' had the highest financial capabilities. 'Followers' and 'drifters' had similar financial capabilities but 'followers' exhibited more responsible financial behaviors. They suggested matching financial identity to specific financial programs to improve effectiveness. All these recent studies argued that a one-size- fits-all approach to financial education will not be effective.

To improve the financial well-being of college students, we propose developing the intervention program using a design thinking approach, which is well suited to address the three criteria of engaging, motivating, and impactful. EdLab conducted a Financial Literacy Design Thinking Workshop in 2014 for teachers in which they asked 'If there are no barriers, what kinds of experiences could you do with your students to get them thinking and learning about financial literacy?' The EdLab workshop was teacher focus. In this project, we want to investigate the challenges to achieving financial well-being from the student perspective. MoneyThink is a nonprofit whose mission was to empower 'under-resourced students to achieve college success by supporting financial decision-making through coaching and technology.' They employed a design thinking approach to develop their program. In 2012 they received the White House

Champions of Change award and raised initial seed funding from a consortium of foundations. MoneyThink focuses on low-income students. This paper will illustrate how to apply design thinking to develop solutions for the general student population.

Design Thinking

Design thinking is best summarized as a problem solving methodology. Unlike conventional linear solution-focused methods, design thinking emphasizes a fluidity between the problem space and the solution space. Solution ideation can lead to a more concretely-defined problem, and versa. Above all, modern applications of design thinking revolve around two core concepts: user-centered design and rapid iteration. Nigel Cross (2000) demonstrates the effectiveness of a carefully planned and executed design methodology while also highlighting a variety of approaches. Underscoring this is the assertion that "there is no definitive formulation of the problem". A proper design method is meant to guide background research, ethnography, and finally solution engineering around a problem whose scope can shift and narrow accordingly with the affected users. Background research combines past findings, existing statistics, news articles, and studying subjects as groups. Ethnography studies individual subject in depth through non-statistical based methods. Applying this process to the field of financial literacy is beneficial for several reasons. Firstly, solution-oriented approaches use research and user feedback to improve existing solutions or create new ones when assumptions made in the original scope became problematic in the current environment. For example, a financial literacy program designed a decade ago may be based on information that is no longer relevant or a program that is effective only for a subset of the population. Design thinking incorporates existing research results alongside current feedback from users within the scope being studied, which allows for checking what data is valid on a case-by-case basis, thereby avoiding a one-size fits all solution. Furthermore, properly conducted ethnography allows for an intimate, personal understanding of the problem space. Individual experiences revealed through interviews, observation, and investigation can prove essential to defining a problem accurately. This level of accuracy cannot be captured by statistics, research, or polling. To this effect, design thinking and methods bring human factor into the solution space in a way that can be leveraged easily and powerfully.

Drawing from past studies, two concepts became the most relevant towards narrowing this project's scope: student motivation and awareness. Existing approaches generally assume a lack of awareness is the reason why college students are financially illiterate, then move forward into an educational solution space to provide tools that students can use to address their problems. The solution is usually intended to be either preventive or remedial. Preventive education solutions are delivered early in the student's career or even throughout primary and secondary education. Remedial education solutions are delivered when a critical event occurs, such as late payment or loan default. This project starts by questioning the "no awareness" assumption and relating it to student motivation. How aware are college students of their financial stress, actually? If they are unaware, are they motivated to learn? If they are aware, are they motivated to find solutions? Questions such as these seek to deepen understanding of the gray areas between ignorance, knowledge, and action. Once ethnography is conducted and

documented, these findings can help narrow or even redefine the scope of the problem if necessary to provide a more accurate solution.

Methodology

The first part of this study is an initial survey of the subject group, which comprised of undergraduate students in one four-year public university and one four-year private university. Survey questions are included in Appendix A. The goal of this survey is to gain a general overview of the subject group. This approach distinguishes a design thinking approach from traditional statistical tests. Based on findings from the survey, we will be determine the specific ethnographic instrument for the second step of this study. Our current plan is to complete the survey by March and develop ethnography studies by April.

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Thank you for volunteering with our project. Your participation is completely voluntary and you may exit the survey at any time. No personally identifiable information will be collected. Thank you again!

1. Gender

( ) Female

( ) Male ( )

Other

2. Age

[   ]

3. Class Level

( ) Freshmen ( )   ( ) Senior

Sophomore   ( ) Graduate

( ) Junior

4. Your Major

[   ]

5. Name of your school

[   ]

6. Your Annual Family Income

( ) Less than $40,000   ( ) $150,000 to $199,999

( ) $40,000 to $74,999   ( ) $200,000 to $299,999

( ) $75,000 to $99,999   ( ) $300,000 to $499,999

( ) $100,000 to $149,999   ( ) $500,000 or more

* 7. Is money a stress factor in your college life?

◯ Yes

◯ No

8. If so, lists the reasons why money is a stress factor:

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9. What steps have you taken to address financial stress in your life?

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```

10. Do you know of resources that can assist you with financial stress?

◯ Yes

◯ No

11. If so, please list resources that you are aware of:

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12. Have you used any of these resources?

◯ Yes

◯ No

13. If yes, which resources do you find effective?

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[                                        ]
[                                        ]
[                                        ]
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14. If no, why do you not use them?

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[                                        ]
[                                        ]
[                                        ]
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Influence of Startupper Teams' Skills on Their Collaborations with Large firms to Innovate

Ms. Clarice Bertin, ICN Business School &
University of Strasbourg, CNRS, Beta Laboratory

Aim of the communication and originality of the subject: Searching for rapid growth to ensure their survival, more and more startups are engaging or would like to engage in collaborations with large firms: some startups are experiencing successful collaborations while others do not succeed in it. This type of asymmetrical collaboration poses indeed many challenges which can sometimes be difficult to overcome for stakeholders. This paper aims to explore to what extent the startuppers-entrepreneurs skills -as individuals and team members- together with the nature of their startups are prone to impact the collaboration with a large firm to innovate and what are the antecedents of these skills. I question thus if specific characteristics participate in the collaboration efficiency with large firms and if it is the case how they allow startups to lead their collaborations with large firms to success. To our knowledge this issue has not been explored by researchers yet.

Methodology: From the literature on entrepreneurship and on startup-large firm collaboration, I consider both the characteristics of the startup and the cognitive and social skills of the startupper (and his / her associates) which are incline to an efficient collaboration for the stakeholders given the challenges such collaboration poses for them. The weight of these characteristics in the success of collaborations is then measured via a quantitative questionnaire survey administered to startups from various activity areas. My sample includes not only startups collaborating successfully with large firms, but also startups willing to collaborate with them and even startups whose collaborations with large firms failed. I assume that failure cases can really be precious to help understand better the key characteristics/skills and antecedents leading to successful collaborations. The results will highlight potential correlations between variables -and not causality effects- as there are plenty of contingency factors involved in startup-large firm collaborations. In order to strengthen the robustness of the results ensued from the quantitative analysis, I complete them with a qualitative study means individual semi-directive interviews with startupper team members. It will allow to deepen the understanding of the impact of key characteristics previously identified through the survey.

Expected results and their implications on public policies: My results should be of interest for startups and large firms within the framework of the continuous improvement and optimization of their collaborations, but also incubators and accelerators as part of their training and advisory missions, as well as public policies supporting innovation networks. By shedding light on the startupper teams' profile determinants -in particular the cognitive and social ones- as part of their collaborations with large firms, I hope that this work will enable some of them to better address this type of asymmetric relationship and to collaborate more effectively with large firms. At the

academic level, I plan to contribute to knowledge on key cognitive and social skills of startupper team members involved in collaborations with large firms to innovate.

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Use of Multi-Criteria Decision Making for Planning of Closed- Loop Supply Chain

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Abstract

The number and variety of manufactured products have increased tremendously due to the industrial revolution. Along with industrialization, several environmental issues started to rise, among which, the issue of products reaching their end of life (EOL). Gupta (2013) divided EOL products into: products which are disposed of while still functional due to the customer's desire to upgrade to a newer technology, products which are not functional after their leasing contract is expired, products returned due to dissatisfaction or for finding a better deal, and products returned for repair services but found un-repairable.

Due to the increase in the level of awareness in the consumers, in addition to the strict government legislation, manufacturers and supply chain decision makers seek investing in environmentally conscious manufacturing (ECM). Generally, ECM is concerned with the application of environmentally friendly principles to each phase of production, starting from the design of the products to their final delivery, and including disposal of EOL products. (Gungor & Gupta, 1999; Gupta & Ilgin, 2018; Ilgin & Gupta, 2010; Ilgin, Gupta, & Battaïa, 2015).

Closed loop supply chain (CLSC) is one of the topics covered under environmentally conscious manufacturing and product recovery (ECMPRO), which is a result of the integration of forward and reverse supply chains. The idea of a CLSC has successfully shown its capability of achieving financial and environmental benefits, and many industries are employing the concept of CLSC in their practices today, e.g. Xerox Corporation and Caterpillar Inc. (Ferguson, 2009).

This paper addresses the planning of CLSC networks where product substitution is allowed, and considers the impact of government regulation of carbon (generated during

production processes and transportation activities) on the CLSC. In the addressed CLSC, we consider multiple manufacturers, remanufacturers and collection centers with only a single distributor and a single disposal center. To ship the product between the facilities in the CLSC, three transportation modes are evaluated where each one has a different carbon emission rate and load capacity. Due to uncertainty in the demand of new products, remanufactured products and number of returned products, a two-stage robust optimization model is proposed. In the first stage, strategic decisions are made, that is, the number of facility centers to open (e.g. manufacturers, remanufacturers, collectors). In the second stage, tactical/operational decisions are made, which are the quantity of new and remanufactured products to produce and transport in the CLSC. In the product substitution, one-way substitution is taken into account, in which the new product substitutes the remanufactured product (downward substitution). For the carbon emission regulation, we consider the carbon cap policy, in which the production and transportation activities only generate a limited volume of carbon over the planning horizon. For the analytical part, we study the impact of the substitution concept on designing the CLSC and the impact of carbon emission regulation on the substitution rate and the design of CLSC.

Keywords: Closed Loop Supply Chain (CLSC), Product Substitution, Carbon Emission, Robust Optimization

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The Influence of Product Management on the Structure of the Supply Chain in the Fashion Industry - Case Studies

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ABSTRACT
The paper presents an alignment of type of product with a supply chain. This relationship is described in a theoretical context and at the example of four European supply chains in the fashion industry. Each of the listed manufacturers supports a different segment of the market divided according to two dimensions: price and fashion. Therefore, the question arises whether all of these products are in the same way supplied to the market, and whether the strategy of the supply chain is the same? The purpose of the paper is to verify the assumption that the supply chain organization depends on the type of product in fashion industry.

KEYWORDS
fashion industry, distribution channels, complex products

INTRODUCTION
Supply chain consists of entities forming a network of relations and interdependencies, from suppliers to end customers, within which material and information flows are carried out in order to meet the needs of end customers (Skjott-Larsen et al. 2007; Christopher 2013). It is a form of organizing participating entities, which operate on the basis of mutual cooperation, as well as jointly control and improve material and information flows (Ballou 1992). Growing customer expectations, uncertainty in the market and technological advances that determine, among others, the introduction of complex and diverse products that meet more needs of the consumers, cause the management of global supply chains to become increasingly difficult (Kharlamov and Ferreira 2012). In order to achieve a sustainable competitive advantage, companies seek to adjust the strategy of supply chain management to the type of product on the particular market. If the product meets one need, has a defined group of clients and a long life cycle, the task is not difficult and is widely described in the literature. One of the most known division of products according to the nature of the supply chain was stated by Fisher (1997), who divided the products into functional and innovative, and whose approach has been developed in many publications, among others, by Kaipia and Holmstrom (2007). Nonetheless, other attributes are distinguished by different researchers - Payne and Peters (2004), who divide products according to seven categories, including: volume, variability, weight, customers, etc., or Christopher (2009), for whom beside the volume and variability, also product life cycle, lead time, product variety and nature of demand are significant characteristics. In modern marketing much attention is paid to products that are complex, multi-core, or meet more than one need (Żabiński 2012), which include, among others, fashion products (Rupik 2012). And precisely for such products alignment of supply chains becomes a challenge.

The purpose of this paper is to present the relationships between complex products of fashion industry in a particular supply chain with the manner of its organization. The case studies of four European clothing manufacturers: Spanish Zara, Italian Benetton, French Luis Vuitton and Polish Big Star will be presented.

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Café Solar® – Sustainable Coffee in Central America

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ABSTRACT

Coffee cultivation is a significant cause of deforestation, water shortages, and loss of habitat for endangered bird species. Café Solar® is a brand that embodies the culmination of the vision of founders to address forest denudation and social issues haunting Honduras. The Café Solar® case narrative begins with the story of the formation of a nonprofit, Mesoamerican Development Institute (MDI), and transitioning to a for-profit enterprise to cultivate sustainable coffee, drawing from the experience and expertise of ornithologists, engineers, academics, coffee farmers, women activists and an array of global stakeholders. The vision was taking shape in the emergence of sustainable coffee manufacturing technologies, and cooperatives of coffee growers seeking to implement sustainable cultivation, with increased participation of women at all levels. Crucial to success was a brand that attracted a network of global customers desirous of Fairtrade and a desire to make a difference in coffee growing areas. Further, economic benefits also emerged from the increased yields and revenues from carbon.
The case presents the multifaceted nature of sustainability, highlighting the roles of stakeholders that operate globally to create opportunities, address problems and constrain externalities in the globalized world.

INTRODUCTION

MDI announced the sale of the carbon offsets, a major, symbolic milestone achievement that acknowledged the spirit and courage of a poor farming community to steer their destiny to an alternative model of sustainable coffee production. The over-the-counter sale to Bewley's Limited, expected to be the first of its kind, now provided a market incentive for the adoption of Integrated Open Canopy™ (IOC) coffee farms that would reverse the deforestation of coffee plantations in Honduras. The initiative would also bring together a range of stakeholders to develop sustainability initiatives to make a difference to communities in Honduras.

Honduras, part of Spain's vast empire in the New World until 1821 was one of the poorest economies in Latin America, having had to endure military rule and regional conflict, high rates of crime, inequality and underemployment.[1] With poor quality education and limited job opportunities outside agriculture, most rural youth migrate to crime infested cities increasing pressures on infrastructure, or take the long arduous road to the US borders, where they could be the victims of gangs, the Mexican police and the elements.

Coffee was a key source of revenue and employment for the rural communities of Honduras. It was the largest producer of coffee in Central America, the world's second largest coffee producing region after Brazil. However, coffee was replacing tropical forests, including cloud forest, rain forest and pine-oak forest, thereby choking off headwaters for watersheds that flowed into the water reservoirs feeding the El Cajon dam, the primarily source of electricity for the region. This threatened forest habitat was critical to maintaining environmental equilibrium, while preserving national parks and endangered species in Honduras and other regions of Central America (Honduran Forest Service, 2013; American Bird Conservancy, 2013; United Nations' top 10 disappearing wonders of the world).

----------- Figure 1: The Coffee Growing States ----------

Given the importance of the sustainable development of the coffee industry for the well-being of the local municipalities in Honduras, two environmental engineering students from the University of Massachusetts Lowell (UMass Lowell) formed the Mesoamerican Development Institute (MDI) to address the issues plaguing coffee cultivation in Honduras and to create a model for coffee cultivation in the regions of Central America. In the process, they would target meeting UN Millennium Development Goals to better the life of the coffee farming communities.[2]

MDI: A VISION AND MISSION FOR SUSTAINABLE COFFEE

Set up as a non-profit, nongovernmental organization with offices in Honduras and at UMass Lowell, MDI's mission was the design and implementation of sustainable technologies

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[1] https://www.cia.gov/library/publications/the-world-factbook/geos/ho.html
[2] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

and biodiversity-friendly production methods for rural productive applications. Through technology transfer and sustainable market development in Mesoamerica, MDI sought to create conditions in which new tools could be adopted by rural enterprises that allowed them to participate in agro-industrial processing and the export of value-added products. To this end, MDI began seeking innovative approaches beginning with the production of coffee to its marketing and final consumption.

Sustainability began with coffee cultivation. The Integrated Open Canopy (IOC)™ coffee production, conceived by a coffee farmer and agronomist, Victor Julio Arce, working with MDI, developed protocols with input from the local community and coffee producers. IOC coffee was produced typically in 3 hectares cultivated areas with a minimum 1:1 ratio of forest area to coffee production area.[3] The goal was to allow forest regeneration and preservation areas to serve as carbon sinks or areas of sequestration cover while providing habitat for many forest- dependent species, including some migratory birds, that were not found in shade coffee produced under the current production methods. The regenerated forests would also greatly enhance all hydrologic conditions for the environment, while also increasing yields. Since the forest areas sequester carbon, they allow producers to sell carbon, providing an additional premium from their coffee farms.

--------- Figure 2: Integrated Open Canopy, Reforestation and Yield --------

Partnerships were of the essence in MDI's approach. One important partner was COMISUYL (Cooperativa Mixta Subirana Yoro Limitada), a Fair Trade Cooperative serving the producers of the Yoro region. In addition to having the required coffee quality, the cooperative had a strong vision and strategic plan regarding the partnership with MDI and the confidence to co-invest their funds in the project. The cooperative included many members with decades of experience in sourcing coffee, including the former General Manager, a dynamic woman (herself a coffee producer), Maira Manzanares. MDI also partnered with academics and the US Forest service to study the IOC's benefit to biodiversity through its impact on the migratory Golden-Winged Warbler, with breeding grounds in northeastern United States and wintering grounds

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[3] These forest areas consisted of either existing forest or areas that would be regenerated to secondary forest, or a combination of both.

that included the coffee regions of Honduras.[4] These initiatives also resulted in another partnership between MDI and the Honduran Forest Service that launched the Yoro Biological Corridor Initiative to expand and replicate the Yoro Model throughout the coffee growing regions of Yoro.[5]

Drying processes were another important stage in coffee production. However, drying consumed energy often from wood or the hydroelectric power, which was erratic, being highly depended on the reservoirs that could dry up from lack of headwaters. The use of such energy sources increased GHG emissions. Rudimentary "solar" power solutions involved the use of "patios" and other forms of passive solar systems in very small scales and usually in regions in which wages are kept artificially low. In Nicaragua for example, if minimum wages laws were enforced, the highly labor intensive method of drying on plastic sheets requiring 7 to 15 day drying intervals would not likely be economically sustained.

MDI combined IOC cultivation with the industrial use of solar and biofuel energy for drying, eliminating the use of firewood from tropical forests for the drying of the annual coffee harvest. The initial off-grid green factory (Beneficio), a joint investment of MDI and COMISUYL, was the first coffee processing and export facility powered by clean technology. MDI projected that their technology would serve over 8,000 registered families producing coffee in the Yoro Biological Corridor protecting four national parks.

--------------- Figure 3: COMISUYL Farm Clusters -------------

Coffee production had another challenge to overcome. When exposed to prolonged drying periods, such as when patio drying with cloudy and rainy periods, or when allowed to re-absorb moisture from the atmosphere during storage and/or transport, green coffee developed

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[4] Research conducted jointly by University of Massachusetts and the US Forest Service demonstrated that these sustainable practices supported migrant bird populations. Such practices are viewed by Honduran Conservationists as the last best hope for conserving the region's dwindling forests, critically threatened by expansion of unsustainable coffee cultivation.

[5] MDI and COMISUYL were designated as co-managers of Pico Pijol National Park by the Honduran Forest, Park and Wildlife Services in order to address the threats to clouds forest and national parks posed by expanding coffee production and processing. The Yoro Biological Corridor Initiative would promote the transition to IOC coffee farms to provide habitat for biodiversity and protect the headwaters of threatened watersheds that provide drinking water for municipalities and water for the nation's largest hydropower utility (300MW) at the El Cajon Reservoir. http://mesoamerican.org/2017/09/07/six-ways-cafe-solar-different-coffee/

mold and fungus.[6] This could result in Ochratoxins that had damaging effects to the kidneys and liver and was also a suspected carcinogen that could impair the immune system. Since Ochratoxin A survived the heat of the roasting process, this was a health concern associated with coffee.[7] To address this issue, MDI introduced hermetic storage to the coffee sector with GrainPro Inc. Recognizing that the properly dried coffee and the use of hermetic storage prohibited the development of molds, the storage method was later endorsed by the coffee institutes of Honduras and Costa Rica.

Implementing the vision

There were four phases to the implementation of the vision, with the first two involved with implementing the plans at the local level to illustrate the efficacy of the model. The next two phases would extend the vision across the coffee growing regions of Central America to create change that allowed sustainable practices to be implemented at a global scale. The progression of the plan's implementation is outlined in Figure 4.

---------- Figure 4: The phases in expansion program ----------

Critical to the viability of the vision was transitioning to a for-profit company that could lead to marketing a brand that brought together the multifaceted aspects of coffee production. This was the Café Solar®, the result of all the coffee marketing and brand management related activities incubated in the non-profit Mesoamerican Development Institute (MDI). The hybrid model of non-profit and for-profit enterprise served to remove barriers for emerging technology and coffee production methods researched, developed, and piloted by MDI. The business arrangement supported the two key innovations for the supply of sustainably produced and processed coffee for the Café Solar brand. The first, Integrated Open Canopy (IOC) coffee farming systems, produced significant positive impact on sustainability, particularly environmental through reforestation and maintenance of forest habitat. Introduction of the

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[6] Coffee is hygroscopic and readily absorbs moisture from the air when the relative humidity is above 65% (which is most of the time in producing countries). Of concern in coffee are Ochratoxins primarily produced by species of Penicillium and Aspergillus.
[7] The European Union adopted minimum standards for Ochratoxin A in coffee in 2005 and tested incoming coffee. In the United States, the FDA does not monitor Ochratoxin in coffee.

integral model combining MDI's patented Solar/Biofuel coffee drying technology increased benefits through clean energy technologies resulting in energy savings. The off-grid drying systems were particularly important for the coffee-rich Department of Yoro that had no coffee mill capable of preparing coffee to export standards for the specialty coffee market. This highly scalable drying factory was installed with one MDI patented solar/biomass technology drying tower of 7,000 qq. annual throughput. The coffee preparation line included milling and sorting capacity of 9,600 qq (with one shift) (see Table 1 for measures). The factory was designed to allow for expanding drying throughput based on market expansion.

------Table 1: Table of Units Used in Coffee Production and Processing-----

----------- Figure 5: Off Grid Processing and Export Centers -----------

This Off-Grid Facility was the first industrial plant (Beneficio) to break 140 years of the use of tropical forest in the form of firewood to dry the coffee harvest. MDI and the Honduran Coffee Institute (IHCAFE) provided intensive training for the local youth in charge of operating the factory. Currently, 55 employees are involved in running the factory at peak operation. The factory was the only coffee mill in the Department of Yoro with the equipment required to meet Specialty Coffee of American Standards for SCAA-85 quality classification for export to the specialty market. The facility met organic certification requirements and was a registered food processor with the US FDA and Japanese authorities.

The quality and sustainability aspects of coffee produced through this joint MDI and COMISUYL initiative had the attributes that could be sought after by market partners and global markets, namely high-quality coffee with a great flavor profile that is Fair Trade and organically produced, with significant involvement of women in management and operations.

----------------- Figure 6: Café Solar® Brand ----------------

The economic chain therefore, now began with the MDI Honduras consolidating the green coffee purchases that underwent the off-grid drying processes to be shipped to the roasters. Coffee thus produced and processed through the program was exported to the United States (Red

Barn Coffee Roasters, Bay Coffee & Tea), Canada (Merchants of Green Coffee), Sweden (Nordiska Kafferosteriet) and Ireland & Australia (Bewley's Coffee) creating new high-value markets for producers.[8] The coffee was also served in cafés and cafeterias at UMass campuses, and venues such as airports. However, key to economic viability of the project was the relationships with the loyal customers who provided the financing to continue to pay the farmers and the ongoing processes that led to the quality coffee.

---------------- Figure 7: The MDI and distribution ----------------

Bewley's, an example of this type of customer, valued sustainability in coffee production and was the first to purchase over-the-counter carbon offsets. They highlighted the fact that they served coffee processed at COMISUYL's Off-Grid Processing Facility to dry the coffee harvest using solar/biomass energy, eliminating the burning of tropical forest as the thermal energy source for coffee drying, and reducing electricity consumption by 80% as compared to conventional wood-burning dryers. Further, Bewley's managers and owners regularly visited farmers in far-flung destinations along the coffee belt, where high-quality Arabica coffee flourished, to reestablish old friendships or create new ones. Overall, each customer made significant purchase commitments that formed the basis for the confidence of the cooperatives on their ability to be able to continue to serve the sustainable coffee to a global customer base.[9]

------------------- Table 2 (Sale contracts & estimates) -------------------

Crucial to the economic sustainability of the new MDI Honduras was the continuity that came through overall cash flows, so that they could now be self-sufficient as a for-profit enterprise and continue to enable the cooperative to sustain and expand production. Cash projections were laid out that presented a healthy financial future, although there were certainly challenges ahead.

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[8] http://mesoamerican.org/2017/04/18/carbon-offsets-advance-innovations-forest-conservation-coffee-region-honduras/

[9] Their website highlighted the unique sustainable context of their backstory that inspired Bewley's to become more actively involved. At one such visit, Bewley's presented a check for carbon offsets, with the commitment to double purchases from the cooperative. https://www.bewleys.com/ie/comisuyl-2/

----------------- Table 3 (Sales Projection & Cash Flow estimates) --------------

Sustaining the Vision – Challenges and Opportunities

The journey to lift the coffee growers of Subirana (Yoro, Honduras) to self-sufficiency and a sustainable, productive coffee collective faced multifaceted challenges. In recent years, the community has faced tough times. Leaf rust, an airborne fungal disease specific to coffee, has had the most devastating impact on the health of coffee trees and yields. This resulted in the cancellation of exports and the loss of vital income. Up to 40% of the trees have been lost, causing massive income destruction and the requirement for increased investment to replace the dead trees. This double calamity has meant that the original debt had to be re-phased at steep interest rates, meaning progress has stalled, for example on education and women's support programs.

Women were hired to work with MDI had continued to build their expertise. Also, several women coffee producers in the area, including the mayor, had formed a new company that would supply coffee to the Café Solar® brand. The long-term educational effort, particularly the collaboration with the National Autonomous University of Honduras (UNAH) had brought women into the program who had received university degrees and were mentors for the community, advancing the Yoro Biological Corridor by leading discussions at the public hearings and successfully lobbying the 11 mayors and governor. Nevertheless, there were challenges. Maria Manzanares, one of the dynamic founders of the cooperative, a quietly determined small Finca (farm) owner cum co-op general manager, led the early skirmishes and heated debates, first with their fellow members and then with the banks, as she and Augustin set out to develop their innovative clean mill. Now news arrived at MDI that a few of the newly elected men on the board fired Maria, the General Manager, and have marginalized highly trained women who were key to the success of the cooperative. It appeared that some gains made for women were being rolled back. [10] These are some of the additional challenges with these

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[10] The financial sector was particularly hard on the women – when COMISUYL was trying to find new lines of credit for coffee procurement, men from different lending programs visited the operations and were not willing to speak with the women in charge of the operations – they left the processing plant and went to the main office in the center of town looking to speak with the man in charge.

programs. MDI leader, Raul headed to Subirana to meet with the cooperative board and set up meetings with some of their customers.

The final two phases (Figure 5) also posed continued challenges. A wider acceptance of the "Yoro Model" required a system of agro-industrial practices linked to high-biodiversity agroforestry systems, technological advances, empowerment of women, and socioeconomic structures that offer a market-based solution to rural poverty, employment and training of local youth, deforestation and degradation of water resources, and climate change. Several initiatives such as IOC farms and measuring coffee yield, carbon sequestration, and expansion of clean processing infrastructure in rural communities, needed to be replicated. Long-term training and education programs were necessary to support the enterprises and activities within the Yoro Biological Corridor that enabled rural communities to directly supply the evolving international coffee and carbon trading markets.[11]

However, questions remained about the benefits to producers, as only 25% of certified sustainable coffee provides any premium for the producer (Coffee Barometer Symposium, HIVOS, Amsterdam, 2013). For the small producer, sale of carbon offsets represented a significant potential source of income. International surveys found that of the following factors, namely organic certification, fair trade certification, women workers in the coffee region, and the coffee drying with conventional wood burning dryers, the use of firewood in coffee drying was most likely to impact consumer purchasing decisions. The transition from securing environmental gains to translating it to economic ones posed another challenge. Critical to the effectiveness of carbon trading was the stronger verification systems that allowed carbon trading over and above that purchased through over-the-counter transactions such as that of Bewley's. MDI saw this as a new challenge that would allow broader capability of such assessments that give farmers more value from the sequestration efforts, while also addressing the battle against the spread of airborne leaf rust. The initiative will also increase the opportunity of new revenue streams from the sale of carbon credits of the form undertaken by Bewley's.

While challenges remained, the plans to meet UN Millennium Development Goals appeared to be in place. There was increased optimism in the MDI that with perseverance the vision could be realized in time.

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[11] http://mesoamerican.org/2015/10/18/the-yoro-biological-corridor-initiative-inicitativa-corredor-biologico-yoro/

QUESTIONS

1. Consider the definition of sustainability highlighted by the World Commission on Environment and Development (WCED), the mission of the Brundtland Commission and the UN's Sustainable Development Goals (SDGs). Discuss how the case would implement these areas.

2. Review the main elements of the value chain from the case and highlight how sustainability impacts different components of the value chain.

3. Analyze the cash flow statement and identify the inherent risks that could surface in future. Indicate how MDI Honduras could guard against them.

4. What are the challenges and opportunities for brand development, integrating sustainability and the other factors that can influence the ability of the sustainability entrepreneur to succeed?
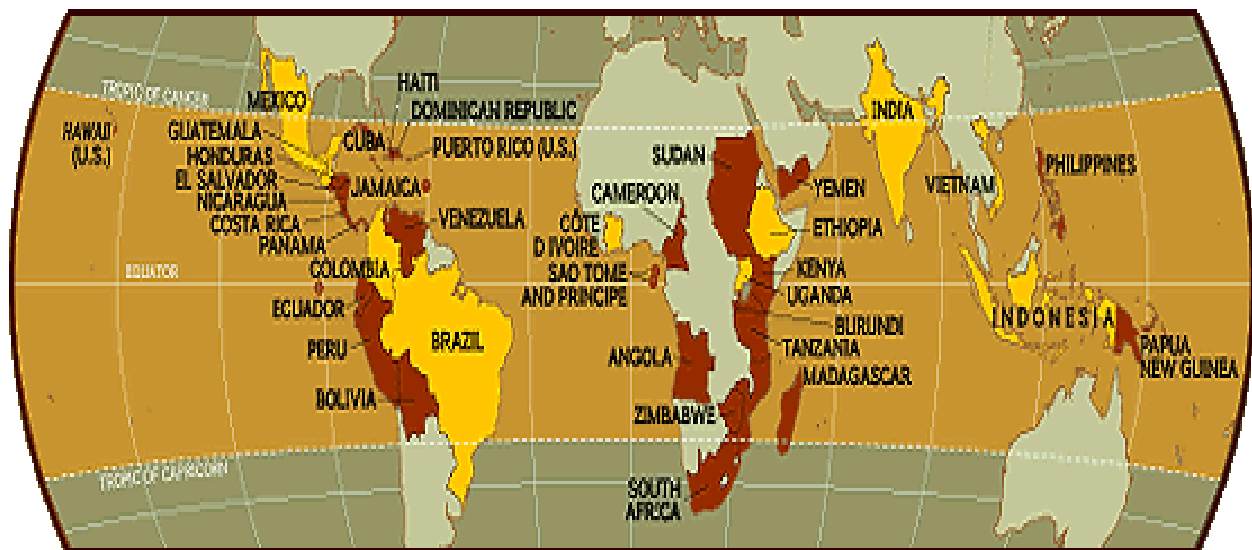
Figure 1: The Coffee Growing States
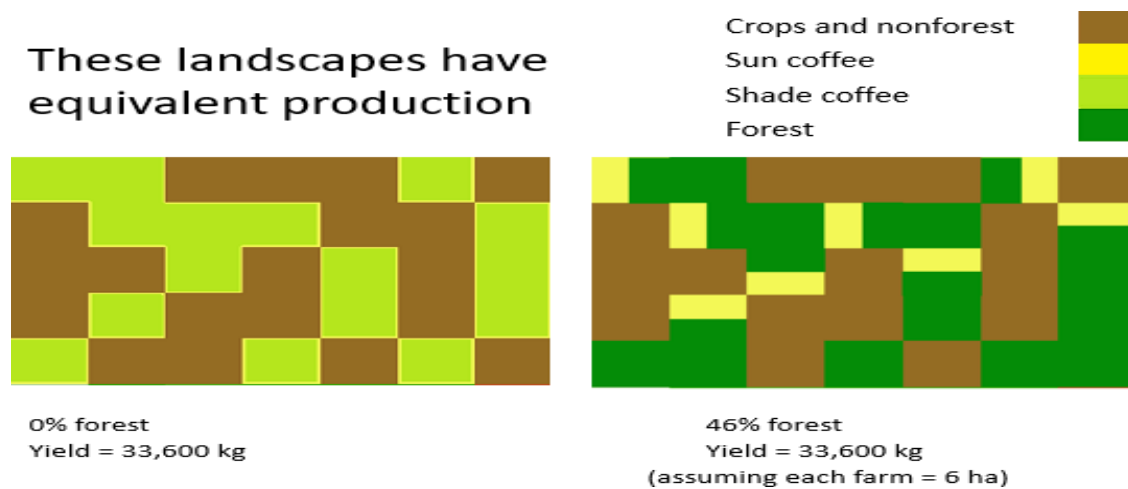

Figure 2: Integrated open canopy, reforestation and yield

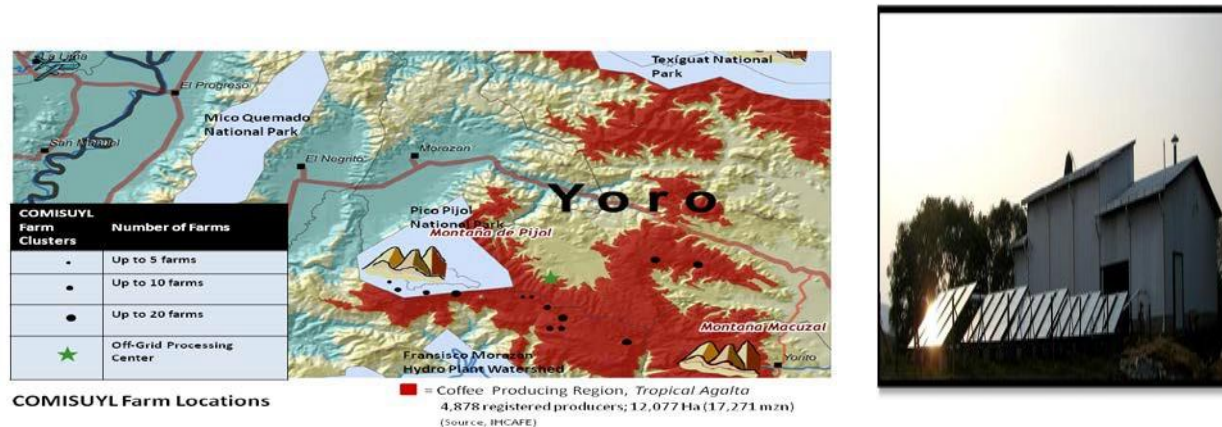**Figure 3: COMUSUYL Farm Clusters and Off-Grid Processing Center**

Figure 4: Phases in Expansion Program

Phase I

Initial system becomes operational (2011/2012 harvest)
(Off-Grid Processing Facility)

- Café Solar® supplied to Markets
- Carbon Trading Project under development—provides brand certification
- IOC pilot farms established.
- First sale of carbon offsets (2017) from IOC production linked with

Expand Off-Grid Processing Factory (2018--2020) to keep pace with orders
Increase throughput through planned improvements and five additional drying towers.

Establish initial coffee purchase line of credit.

Phase II

- Café Solar® brand expanded in US, Canada, Ireland, Scandinavia and elsewhere
- Establishment of academically researched Café Solar® Experiential Cafes (on and off campus)
- Promotion of UMass on-line sales with University community

As larger companies participate addition facilities are installed. Additional tooling and larger manufacturing runs reduce cost to manufacture.

Phase III

- Off-Grid Processing Facilities are replicated

Replication of proven Café Solar® model in other regions using standardized equipment, training, and marketing tools.

Phase I

- Hybrid of non-profit/for profit has eliminated barriers to disruptive renewable energy and sustainable processes at a global scale.
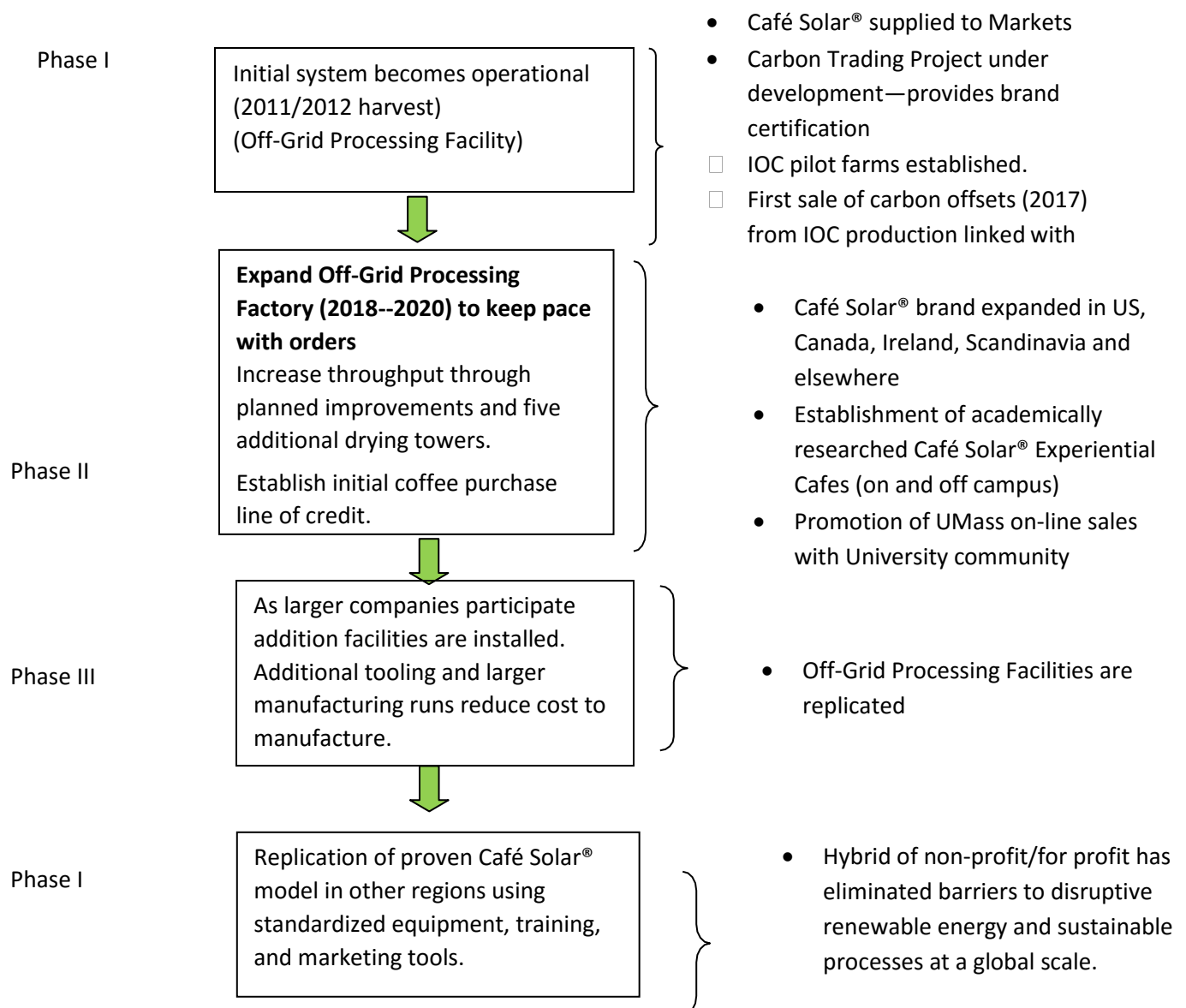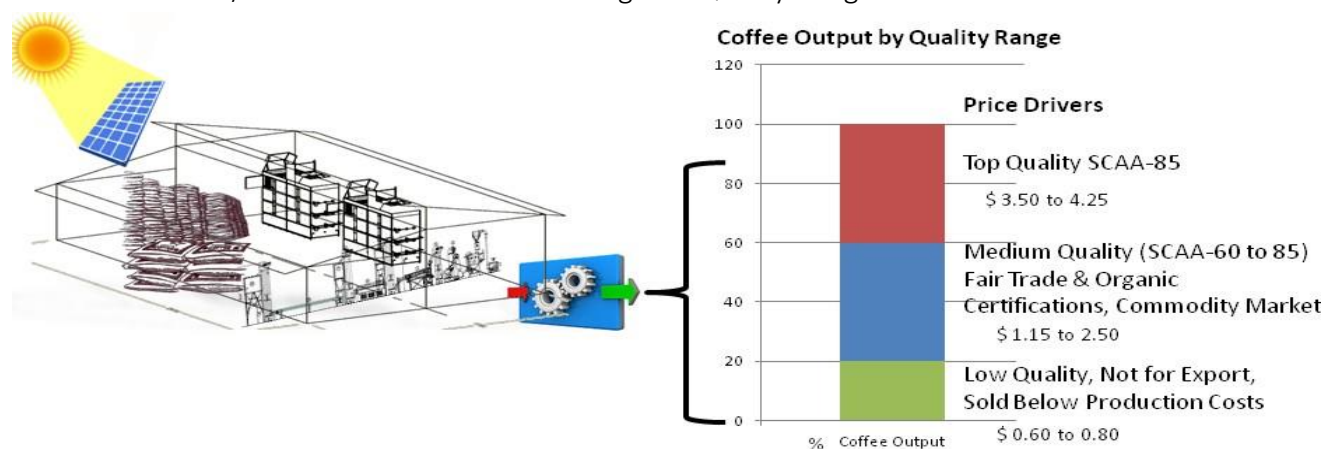
Figure 5: Off-Grid Processing and Export Centers

Detail of the MDI/COMISUYL Off Grid Processing and Quality Range

A summary of processing costs per 100 lb. sack (qq) comparing conventional processing costs with the Solar Biofuel Drying technology is provided below. qq = 1 quintale = 100 pound sack

Processing Cost Savings for Cooperative COMISUYL through Solar/Biofuel Drying with One Drying Tower (6,000 qq throughput per season of five months)

Activity or Fee	Historical Conventional Cost PerSack ($/qq)	Conventional Processing (% of Cost)	Off-Grid Processing Facility ($/qq)
IHCAFE (Coffee Institute Fees)	4.25	14%	4.25
Government Trust Fund	9.00	29%	9.00
Processing (milling, classification, selection and sacking)	12.00	38%	12.00
Drying	4.00	13%	0.40
Local Tax	0.05	0%	0.05
Transport to Port	2.00	6%	2.00
Total:	31.30	100%	27.70
1 Drying Tower Production 7,000 sacks (qq per year)			
Total Processing Costs	$187,800		$166,200
Annual Savings with Solar/Biofuel Option per drying tower			**$21,600**

Figure 6: The Café Solar® Brand

Figure 7: The MDI and distribution

Table 1: Table of Units Used in Coffee Production and Processing

Table of Units Used in Coffee Production and Processing	
Quintal (qq)	Unit of coffee in production and processing: 1 quintal is equals 100 lbs.
Coffee Container	Standard unit of coffee in used in contracts and transport. One container equals 37,500 lbs. (or 375 qq)
Export Sacks	The standard export sack of coffee is a sack of 150 lbs.
MDI Drying Tower Throughput	The drying throughput per drying tower at Cooperative COMISUYL is 18.67 containers per season (or 7,084 qq of milled coffee—milled coffee is usually referred to as green coffee)
Roasted Coffee	The roasting of green coffee provides the final consumer product. On average, approximately 15 percent of the weight of coffee is lost during the roasting process.

Table 2: Sales Contracts and Estimates

Contract Pricing with Customers for 2017 - 2018 Harvest

Contract Pricing Signed by Sept 2017	ICE base (May 2016)			FLO	Organic	Quality	Total. $/lb green
Tier 1 - SCAA 85	$ 2.3000			$ 0.20	$ 0.30	$ 0.85	$ 3.6500
Tier 2 - SCAA 60 > 70	$ 1.5200			$ 0.20	$ 0.30	$ 0.60	$ 2.6200
Naturals-SCAA 70 > 80-peaberry+Screen 20+	$ 2.3000			$ 0.20	$ 0.30	$ 0.60	$ 3.4000

Contracts for 2017 -18 for shipping after March 2018

Original Contracts	Containers	qq	Total qq	Quality Rating	T. Sacks(150lb)	Pricing, $/lb	Total
Bewley's	7	375	2,625.0	Tier2- SCAA60>70 (Café Especiali	1,750.00	$ 2.6200	$ 687,750.00
Nordiska	1	400	400.0	SCAA 85	266.67	$ 3.6500	$ 146,000.00
Merchants	1	375	375.0	SCAA 70-80 Sec Tier (screen 20)	250.00	$ 3.6500	$ 136,875.00
Bay Coffee	1	375	375.0		250.00	$ 2.6200	$ 98,250.00
Red Barn	0.189	375	71.0	SCAA 85 (screen 16)	47.35	$ 3.6500	$ 25,926.32
Totals	10.189		3,846.0		2,564.0		$ 1,094,801.32
Additional Contracts							
Roasted Coffee to Umass campus	0.811	375	303.97	Tier 1, roasted by pkgs	202.65	$ 7.9131	$ 240,533.71
	0				0		$ -
	0				0		$ -
Totals	0.811		303.97		202.65		$ 240,533.71
Total Value of Contracts			4,150.00		2,766.67		$ 1,335,335.02

Table 3: Sales Projections and Cash flow estimates

Mesoamerican Development Institute Honduras S. de R.L. de C.F. Consolidated Cash Flow Projection

MDI Honduras S de RL de CF-- October 2017		Café Solar® Production Platform and Marketing Business Plan: Consolidated Cash Flow							
		Cash Flow Forecast at the End of Fiscal Year							
	year 1=Invest Oct-17	year 2 Oct-18	year 3 Oct-19	year 4 Oct-20	year 5 Oct-21	year 6 Oct-22	...	year 10 Oct-28	Total in 7 yrs Oct-23
Beginning Cash Balance (Investment)	$ -	$ 1,123,319.16	$ 2,007,209.97	$ 4,155,525.90	$ 16,066,356.42	$ 25,555,345.64		$ 36,097,378.28	
Ln **Revenue Receipts**									
Café Solar Royalty, $	$ -	$ -	$ -	$ 681,116.29	$ 964,058.29	$ 1,016,066.29		$ 1,212,515.29	
Line of Credit (yr 1) and FIRSA First Capital Investment (yr2), $	$ 547,487.36	$ 1,000,000.00							
FIRSA Second Capital Investment (yr 4) $				$ 4,000,000.00					
Interst from Cash Balances	$ -	$ 33,699.57	$ 60,216.30	$ 124,665.78	$ 481,990.69	$ 766,660.37		$ 1,082,921.35	
Interest on Line of Credit for Green Coffee	$ 31,318.12	$ 56,034.44	$ 125,684.41	$ 226,429.60	$ 321,511.34	$ 368,600.80		$ 559,107.72	
1 Café Solar SCAA Tier 1 Website, 1 lb pkg per year	$ 652.50	$ 2,610.00	$ 5,220.00	$ 10,440.00	$ 20,880.00	$ 41,760.00		$ 83,520.00	
2 Café Solar SCAA Tier 1 Website, 5 lb pkg per year	$ 3,750.00	$ 62,500.00	$ 125,000.00	$ 187,500.00	$ 187,500.00	$ 187,500.00		$ 187,500.00	
4 Café Solar SCAA Tier 1 Wholesale, 5 lb pkg	$ 7,360.00	$ 22,080.00	$ 66,240.00	$ 264,960.00	$ 794,880.00	$ 993,600.00		$ 1,242,000.00	
6 Café Solar SCAA Tier 1 Wholesale, 1 lb pkg	$ 69,000.00	$ 138,000.00	$ 2,392,000.00	$ 3,634,000.00	$ 6,440,000.00	$ 6,900,000.00		$ 7,820,000.00	
9 Café Solar Alumni SHG Tier 1 5lbpkg, $ per year	$ 161,756.35	$ 416,182.97	$ 1,981,284.38	$ 3,328,024.88	$ 3,328,024.88	$ 3,328,024.88		$ 3,328,024.88	
14 Green Coffee Tier 2, Container green per year	$ 1,051,875.00	$ 2,066,925.00	$ 1,573,530.00	$ 2,247,900.00	$ 2,833,687.50	$ 3,457,575.00		$ 8,067,675.00	
Branded and Non branded Coffees Total Sales	$ 1,294,393.85	$ 3,091,922.97	$ 6,755,574.38	$ 12,022,424.88	$ 17,208,572.38	$ 19,442,059.88		$ 27,093,519.88	$ 58,520,554.47
Total Cash Receipts	$ 2,452,004.80	$ 5,271,391.00	$ 7,127,375.79	$ 22,086,848.20	$ 20,743,693.02	$ 23,744,714.79		$ 32,802,608.59	$ 78,974,022.80
Cash Disbursements									
Café Solar private label, 1lb pkg	$ 4,588.65	$ 9,444.60	$ 155,509.20	$ 236,768.40	$ 420,076.80	$ 454,053.60		$ 522,007.20	$ -
Café Solar private label, 5lb pkg	$ 41,062.48	$ 116,307.98	$ 511,648.34	$ 894,203.48	$ 1,028,545.88	$ 1,078,924.28		$ 1,141,897.28	$ -
Shipping and handling, $/5lb pkg	$ 1,050.00	$ 11,800.00	$ 23,600.00	$ 37,200.00	$ 44,400.00	$ 58,800.00		$ 87,600.00	$ -
Shipping green coffee, $	$ 75,674.09	$ 140,731.95	$ 247,782.50	$ 441,166.74	$ 642,195.54	$ 764,846.74		$ 1,181,520.34	$ -
Alumni Scholarship Fund,	$ 6,602.30	$ 16,987.06	$ 80,868.75	$ 135,837.75	$ 135,837.75	$ 135,837.75		$ 135,837.75	$ -
Green Coffee purchasing, $	$ 695,958.13	$ 1,245,209.80	$ 2,792,986.88	$ 5,031,768.86	$ 7,144,696.46	$ 8,191,128.86		$ 12,424,616.06	$ -
Total Cost of Coffee Sales	$ 824,935.64	$ 1,540,481.39	$ 3,812,395.66	$ 6,776,945.23	$ 9,415,752.43	$ 10,683,591.23		$ 15,493,478.63	$ 48,547,580.20
MDI Subcontract for Yoro Model Development & Operations	$ -	$ 1,694,410.30	$ 332,983.20	$ 2,315,129.00	$ 390,129.00	$ 392,986.29		$ 392,986.29	$ 5,518,624.08
Coffea Green Management & Operations :									
Salaries	$ 255,750.00	$ 314,372.40	$ 386,781.00	$ 386,781.00	$ 398,281.00	$ 400,581.00		$ 405,411.00	$ 2,547,957.40
Startup Cost & Prepaid Expense	$ 133,000.00								
Loan Principal Payments: Line of Credit and FIRSA 1st Loan	$ -	$ 547,487.36	$ -	$ 167,092.46	$ 182,130.78	$ 198,522.55		$ -	$ 1,547,487.36
Interes on Principal Payments , Interes at 7.25% in L	$ -	$ 54,748.74	$ 90,000.00	$ 90,000.00	$ 58,569.91	$ 40,702.88		$ -	$ 395,952.22
FIRSA Second Loan Principal Payments						$ 610,600.21		$ 637,383.97	
FIRSA Second Loan Interest Payments/ Payments					$ 255,849.69	$ 255,849.69		$ 205,932.03	
E-commerce Platform Development	$ 20,000.00	$ 90,000.00	$ 135,000.00	$ 162,000.00	$ 194,400.00	$ 233,280.00		$ 279,936.00	$ 1,114,616.00
MDI's Branding Tools and Packaging	$ 5,000.00	$ 10,000.00	$ 10,000.00	$ 25,000.00	$ -	$ -		$ -	$ 50,000.00
Legal Services	$ 10,000.00	$ 30,000.00	$ 30,000.00	$ 35,000.00	$ 40,000.00	$ 45,000.00		$ 50,000.00	$ 240,000.00
Accounting Services	$ -	$ 10,000.00	$ 15,000.00	$ 20,000.00	$ 20,000.00	$ 20,000.00		$ 20,000.00	$ 105,000.00
Insurance	$ -	$ 10,000.00	$ 10,000.00	$ 20,000.00	$ 20,000.00	$ 30,000.00		$ 30,000.00	$ 120,000.00
Associations and Membership Fees	$ -	$ 3,000.00	$ 3,900.00	$ 5,070.00	$ 6,591.00	$ 8,568.30		$ 11,138.79	$ 38,268.09
Marketing & Promotion	$ 50,000.00	$ 50,000.00	$ 100,000.00	$ 100,000.00	$ 200,000.00	$ 200,000.00		$ 200,000.00	$ 900,000.00
Miscellaneous	$ -	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00	$ 3,000.00		$ 3,000.00	$ 18,000.00
Travel	$ 30,000.00	$ 30,000.00	$ 50,000.00	$ 70,000.00	$ 70,000.00	$ 80,000.00		$ 80,000.00	$ 410,000.00
Total MDI Honduras S de RL Management & Operations	$ 503,750.00	$ 2,847,018.80	$ 1,166,664.20	$ 3,399,072.46	$ 1,838,951.37	$ 2,519,090.91		$ 2,253,248.71	$ 14,527,796.45
Total Cash Disbursements	$ 1,328,685.64	$ 4,387,500.19	$ 4,979,059.86	$ 10,176,017.68	$ 11,254,703.80	$ 13,202,682.14		$ 17,746,727.33	$ 63,075,376.65
Year Net Cash Flow (Net Income)	$ 1,123,319.16	$ 883,890.81	$ 2,148,315.93	$ 11,910,830.52	$ 9,488,989.22	$ 10,542,032.64		$ 15,055,881.26	$ -
Ending Cash Balance	$ 1,123,319.16	$ 2,007,209.97	$ 4,155,525.90	$ 16,066,356.42	$ 25,555,345.64	$ 36,097,378.28		$ 51,153,259.54	$ 51,153,259.54

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Café Solar® – Sustainable Coffee in Central America

TEACHING NOTE

Case Summary:

Coffee cultivation is a significant cause of deforestation, water shortages, and endangering species. The case presents the multifaceted nature of sustainability, highlighting the role of stakeholders that operate globally to create opportunities, address problems and constrain externalities in the globalized world. The Mesoamerican Development Institute (MDI) is a cooperative that is involved in coffee cultivation, production and marketing. The effect of such a sustainable approach has impacts on stakeholders, particularly farmers, rural and urban communities in Honduras and on Green House Gases (GHG) emissions and species endangerment. The case highlights the application of proactive value chain/supply chain, and innovative technologies to provide alternative cultivation and production methods that reduce impact of deforestation and energy use. Finally, the economic benefits also extend to sale of carbon offsets that will enable reinvestment and growth.

Key Objectives:

Key objectives of the case include:

☐ Opportunities and Challenges of sustainable entrepreneurship in Central America

☐ Understanding the sustainability concerns confronting the coffee industry including challenges to the small producer

☐ Implications of social (Fairtrade) and environmental (deforestation and GHG), economic (Carbon trading) and other institutional factors (UN SDGs) on the coffee business practices

• Value chain and supply chain – tangible and intangible value creation in the sustainability environment, and managerial accounting

☐ Brand development, Sales and Cash flow analysis in projecting future stability, risk factors and growth.

Contextualizing Notes and Educational Rationale:

In relation to learning concepts and technical content, case studies have the advantage over traditional lectures as they provide real-life situations that enable students to understand the relevance of their application through a "deeper" understanding of the implications and issues related to the topic. Additionally, cases can be particularly useful in relation to evolving topics with on-going research where textbooks may soon become outdated or provide inadequate coverage of extensions in the area. This case fits that description. Based on the experiences of a sustainability entrepreneurship, the case highlights the questions raised during the early stages, with direct access to the history of the entrepreneurship by those directly involved with it. Given the intrinsic goal of transparency and need for education, the entrepreneurship has provided the materials that form the resource base for the case. Additionally, that information is corroborated and supplemented with information available from secondary sources, such as supplier information (Bewley's), macro level information from website publications (CIA), and related information. The case setting is international, with particular insights into the emergence of challenges facing rural regions of Central America where economic growth can be thwarted by sustainability, political and social issues. The application of technology and modern management accounting tools including Value Chains and cost management techniques would enhance strategy implementation. The case allows for detailed illustrations of the integration of several aspects of sustainability in the business value chain in the South American context, where there is a specific shift to increased use of modern technology to avail of economies of scale while involving local farmers and educational institutions. The case is primarily intended for use in the MBA or MS (Accounting) programs, preferably as a second level course in Management Accounting with an emphasis on Sustainability or Sustainable Entrepreneurship.

CASE QUESTIONS AND SUGGESTED ANSWERS

Questions:

1. Consider the definition of sustainability highlighted by the World Commission on Environment and Development (WCED), the mission of the Brundtland Commission and the UN's Sustainable Development Goals (SDGs). Discuss how the case would implement these areas.

2. Review the main elements of the value chain from the case and highlight how sustainability impacts different components of the value chain.

3. Analyze the cash flow statement and identify the inherent risks that could surface in future. Indicate how MDI Honduras could guard against them.

4. What are the challenges and opportunities for brand development, integrating sustainability and the other factors that can influence the ability of the sustainability entrepreneur to succeed?

Suggested Answers:

1. *Consider the definition of sustainability highlighted by the World Commission on Environment and Development (WCED), the mission of the Brundtland Commission and the UN's Sustainable Development Goals (SDGs). Discuss how the case would implement these areas.*

This question addresses two perspectives of the sustainability issues addressed in coffee production in Honduras. The first, a broad definition of the UN Brundtland Commission, connects the environmental, social and economic issues broadly as it pertains to the inter-generational impacts. The second, the UN's SDGs address sustainability questions from a narrow and well-defined perspective to proactively seek change within the larger systems. The Brundtland Commission defines sustainable development in terms of growth that provides for the future generations.[12] Three areas in sustainability include environment, social and economic. The integration of sustainability and SDGs present a holistic approach to considering issues such that the inter-related issues can be understood and addressed.[13] For example, increased efforts to conservation and reduction of deforestation can lead to increased costs in the short run. Research into the area is time-consuming and often expensive. Therefore, the integration of nonprofits and for-profit enterprises serves to address these early stage challenges. In addition, the integration of the components of the sustainability, environment, social and economic, also must be considered as holistically integrated in the coffee cultivation case. Without economic sustainability, for

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[12] "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." http://www.iisd.org/topic/sustainable-development
[13] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

example, the other factors would be difficult to implement, while social and environmental sustainability become key issues for improving quality of life and enabling economic sustainability to be viable and long-term, within the Brundtland definition. The Café Solar® case effectively considers these perspectives as follows:

- **Environmental** (deforestation and GHG, species endangerment, and solutions) –

The Institute for Forest Conservation (ICF), the ministry-level branch of the Honduran government in charge of forest conservation, protected areas and wildlife, has identified coffee production as the primary threat to its national parks. Additionally, it is also the primary threat to the cloud forest throughout Central America (Honduran Forest Service, 2013; American Bird Conservancy, 2013; United Nations' top 10 disappearing wonders of the world). However, research studies suggested that nearly 80% of coffee consumers are unaware that firewood is the energy source for conventional coffee drying, or of its contribution to deforestation in Central America. The impact is local and global. The local impact on the cloud forests in Honduras and Central America, that are disappearing at an alarming rate, has implications on water supply. Cloud forests are the headwaters of the watersheds that provide drinking water for the surrounding cities and communities and water for hydropower utilities. The mayors are very concerned that drinking water is diminishing due to the clearing of the cloud forest for coffee production. They and the US and Honduran Forest Services have endorsed MDI's forest-friendly production and processing methods. Wood burning also results in GHG that impacts global warming.

Overall, coffee plantations have implications on access to water and sanitation for all (SDG 6), ennvironmental sustainability (SDG 7), sustainable consumption and production patterns (SDG 12) and sustainable management of forests, combating desertification, halting and reversing land degradation, and halting biodiversity loss (SDG 15). These factors are inter-related, as indicated above, and addressing them can also lead to inter-related outcomes. For example, reduction of the use of wood is a key goal, along with alternative sources of energy. Likewise, reduction in use of wood as an energy source would not prevent forests from denudation for coffee cultivation unless such use of land is integrated with the need to retain forest cover, minimizing the negative impact on habitat and cloud cover.

The solution of the MDI, the Integrated Open Canopy (IOC) coffee farming method preserves and/or regenerates forest habitat. Under the IOC approach, forest patches of equivalent

area to coffee plots are conserved, with the cost offset by sales of sequestered carbon. IOC production provides superior habitat for birds, providing habitat for forest-dependent species that are not found in shade coffee. IOC production greatly enhances hydrologic conditions for the environment through forest preservation and/or regeneration. Cloud forests are also very important in mitigating global warming, as they remove carbon dioxide, a greenhouse gas, from the atmosphere. Carbon emissions from deforestation are equal to emissions from burning fossil fuels for the transportation sector. The forest regeneration and preservation areas served as carbon sinks or areas of sequestration cover providing habitat for many forest-dependent species, including some migratory birds, that were not found in shade coffee produced under the current production methods. The regenerated forests also greatly enhanced all hydrologic conditions for the environment, while also increasing yields.

IOC production is combined with the industrial use of solar and biofuel energy through the off-grid drying facilities, which eliminates the use of firewood (and its associated emission of carbon dioxide during combustion) derived from tropical forests for the drying of the annual coffee harvest, creating a high-quality carbon transaction. Coffee will be processed using industrial-scale solar-hybrid coffee dryers that eliminate the use of fuelwood, which is conventionally used to dry coffee and has been identified as a key driver of deforestation. Solar dryers also reduce coffee processing costs and add value to carbon sequestered in IOC forest patches. The initial off-grid green factory (Beneficio), a joint investment of MDI and COMISUYL, reduces electricity consumption from 10.5 kilowatt hours per sack for conventional mechanized dryers to 2.0 kilowatt hours per sack. This amounts to electricity savings of 60,214 kilowatt hours per season per drying tower, equivalent to 49 metric tons of carbon dioxide per season, if supplied by the electrical grid. Each 100 pound sack of coffee dried in MDI's solar/biofuel drying systems saves 0.07 to 0.12 cubic meters of firewood over conventional wood-burning coffee dryers. This amounts to an area of forest of 4.6 hectares per season per drying tower, equivalent to 364 metric tons of carbon dioxide per season. The electricity for the operation of the coffee processing facility at COMISUYL is in transition to 100% renewable energy using locally produced biofuel from small producers.

Further, expansion of the innovation at MDI could have a positive impact on the Yoro Biological Corridor that will cover thousands of square kilometers and will link three parks and a wildlife refuge and enhance the ecological integrity of these protected areas, protect the critical

watersheds that serve the surrounding communities, and establish the foundation for sustainable livelihoods within the region. The biological corridor will be managed under a co-management agreement between the Institute for Forest Conservation (ICF), the eleven municipalities within the corridor, the COMISUYL coffee cooperative and the Mesoamerican Development Institute (MDI). Management of the corridor will include the promotion of sustainable coffee production and processing methodologies developed by MDI and piloted at COMISUYL. Under this system coffee is produced with IOC and processed using industrial-scale solar-hybrid coffee dryers that eliminate the use of fuelwood, which is conventionally used to dry coffee and has been identified as a key driver of deforestation. The Café Solar® production program is creating an example of coffee production in harmony with national parks and their resources. The proposed Yoro Biological Corridor directly addresses the primary threat to Yoro's national parks and provides the technology, training, education, and production methods to transform the agricultural landscape of the region to be in compliance with the Convention on Biodiversity, allowing for the preservation of local biodiversity through preservation and expansion of forest habitat.

- **Social** –

Social issues that plagued Honduras included poverty and lack of opportunities for the youth, particularly the vulnerability of the female population, high levels of inequality, urban slums, and the need for rural development. UN SDGs have goals that consider these aspects, such as end poverty in all its forms everywhere (SDG 1), reduce inequality within and among countries (SDG 10), achieve Universal Primary Education (SDG 2), and promote Gender Equality and Empower Women (SDG3).

The Café Solar® case addresses these issues in different ways. The MDI and COMISUYL Off-Grid Processing Facility, includes women in management positions serving as mentors and role models for their communities and the coffee sector as a whole. Sales of fair trade Café Solar® increased revenues for rural families and communities by providing value-added processing and direct export to a growing market for sustainably produced coffee. Value-added processing and export services attracted new members, allowing the cooperative to grow, moving more product to high-value global markets and moving producer communities away from poverty.

The initiative also increased educational opportunities. MDI introduced sustainable technologies for the rural productive industry, including the high-efficiency drying chamber used

in Solar/Biofuel drying systems, hermetic storage systems for coffee, and Integrated Open Canopy production (IOC). These innovations necessitated skilled and semi-skilled labor and management abilities to continue to develop and extend. COMISUYL contributed to the Instituto Hondureño de Educación por Radio (IHER), a program of secondary education endorsed by the Ministry of Education. Most members of the Board of Directors of Cooperative COMISUYL and current General Manager are graduates of the IHER diploma program. As increasing volumes of Café Solar® move through the market, more funds will be directed to the IHER program. In addition, COMISUYL is working with the National Autonomous University of Honduras (UNAH) and the MDI in the development of certificate programs that will be taught at COMISUYL's processing facility. The scale up of the conversion to IOC coffee production adjacent to National Parks and within key watersheds in order to promote conservation and/or reforestation on private lands further extended educational needs. Key local skills related to IOC were the ability to measure biodiversity impact on key indicator bird species (bird surveys such as with the Golden-Winged Warbler), the ability to plot and measure IOC farms, and conduct carbon assessments according to protocols and guidance from the US Forest Service, UMass, UNAH and MDI.

Connected to this goal are the global business networks that can integrate and motivate the supply chain to overcome challenges that emerge from attaining sustainability goals. Specifically, the combined integration of coffee production and distribution with the coffee processing and finally outlets in specialty coffee stores allow such prices to be charged with a conscious purpose of providing opportunities and restoring the ability of individuals (particularly women) to become self-sufficient. The increased revenues provided through MDI's clean energy technologies increases job opportunities for rural youth and increases revenues for small producers, thereby helping to limit migration of rural people to the slums in the major cities.

- Economic –

As indicated, economic sustainability is key to the continuation of the other forms, and therefore, needs to be considered alongside other aspects. The case presents several areas where economic aspects integrate with other areas through innovations at different points in the value and supply chain such as the sale of carbon offsets, global supply chain and Fairtrade, continuation of revenue streams and educational opportunities. The UN SDG goals encompasses such aspects that highlight this integration by encouraging partnerships and innovation.

Specifically, global partnerships are necessary to revitalize sustainable development (SDG 17) and cooperation with private sector to make available benefits of new technologies (SDG 8). Further, sustainability requires resilient infrastructure that promotes sustainable industrialization and fosters innovation (SDG 9).

The case provides some examples of the economic gains with relevant metrics. For example, the IOC benefits extended to economic ones, with increasing yields and additional revenues from carbon. Specifically, since the forest areas sequester carbon, they allow producers to sell carbon, providing an additional premium from their coffee farms. For the typical small producer, 145 metric tons of carbon dioxide is sequestered annually with IOC. Carbon trading also provided incentives for forest habitat preservation and restoration for participating coffee and biofuel producers. IOC production has been proven to increase coffee yields, while supporting forest habitat and the biodiversity that forest support. The Fair trade markets for Café Solar® also provides an additional $20 for each 100 pound sack of green coffee (qq) and $50 for each sack of fair trade and certified organic coffee. These increase revenue for the farmer and reduce inequalities.

Cost benefits from the off-grid dryer also lead to energy savings annually starting at $21,600 for each high-efficiency drying tower. The clean technology energy costs reductions also increased for the cooperative even as rural employment through the training and hiring of local youth to operate and maintain the off-grid processing facility also increased. Alongside, new local markets and local jobs are created for the farmer owned company producing jatropha oil for electricity generation at the off-grid coffee processing facility.

The hybrid model of non-profit and for-profit enterprise served to remove barriers for emerging technology and coffee production methods researched, developed, and piloted by MDI. The business arrangement supports two innovations of major social and environmental benefit developed by MDI for the supply of sustainably produced and processed coffee for the Café Solar® brand. MDI's technology expanded to include other fair trade cooperatives through an alliance of private sector companies developing and distributing the Café Solar® brand. The MDI affiliate, Mesoamerican Development Institute Honduras S. de R.L. de C.F., for-profit business model overcomes barriers to new technology introduction and places the costs of technology transfer on consumer countries rather than the small producer. MDI and COMISUYL

are partnered with the Federal and Municipal governments through their designation as Co-Managers of Pico Pijol National Park.

The Café Solar® brand association with fairtrade and environmental, social and economic sustainability provided a product that depicted an environmentally friendly alternative with market potential for every link of the supply chain. Expansion of the brand into new territories and consumer segments would be crucial to the continued economic sustainability of the initiative.

2. *Review the main elements of the value chain from the case and highlight how sustainability impacts different components of the value chain.*

Value chain are those components of firm activities that create value for customers. Generally, the key components of the value chain include Research and Development, Design, Production, Distribution, Marketing and Customer Service. Each firm has differnet emphasis on value chain components based on industry and strategic focus. Thus, the goals of the value chain are attained through management strategy that integrates several aspects such as partnerships between entities, such as private-public and profit-nonprofit entities, as the case illustrates, or the supply and distribution chain that enables raw materials and finished products to be transported to production facilities and customers. The key components of the value chain and their sustainability impacts are briefly described below:

- Research and Development: Crucial to the Research and Development initiative was the formation of the non-profit MDI that partnered with the universities and US Forest Services to determine crucial sustainability areas and solutions to the cultivation, production and packaging problems to arrive at innovative solutions. Thus, research on cultivation included reforestation, production involved use of solar power for large scale drying, and hermeneutic storage for mold-prevention.
- Design: The design stage involved designing the different forms of IOC plans, the design of machines, and also packaging that could enable the coffee to reach roasters in the state for high quality product. This coordination also led to the planning of the brand, so that the key sustainability issues and solutions are highlighted to create customer value and identification.

- Production: Production begins with the purchase of coffee beans from the Cooperatives and the drying process. Given the proximity of the off-grid dryer to the cooperative farms, this also reduces transportation and the costs/environmental aspects associated with it. Further, the drying throughput per drying tower at COMISUYL is 18.67 containers per season (or 7,084 qq of milled coffee; milled coffee is usually referred to as green coffee), which presented some economies of scale. The more reliable power from the solar and oil based energy source also allowed for greater reliability. Other aspects of the sustainability components such as cloud forests in mitigating global warming, and reduced carbon emissions from deforestation have been discussed. Additionally, the annual savings with Solar/Biofuel Option per drying tower $21,600, is highlighted in Figure 5. The roasting of green coffee provides the final consumer product. On average, approximately 15 percent of the weight of coffee is lost during the roasting process.

- Distribution: MDI introduced hermetic storage to the coffee sector with GrainPro Inc. and they are now endorsed by the coffee institutes of Honduras and Costa Rica. Mold and fungus development can occur when green coffee beans are exposed to prolonged drying periods, such as when patio drying with cloudy and rainy periods, or if the coffee is allowed to re-absorb moisture from the atmosphere during storage and/or transportation. With properly dried coffee and the use of hermetic storage, the development of molds is prohibited. Thus, distribution of quality seeds was crucial for the next step, the roasting. Roasters were located closer to the consumer outlets, such as Red Barn Coffee Roasters, Bay Coffee & Tea (United States), Nordiska Kafferosteriet (Sweden) and Bewley's Coffee (Ireland & Australia) creating new high-value markets for producers. The coffee is also served in cafés and cafeterias at UMass campuses, and other venues such as airports. Bewley's was also a high value customer who valued sustainability in coffee production, purchasing both coffee and carbon offsets, the first one to do so.

- Marketing: The Café Solar® brand expanded in US, Canada, Ireland, Scandinavia and elsewhere. The brand depended on the high quality coffee from the farming stage through the drying and sorting. The off-grid factory was the only coffee mill in the Department of Yoro with the equipment required to meet Specialty Coffee of

American Standards for SCAA-85 quality classification for export to the specialty market. The facility met organic certification requirements and is a registered food processor with the U.S. FDA and Japanese authorities. Hence, the marketing of the coffee extended from the quality and the sustainability to form the marketable brand. As Bewley's pointed out, COMISUYL had coffee with the attributes that market partners and global markets were seeking: high-quality coffee with a great flavor profile that is Fair Trade and organically produced, with significant involvement of women in management and operations.

- Customer Service: There is continued focus on quality, direct connection with distributors, developing relationship with customers who understand the mutual benefits from this relationship, and continuing to innovate to form new flavors and sustainable solutions to retain and expand in the consumer segment. Additionally, the carbon Trading Project under development provided brand certification and increased efforts to generate revenue through customer involvement and purchase of offsets.

3. *Analyze the cash flow statement and identify the inherent risks that could surface in future. Indicate how MDI Honduras could guard against them.*

The case highlights the distribution networks that have emerged and allowed the brand to extend to different continents. Bewley's was one significant buyer who visited far-flung destinations along the coffee belt, where high-quality Arabica coffee flourishes, to reestablish old friendships or create new ones. They found the high-quality coffee being produced by the individual small holders and the unique sustainable context of their backstory inspiring. This led to the significant purchase orders that Bewley's made (Table 2). Bewley's representatives presented a check for carbon offsets at one such visit, with the commitment to double purchases from the Co-Op. Overall, each customer made significant purchase commitments that formed the basis for the confidence of the cooperatives on their ability to be able to continue to serve the sustainable coffee to a global customer base (Table 2).

A review of the sales contracts indicate that the quality that most customers sought after was the highest Tier 1 (SCA-85,) but the largest customer, Bewley's, bought the largest quantity of the Tier 2 (SACAA 60>70), clearly indicating that Tier 2 coffee was the main product that

generated 62.8% of the total revenues. It is important for MDI to generate information on the costs for each Tier coffee to find out the best strategy for cultivation and extension of the processes to support the customer. Developing a sense of the contribution margins for each product type would enable MDI to develop strategies to highlight and market each product in the light of the overall consumption patterns and value creation. This would also enable MDI to profile customers to find profitable customers who are willing to pay the premium for the attributes that the brand communicates.

Table 3 provides further insights into the main costs that comprise the total expenses: cost of Green Coffee, followed by salaries, the e-commerce platform, and marketing costs. These projects were based on the assumption of growth rates of over 100 percent for the first few years. This would clearly be a challenging proposition, requiring new customers who are able to generate the required revenue increments. The costs are also conservative, with the increases in the e-commerce platform indicating that the overall marketing strategy would now diversify to the internet. The challenge, in this case, is the need to ensure that supply chain functionality continues to reflect this sales channel. Overall, as the case suggests, the overall cash flow projections are crucial for the MDI to be economically sustainable. Undoubtedly, there would be challenges ahead, and their ability to make provisions to address such contingencies would be crucial to the success of the initiative.

It may also be pointed out that the sale of carbon offsets represents approximately 25% of the net income derived from coffee revenue for the typical coffee farmer, but does not form a source of cash flow for the for-profit MDI Honduras. Thus, this avenue of cash flow would primarily be a motivation for farmers to continue with the sustainability approach to production, while it also serves to encourage the suppliers to be part of the solution to the sustainability challenges in the coffee producing regions of the world.

4. *What are the challenges and opportunities for brand development, integrating sustainability and the other factors that can influence the ability of the sustainability entrepreneur to succeed?*

Some strategies for the sustainable entrepreneurship to become financial viable in the long term include:

- **Leveraging nonprofit/forprofit combination across the value chain:** This forms an important means to develop value. For example, while the cultivation and production have been directly impacted, there is greater avenue to expand on the direct marketing venues using outlets that expand product offerings within coffee and also other related items. This would be coordinated by expanding opportunities for college students to enter the value chain through training across aspects that would develop skills and expand opportunities. The educational expansion could relate the strategy from the coffee value chain to other related products encompassing a range of disciplines from sciences, to the arts and business. Having educated personnel at different levels in the value chain, for example, in the production stage could lead to yield improvements as intervention becomes more likely to occur at the right stages.

Additionally, with the replication of IOC farms and measuring coffee yield, the raw materials of high quality at lower costs would expand opportunities for expanding to new markets. Such coordination could also permit risk management ranging from environmental to extensive airborne disease that could impact crops and output. For example, up to 40% of the trees had been lost, causing massive income destruction and the requirement for increased investment to replace the dead trees. This double calamity has meant that the original debt had to be re-phased at steep interest rates, meaning progress has stalled, for example on education and women's support programs. Education and joint profit sharing approaches could enable greater awareness and proactive approaches to reducing risk.

- **Leveraging opportunities for Carbon trading:** Only 25% of certified sustainable coffee provides any premium for the producer (Coffee Barometer Symposium, HIVOS, Amsterdam, 2013). Critical to economic gains was the measurement of carbon sequestration for carbon offsets valuation. MDI saw this as the new challenge that would allow broader capability of such assessment that gave farmers more value from the sequestration efforts, while also addressing the battle against the spread of airborne leaf rust. The initiative will also increase the opportunity of new revenue streams from the sale of carbon credits of the form undertaken by Bewley's. The sale of carbon offsets represents approximately 25% of the net income derived from coffee revenue for the typical coffee farmer. This innovation rewards farmers who are conserving and/or regenerating forest habitat on their property. The transition from securing environmental gains to translating it to economic ones posed another challenge. Critical to the effectiveness of carbon trading was the stronger verification systems that allowed carbon trading

over and above that purchased through over the counter transactions such as that of Bewley's from over-the-counter to assessment and technical assessments.

- **Progress in the face of Adversity:** There were setbacks of various types, for example, the rollback of advances made for women's involvement with the new COMISUYL board membership**.** Despite these setbacks, Maria, Augustin and current President Fidel Bullino have remained steadfast in holding on to their dream. Now they are becoming part of another wider initiative aimed at the protection of the local forest. The "Nerc2arbon" program, announced in 2016 by the Mesoamerican Development Institute in collaboration with National Autonomous University of Honduras, has been designed specifically to provide incentives for the adoption of Integrated Open Canopies (IOC) to address the environmental damage caused by increasing coffee production. The program aims to boost forest regeneration and preserve areas that serve as carbon sinks. At the same time the IOC initiative is expected to increase yields, encourage the use of COMISUYL's clean processing and assist in the battle against airborne diseases like leaf rust.

- **Reputation and the growth of the brand:** Increasing brand recognition provides opportunities to extend product development and increase producer interest. The wider acceptance of the "Yoro Model" required a system of agro-industrial practices linked to sustainability practices such as high-biodiversity agroforestry systems, technological advances, empowerment of women, and socioeconomic structures that offer a market-based solution to rural poverty, employment and training of local youth, deforestation and degradation of water resources, and climate change, that would also directly impact coffee markets and develop increased interests in such initiatives. This would be a significant advance in allowing for brand development. The use of such integration of production with markets would also enable rural communities to directly supply developing international carbon and coffee markets. [14]

- **Institutional developments:** Cooperatives and expansion of production capacity face challenges where institutional developments may favor continuation of contract farming, given reduced risks to producers. Bitzer & Glasbergen (2010) examines intersectoral partnerships formed to promote sustainable cotton production and the extent to which such partnerships are

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[14] http://mesoamerican.org/2015/10/18/the-yoro-biological-corridor-initiative-inicitativa-corredor-biologico-yoro/

facilitated or constrained by their institutional environment. [15] Such institutional factors, which are directly linked to the regulatory environment established by governments determine environments which enable sustainability related strategies. Campbell (2006), for instance, argued that the adoption of CSR practices does not occur automatically in response to functional imperatives of companies, but depends to a large extent on the external institutional environment.[16] As institutional theory recognizes, any technological change pursued by actors and organizations is influenced by institutional structures that play key roles in determining how quickly and the extent to which these changes are accepted (Nelson, 2002).[17] Increasingly, it is acknowledged that institutions can be developed through individuals and stakeholders operating as agents to influence policy. Thus, as MDI creates new opportunities for farmers and highlight the manner in which the new technologies can enable sustainability when implemented across large swaths, this would provide increased opportunities for creation of institutional environments that favor technology shifts.

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[15] Bitzer, Verena, & Glasbergen, Pieter. (2010), "Partnerships for Sustainable Change in Cotton: An Institutional Analysis of African Cases", Journal of Business Ethics 93, 223-40. Based on an analysis of five partnerships in sub-Saharan Africa, Bitzer & Glasbergen (2010) show that institutional factors create both opportunities and obstacles for partnership implementation which are inextricably linked to their adoption of particular farming strategies and sustainability standards. In general, these institutional factors tend to facilitate the implementation of partnerships using contract farming and mainstream sustainability standards and hinder those adopting cooperative farming methods and organic standards.

[16] Campbell, J. L. (2006), "Institutional Analysis and the Paradox of Corporate Social Responsibility", American Behavioral Scientist 49(7), 925–938.

[17] Nelson, R. R. (2002), "Bringing Institutions into Evolutionary Growth Theory", Journal of Evolutionary Economics 12(1), 17–28.

A Simulation of Rainwater Harvesting Design and Demand-Side Controls for Large Hospitals

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Abstract

Inpatient health buildings in the United States are the most intensive users of water among large commercial buildings. Large facilities (greater than 1 million square feet) consume on average 90 million gallons per building per year (Energy Information Administration [EIA], 2012). The distribution and treatment of water places a significant electrical demand may be the single largest energy requirement for states. Supply and demand-side solutions are needed, particularly in arid and semi-arid regions where water is scarce. In this study, we use continuous simulations based on a neural network rainfall forecast to estimate how rainwater harvesting systems and demand-side interventions (e.g., low-flow devices, xeriscaping) would offset the demand for externally-provided water sources in a semi-arid region. Results demonstrate that hospital external water consumption might be reduced by more than 25% using conservative assumptions and depending on design of experiment parameters associated with rainfall capture area, building size, holding tank specifications, and conservation efforts.

Key words: sustainability, rainwater, RWH, hospitals

Introduction

The 2012 Energy Information Administration (EIA) Commercial Buildings Energy Consumption Survey (CBECS) identified inpatient healthcare buildings as the most intensive users of water among large commercial buildings. Facilities over 1,000,000 square feet consumed about 90 billion gallons per building (EIA, 2012). This type of utilization is increasingly problematic in arid and semi-arid regions such as central Texas (San Antonio) where population growth and drought have often resulted in water use restrictions and the emergence of desalination plants for brackish groundwater (Texas Commission on Environmental Quality, 2018). A need exists for demand and supply-side interventions such as the installation of low-flow devices and adoption of rainwater harvesting systems for existing or new construction, and such construction is supported by the State of Texas (Texas Water Development Board, 2005).

Rainwater harvesting systems (RWH) date back to at least 4,000 years ago (Abdullah & Al Shareef, 2009), yet the adoption as a primary or tertiary water source is now gaining traction in the United States and other countries (Jones & Hunt, 2010). Several authors have explicated the methods and requirements for building domestic-use rainwater harvesting in the United States (Lall & Sharma, 1996; Guo & Baetz, 2007; Basinger, Montalto, & Lall, 2010; Fulton, Bastian, Mendez, & Musal, 2013) as well as abroad (Domènech & Saurí, 2011; Al-Houri, Abu-Hadba, & Hamdan, 2014). In the United States, considerations for county-wide adoption of RWH systems have been investigated. With appropriate design and maintenance, quality standards can be met (Ennenbach, Larrauri, & Lall, 2018; Texas Water Development Board, 2005). The use of RWH in healthcare facilities is also not a new concept and one promulgated by the World Health Organization (World Health Organization, 2018). In India, hospitals are sometimes fined for not using RWH ("NGT fines Malls, Hospitals, Hotels over Rainwater Harvesting," 2015).

There are many advantages in using rainwater harvesting. First, the water is free, as the cost is for the collection and use. Rainwater may be used to augment groundwater and surface water as necessary, particularly when water is in short supply. It provides a zero-hardness, no salt solution, which extends the life of equipment and which is important for individuals on low-sodium diets. Rainwater also reduces runoff and non-point source pollution (Krishna, 2003).

Depending on the aquifer absorption rate, RWH may be significantly more efficient in capturing water for use. As an example, a typical RWH is 75-90% efficient in capturing rain. (Texas Water Development Board, 2005). If an aquifer's recharge rate is 20% after runoff and plant absorption and an RWH captures 80% of the rainfall, then four times as much rain would be required if extracted from groundwater rather than harvested.

Further, RWH systems save electricity. Water distribution, desalinization, and other purification measures demand significant kWh. California estimated water related energy use to be 19% of its total energy requirement in 2001 (Klein, Krebs, Hall, O'Brien, & Blevins, 2005). Given that hospitals are the most significant water users of all large buildings, they are then also a significant consumer of electricity due to water distribution alone.

The significance of this study is multifold. First, the study demonstrates the supply and demand-side requirements for building an RWH that achieves an external water source (e.g., ground or surface water) offset proportion for large hospitals, which are the largest consumer of water. Second, the study extends an evaluation of non-stationarity of rainfall in a semi-arid region as an extension of efforts to model daily rainfall (Fulton et al., 2013; Basinger et al., 2010). Third, the study formally assesses models for forecasting rainfall that are reasonably effective for use in simulation. Finally, the study furthers a socially responsible solution that offsets external water and electricity requirements, particularly since the building of large hospitals results in impervious cover affecting ground water recharge (Greater Edwards Aquifer Alliance, 2018) and distribution as well as treatment of water is associated with a significant electricity demand.

Method

Study Design
This study uses 71 years of daily National Oceanic and Atmospheric Administration (NOAA) rainfall supply data (NOAA, 2018), information on hospital water consumption (EIA, 2012), multiple design of experiments (DOE) parameters, and response surface methodology (RSM) to estimate the feasible ground and surface water offset achievable by implementing RWH in large hospitals (those with 200,000 or more square feet of space) and by reducing demand. This study also investigates the possibility of non-stationarity of rainfall (Milley et al., 2008) and provides a fitted equation for calculating "failure probability" based on DOE assumptions, where "reliability" is defined as the proportion of time holding tanks are empty and "1-reliability" is then the failure probability.

RWH Systems
This study requires some familiarity with RWH systems, as the primary DOE components derive from that knowledge. Figure 1 is a diagram of a typical, commercial grade RWH system. Rainwater flows from capture spaces (e.g., roofs, garages, outbuildings) and is largely but not completely captured by guttering systems usually equipped with some sort of debris filter system such as screens. Some of the initial rainwater is flushed out of the system

in order to eliminate contaminants that accumulate on the roof. Water then passes through filtration on the way to storage in a cistern, possibly with pre-treatment. A pump transfers water from the system to a pressure tank (possibly through additional filtration). On demand, water is transferred through filters of decreasing size and purification (e.g., ultraviolet light). Excess water is ejected out of the system, sometimes to non-potable tanks for irrigation of plants. This design is typical of RWH systems (Texas Water Development Board, 2005).
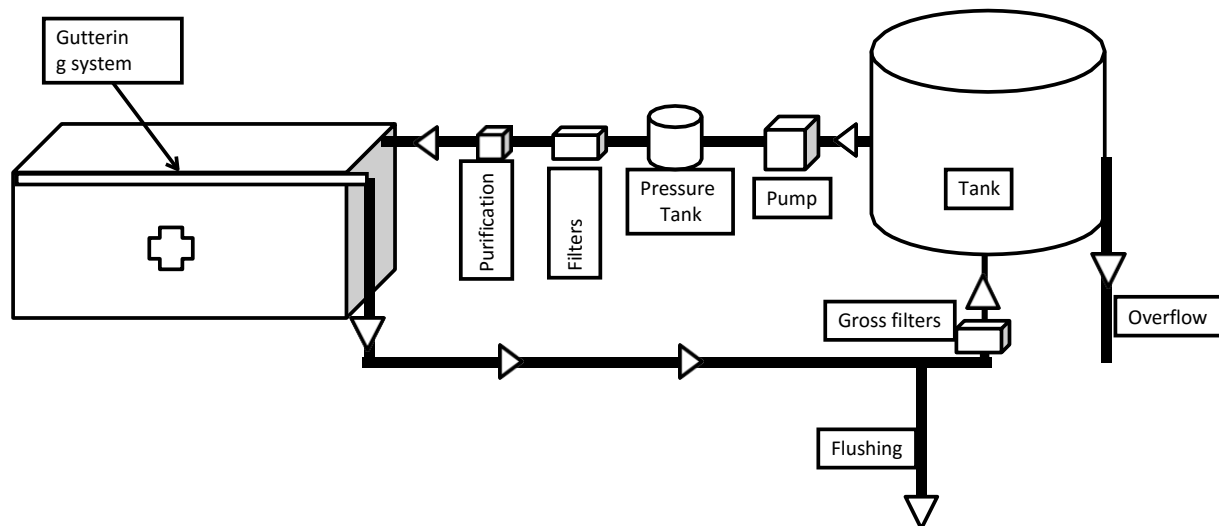

Figure 1. An example of an RWH system

Although generating quality water is a major and clear concern of RWH systems, it is also well-researched (Evans, Coombs, & Dunstan, 2006; Magyar, Mitchell, Ladson, & Diaper, 2007; Texas Water Development Board, 2005). Care must be taken to filtrate and purify (e.g., the use of filters, regenerable charcoal, and ultraviolet light); however, with proper care and maintenance, RWH systems produce high quality, potable, soft water. This study does not focus on the quality achievable from rainwater but rather the achievable offset of external water consumption based on design characteristics of the RWH as well as conservation techniques such as low-flow plumbing installation. Quality of water is specifically delimited.

Study Setting & Data
This study's setting is San Antonio, Texas. The author has been living off of 100% rainwater recapture since 2011 and is a proponent based upon conservation requirements and over-reliance of the region on aquifers. San Antonio, Texas is located in a semi-arid region which routinely experiences droughts. The area has experienced a median annual rainfall of 30.4 inches over the past 71 years with significant variability year to year. Further, the population growth in the area has been robust. The increase is estimated at 12.4% from April 1, 2010 through July 1, 2016, and the total population estimate is now 1.49 million (United States Census Bureau, 2018).

Supply (rainfall) data for the study were available from the NOAA (2018), and the closest reporting station (San Antonio International Airport) served as the source for daily rainfall information. Daily rainfall from January 1, 1947 through December 31, 2017 provided the supply stream. These data are freely available from the EIA's CBECS Study (EIA, 2012).

The historical data provided baseline runs to assist in validating the simulation distributions; however, the uncertain nature of rainfall suggested that alternative supply generators should be investigated (Fulton et al., 2012; Basinger, Montalto, & Lall, 2010). Both time series

models and stochastic generators were evaluated. A review of rainfall stationarity was necessary as part of the process.

Rainfall Stationarity
A complete analysis of the rainfall time series suggested that annual rainfall was stationary year over year; however, monthly seasonality was present. Figure 2 provides a yearly aggregated time series plot (beginning on January 1, 1947) with linear and loess curves superimposed. While a slight upward trend might be inferred from the linear fit, the loess curve suggests otherwise. There is no evidence of significant changes in this reporting station's annual rainfall.
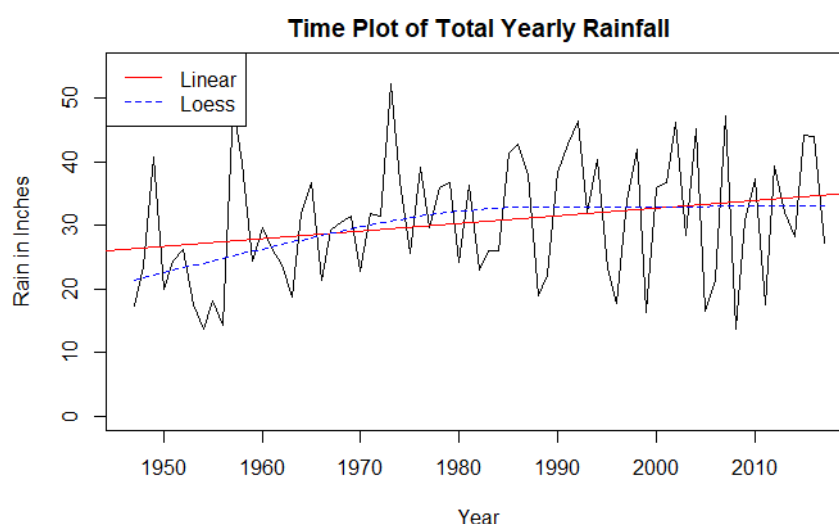

Figure 2. Rainfall distribution by year

Decomposition of the monthly aggregated time series also suggest the absence of trend; however, volatility and seasonality appeared present. The volatility is evidenced by reviewing the error (random) components, while the seasonal components are graphed separately. Some cyclicity appears to exist, as there are multi-year waves, particularly noticeable starting in 1970 through the mid 2000's. Figure 3 depicts that decomposition.
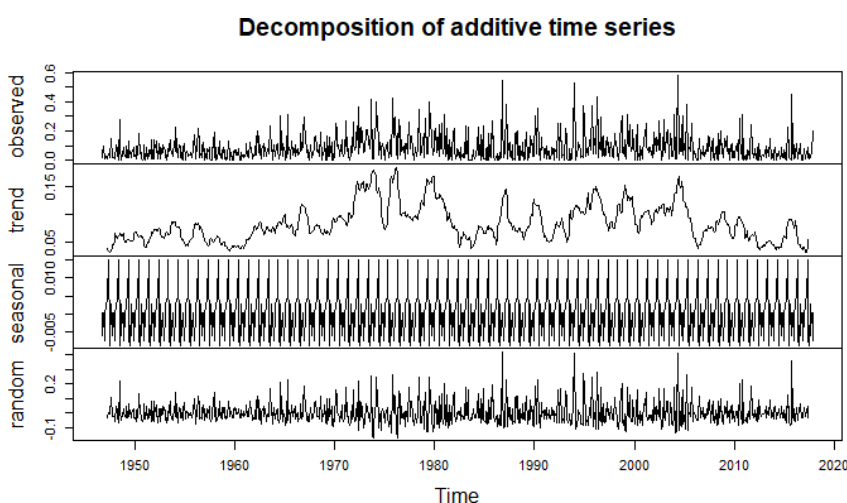

Figure 3. Decomposition of monthly rainfall using R (R Development Core Team, 2016)

Figure 4 depicts side-by-side notched boxplots by month illustrated that seasonality. Notches which do not overlap indicate statistical significance (α=.05). Darker boxplots highlight the months with the heaviest rainfall. May, June, September, and October are the months with the most significant median rainfall.
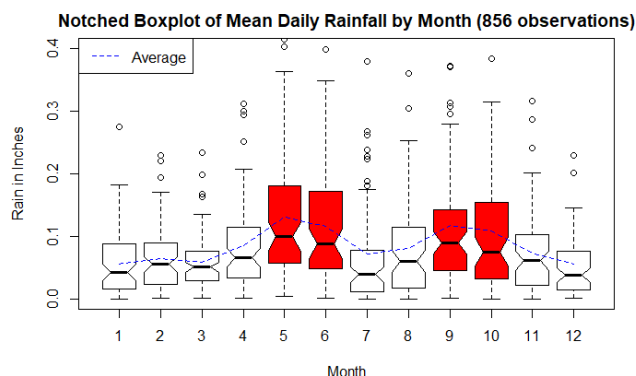

Figure 4. Notched boxplot of mean daily rainfall

When looking at the daily time series, the volatility is clear. While aggregated data illustrate a lack of trend (yearly data) and definite seasonality (monthly data), the daily data illustrate volatility. Figure 5 depicts the daily rainfall time plot.
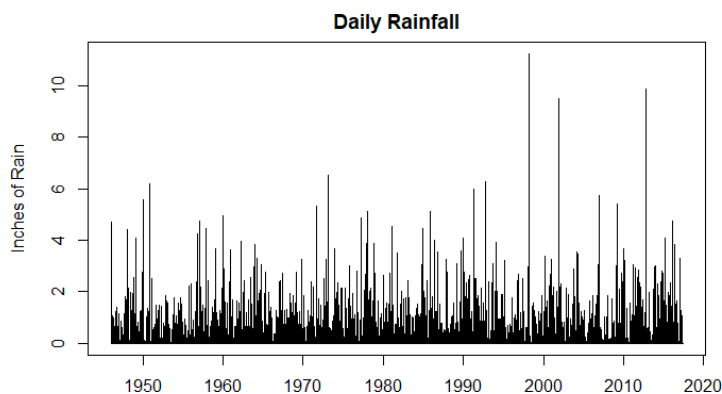

Figure 5. Time plot of daily rainfall

Time Series Analysis
Options for rainfall generators outside of historical data were investigated for use in the simulation. All models were built on a sequential 70% training set and evaluated against the same 30% test set (sequential). Naïve, seasonal naïve, Error, Trend & Seasonality (ETS), Auto-Regressive Integrated Moving Average (ARIMA), and a two-stage Gamma Hurdle were considered along with two stochastic, non-parametric generators and a Time Series with Neural Networks model. Each is discussed and compared in the next sections.

Naïve Model
A naïve forecasting model is nothing more than "last = next." The last time-period observation is used to forecast the next period, where multiple period forecasts are simply a straight-line estimate. This model provides a baseline for comparison via the Mean Absolute

Scaled Error (MASE). The MASE provides a ratio of the average absolute error of the forecasting method divided by the average absolute error of the one-step naïve forecast (Equation 1). In Equation 1, the numerator represents the Mean Absolute Error (MAE) of a forecast, while the denominator is the MAE of the naïve forecast. Ratios less than one indicate a forecasting model better than what would be expected from the naïve. In the case of the naïve forecast, the forecast estimates were unbiased based on the Mean Error (ME=0), but the Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) were .488 inches and .138 inches respectively, indicating significant forecast variability.

$$MMMMMMMM = \frac{1}{TT} \sum_{tt=1}^{TT} \frac{|ee_{tt}|}{\sum_{tt=2}^{TT} |YY_{tt} - YY_{tt-1}|/(TT-1)} \tag{1}$$

Table 1. Comparison of models on 30% test set

Model	ME	RMSE	MAE	MASE
Naïve	0.000	0.488	0.138	0.824
Seasonal Naïve	-0.001	0.553	0.167	1.000
ETS(ANN)	0.003	0.324	0.149	0.971
ARIMA(1,1,0)	0.008	0.331	0.165	1.080
Gamma Hurdle	-0.056	0.393	0.192	1.255
Stochastic Generator (Original)	0.003	0.521	0.164	1.072
Stochastic Generator (One-Period)	0.008	0.510	0.158	1.033
TS with Neural Net	0.007	0.378	0.135	0.809

Seasonal Naïve Model
A seasonal naïve model uses forecasts based on the previous season. With daily rather than monthly aggregated data, this type of forecast was not likely to help. A cursory investigation of a seasonal naïve model revealed that it was unbiased but had exceedingly high variability (RMSE=.553, MAE=.167).

ETS Model
An ETS model evaluates a seasonal time series as a function of three components: smoothed error, smoothed trend, smoothed seasonality. The model is explicated thoroughly in many textbooks, and that detail is avoided here. To evaluate ETS models, auto-optimization of parameter coefficients was conducted using the "forecasting" library in R (Hyndman, 2017). The suggested optimal parameters resulted in a simple, relatively unbiased (ME=.003), additive, simple exponential smoothing model: ETS(ANN), Equation 2. In equation 2, *Y* is the random variable representing the times series, and α is a smoothing constant applied to the previous observation with its complement applied to the previous forecast. The RMSE of .324 was lower than either of the naïve models, and the auto-optimized model performed better in comparison to the naïve (MASE=.971).

$$yý_{tt+1|tt} = \alpha\alpha yy_{tt} + (1 - \alpha\alpha)yý_{tt|tt-1} \tag{2}$$

ARIMA Model

An auto-optimized Auto-Regressive, Integrated, Moving Average (ARIMA) model (Hyndman, 2017) with investigation of seasonal components was unable to provide reasonable forecasts for daily rainfall when compared to a naïve model. An ARIMA model uses autoregressors, integrated (differenced) values, and moving averages and may include these components with or without seasonality and drift. Equation 3 illustrates a non-seasonal ARIMA model on an already differenced time series vector, *y'*. In this equation, *c* represents the drift constant, the $\phi\phi$ are the parameter estimates for the autoregressive terms for the differenced data, and the $\theta\theta$ are the coefficient estimates for the moving averages. The "auto.arima()" function in R suggested an unbiased ARIMA(1,1,0) with drift but no seasonal components, yet the model was slightly biased (ME=.008), had higher variability than the ETS (RMSE=.331, MAE=.165), and performed worse in comparison to the naïve (MASE=1.080).

$$ yy_{tt}^{'} = cc + \phi\phi_1 yy_{tt-1}^{'} + .. \phi\phi_{pp} yy_{tt-pp}^{'} + \theta\theta_1 ee_{tt-1} + \theta\theta_{qq} ee_{tt-qq} \tag{3} $$

Gamma Hurdle Model

A zero-inflated Gamma hurdle model was explored. The Gamma Hurdle model uses logistic regression to evaluate the condition of rain or no rain. Subsequently, the amount of rain conditioned on the fact that it rained is modeled using a general linear model with a gamma link function. Unfortunately, this two-stage model had poor predictive accuracy when compared with the naïve model (MASE=1.255), was slightly biased (ME=-.056), and had a relatively high MAE (.192).

Stochastic Rainfall Generator

In line with the work of Fulton et al. (2013) and Bassinger et al. (2010), a stochastic non-parametric rainfall generator was investigated to see if it might be reasonable enough to mimic the historical data stream reasonably while retaining variability. The probability of rain for any individual calendar day (365 days excluding February 29) was estimated as a Bernoulli trial based on the empirical proportion of days rain occurred based on the 71 years of historical daily data. The amount of rain for non-zero amounts was then estimated using the empirical distribution seen on that given day. This method of generating rain produced a slightly biased estimator (ME=.003) with an MAE of .164 and a high RMSE of .521 inches. The model did not perform better than the naïve (MASE=1.072 on the test set).

Updated Stochastic, Non-Parametric Rainfall Generator

In the previous model, centered moving averages were used to estimate rainfall on the 30% test set. With 71 years of daily data, value might exist in modeling the probability of rain and the distribution of the amount of rain without averaging over 30 days. This model sampled from the marginal probability of rain by day. Given that a day received rain, the distribution of rainfall amount for that day was sampled. The results were slightly improved from the original stochastic generator but were still worse than the naïve model (MASE=1.033).

Neural Network (NNETAR) Model

A final model for predicting model was built using time series components as well as a neural network. The model was implement using Hyndman's "nnetar" package in R (Hyndman, 2017). After some parameter tuning on the training set, the model that emerged was a 5- lag, model with 1 layer consisting of 12 hidden nodes, and two external regressors (Month and Day). The slightly biased results (ME=.007) were impressive in terms of MAE (.135) and

MASE (.809). This model outperformed all other models on the MAE and MASE metrics. Since the RMSE penalizes outliers (which exist in the dataset) much more heavily than the MAE, these were considered the most important statistics in evaluating a potential generator. For this reason, the neural network model served to generate forecast for our simulation.

Parameters, Variables, & Flowchart

The simulation begins with the initialization of Design of Experiments (DOE) parameters. For clarity, variables will be italicized, but parameters will be in regular type. Building size, tank holding capacity, roof capture area, and demand are important characteristics to evaluate when considering RWH systems. Table 2 provides the operational definition of these parameters along with the source and values investigated.

Table 2. Design of experiments parameters for the simulation

Parameter Name	Operational Definition	Values Investigated	Notes
BUILD	Building size, ft^2	{200K, 400K..2M}	Definition of Large Hospital (CBECS, 2012)
DEMAND	Water demand, gl / ft^2 / day.	{.04, .10, .15, .19}	For large hospitals, CBECS (2012) reports .19 gl / ft^2 / day.
ROOF	% building ft^2 used for RWH	{50%, 75%,..200%}	
CAP	Holding capacity, gl	{500K, 1M, 1.5M, 2M}	

The building size (BUILD) parameter is necessary to estimate the total daily demand of a facility. The mean daily water demand (DEMAND) parameter is based on the build size, and the proportion of capture area (ROOF) is as well. Capture area (ROOF) may include large, enclosed garages, outbuildings, and any area which has an appropriate roof structure and surface (either when built or after construction) that is not estimated as part of the hospital's building space. Further, free-standing collection areas might also be incorporated. It is impossible to translate building square footage into capture square footage, which is why various values of ROOF are investigated. Holding tank capacity (CAP) for large hospitals may include water-tower like structures, as installed in the Miami Veteran's Hospital (AKEA Inc., 2018), or smaller above or below-ground cisterns.

For the simulation, the balance equation details most of the variables of interest. This model is shown as Equation (4).

$$W_{tt} = \sum_{ii=0}^{ii=tt} MAMM\{0, W_{tt-1} + CC_{tt} - DD_{tt} - OO_{tt}\} \tag{4}$$

Here, V_t is the volume in the tank at time *t* measured in gallons. *C* is the "capture" or rainfall supply while *D* is the associated demand. *O* is the overflow. The volume at time *t* must be positive, semi-definite and is restricted as such by using the maximum operator. Not shown here is that capture of water is imperfect. *The Texas Manual on Rainwater Harvesting* (Texas

Water Development Board, 2015) suggests that capture efficiency (which is identified as *E*) is somewhere between .75 and .90. The simulation therefore uses a uniform distribution to model Equation 5, where S_t is the rainfall supply at time *t*. Table 3 provides a complete list of variables and the associated explanations.

$$CC_{tt} = MM_{tt} \times MM_{tt} \tag{5}$$

Table 3. Variables

Variable Name	Operational Definition	Type	Comments
V	Volume in the tank gallons	Quantitative	Equation 1
S	Daily rainfall inches	Quantitative	1. Historical data from NOAA (2018) & Rainfall Generator 2. Stochastic generator
E	Capture Efficiency $E_t \sim U(.75, .90)$	Quantitative	Derived from *Texas Manual on Rainwater Harvesting* (Texas Water Development Board, 2005)
C	Water captured gallons	Quantitative	Equation 2
D	Water demanded gallons	Quantitative	CBECS (2012) provided demand averages per square foot and associated Root Squared Errors. These were modeled as a Gaussian.
O	Overflow gallons	Quantitative	Calculated if $V_{t-1} + C_t - D_t > CAP$
X	Shortage gallons	Quantitative	Calculated if $V_{t-1} + C_t < D_t$
Empty	Empty Status Indicator	Qualitative	{0=not empty, 1 = empty}

The variable *D* was assumed to be from a Poisson process and therefore modeled as an exponential distribution with a mean of 1 / (DEMAND x BUILD). Because of the daily variability of demand and its strict truncation at zero, the exponential was a reasonable choice.

Figure 7 depicts the variables and parameters for each iteration of the simulation model in a flowchart. An important statistic for this simulation model was the proportion of external water demand offset that a specific design would have. Thus, the number of simulation iterations was set to ensure that the volume in the tank estimate was bracketed within 1000 gallons (margin of error, MOE). The maximum standard error for volume (*V*) across all DOE scenarios was 4,339 gl after a 26,055-day (71-year) run. Using this standard deviation, the MOE of 1000 gallons and α=.05, the estimate for the number of runs was calculated to be 10.

With 6 building sizes (BUILD), 4 capture proportions (ROOF), 4 holding tank capacities (CAP), 4 demand parameters (DEMAND), 365 days per year, 71 years, 10 iterations (sequence *i*), and 2 rainfall generators, the total number of individual daily observations was

6 x 4^3 x 365 x 71 x 10 x 2= 199,027,200 observations. Every day, 6 variables were tracked, yielding arrays of nearly 1.2 billion individual values.

Verification & Validation
To investigate validity, prior distributions were compared statistically and visually with posterior distributions. No significant differences were found. Posterior parameter values all matched the fixed values previously assigned, while the stochastic variables *D* (total daily demand) and *E* (efficiency of water capture) derived from the requisite distributions. The simulation was designed in R Statistical Software (R Development Core Team, 2016) using verbose commenting for debugging and the simulation flowchart (designed a priori) to reduce error. Random number seeds were used to ensure that differences in DOE replications were due to engineering design and not the selection of pseudo-random numbers. The results of the simulation runs were spot checked against direct calculations with no variability.
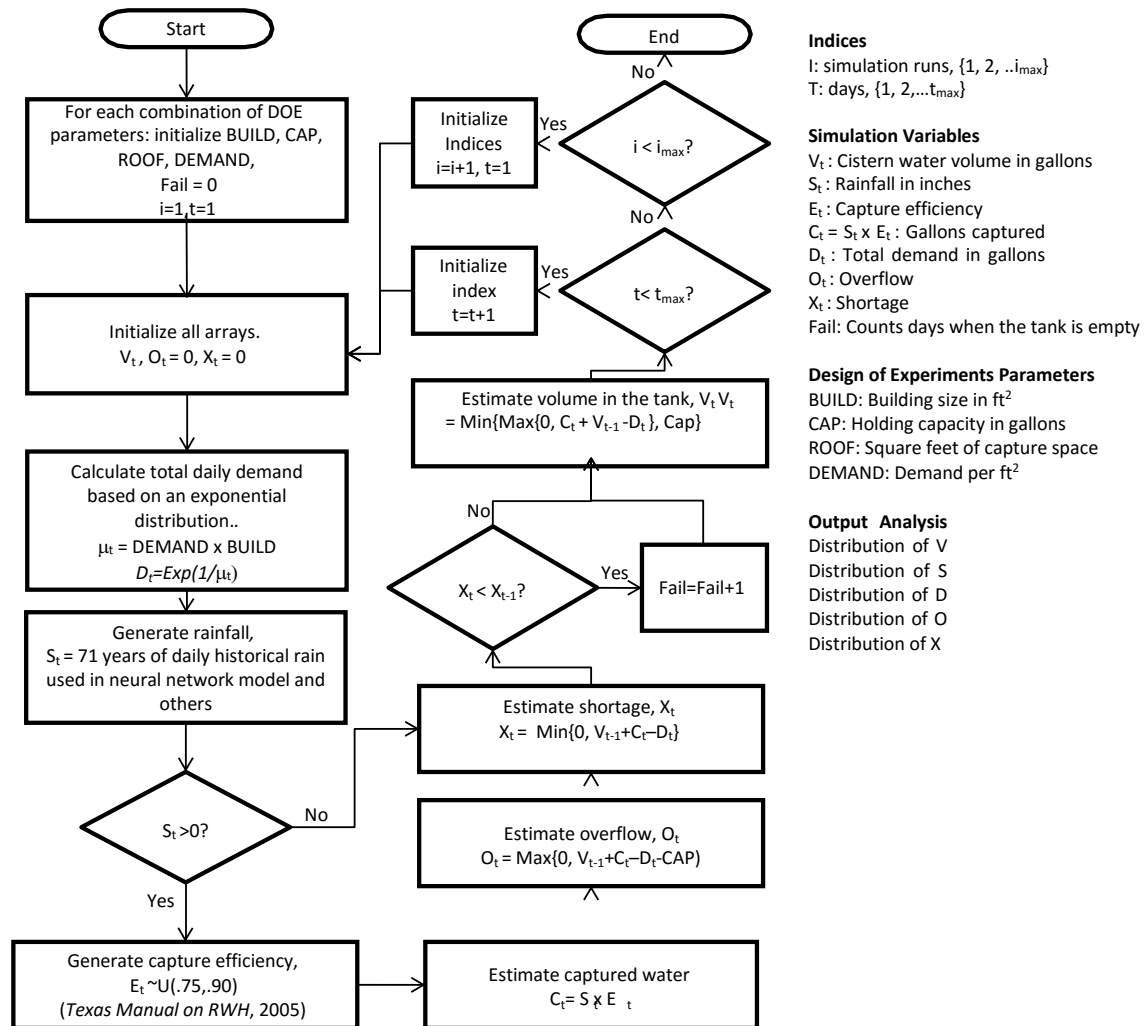

Figure 7. Flowchart for the simulation

Results

Descriptive Statistics
Table 4 shows the descriptive statistics for the rainfall in the geographic region of interest. The average daily rainfall for all days in the dataset was .084. For only those days where rain

occurred, the rainfall estimate was .380. Overall, 22.2% of the days experienced rainfall, although much of that was trace. As depicted previously, rainfall is seasonal.

Table 4. Descriptive statistics for rainfall.

	N	Mean	SD	Median	Min	Max
Daily Rainfall, All Days	26055	0.084	0.352	0.000	0.000	11.260
Daily Rainfall, Rainy Days	5781	0.380	0.669	0.120	0.010	11.260
Proportion Rained Overall	26055	0.222	0.416	0.000	0.000	1.000

Consumption data from CBECS (2012) suggests that large hospitals, on average, consume 67.7 gallons of water per square foot per year. That statistic changes by Census region; however, consumption can range from 55.1 gl / ft^2 in the Northeast to 76.0 gl / ft^2 in the Midwest. There were 3040 facilities from which these statistics were derived.

Simulation Results
The results of the simulation demonstrate the offset available for various choices of the DOE parameters based on the stochastic, non-parametric forecast. Some of the DOE parameters were chosen to estimate what engineering characteristics would be necessary to have a hospital 100% supported by rainwater. While these characteristics may not be feasible at this point, they inform future engineering.

Figure 8 maps the "reliability" proportion, the proportion of water a specific RWH design would provide a hospital based on the proportion of square footage used for RWH and the demand signal per square foot for the neural net rainwater data streams. The historical stream (omitted) is nearly identical. This graphic depicts averages over all other design of experiments factor levels. If demand is maintained at 55 gl / ft^2 (a slight reduction over the average demand of 67 gl / ft^2) and RWH is equivalent to the built space (100% including all capture surfaces such as garage structures, freestanding capture areas, etc.), a facility might reduce its water footprint by 29%. Using the historical data stream, this value is 26%.
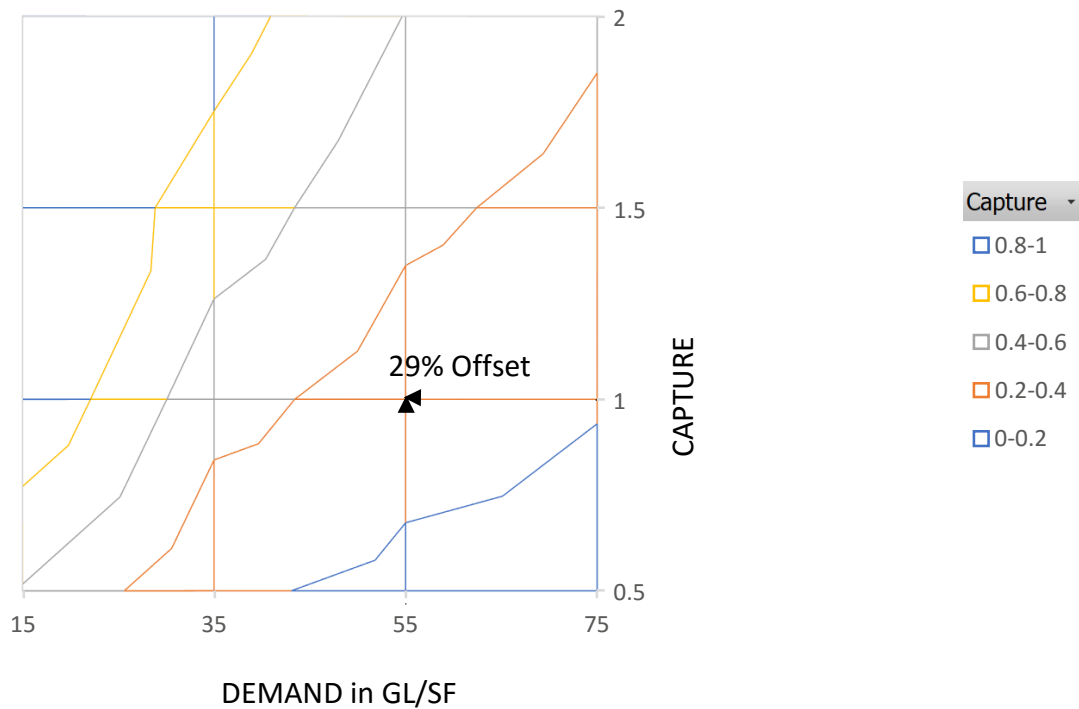
Figure 8. Plot of % external water provided versus the RWH capture proportion and demand

In the simulation DOE, no parameter sets resulted in 100% reliance on RWH using the neural net rainwater stream, and only two sets of parameters resulted in 100% reliance on RWH using the historical stream. Facilities of size 200K ft^2 and 2M gl holding tank capacity with 150% or 200% of the building area dedicated to RWH and associated demand of 15 gl / ft^2 (<1/4 of the average) were able to be fully self-reliant in this semi-arid environment.

Correlation among the design parameters and proportion of reliance on external water sources yielded an interesting finding. Demand was highly and positively correlated with proportion of reliance on external water sources (r=.803 historical, r=.770 neural net). RWH capture proportion was of second highest importance (r=-.400 historical, r=-.560 neural net). Building size (r=.257) and storage capacity (r=-.130) rounded out the parameter importance.

A simple multiple regression equation using only parameter terms, their squares, and their two-way interactions accounted for 98% of the variability in the average proportion of external water required using the historical data, $F_{14,369} = 1354.855$, $p < .001$, $R^2 = .983$. Using the neural net, the same model captured 95% of the variability, $F_{14,369} = 516.124$, $p < .001$, $R^2 = .950$. The value of converting the terms in the model to an equation is that this equation might be used to estimate external water reliance for this semi-arid region. Table 5 provides the standardized coefficients and associated p-values for the historical runs. Of particular interest is that demand reduction is of primary importance in reducing reliance on external water sources.

Table 5. Table of standardized regression coefficients for the DOE parameter fit

Parameter	β	Se	t	p
CAP	-0.328	0.038	-8.587	<.001
ROOF	-0.825	0.038	-21.605	<.001
DEMAND	2.027	0.034	58.796	<.001
BUILD	0.665	0.033	20.218	<.001
CAP x ROOF	0.201	0.038	5.265	<.001
CAP x DEMAND	0.431	0.038	11.293	<.001
CAP x BUILD	-1.248	0.034	-36.202	<.001
ROOF x DEMAND	-0.417	0.033	-12.662	<.001
ROOF x BUILD	-0.065	0.007	-9.711	<.001
DEMAND x BUILD	0.050	0.007	7.497	<.001
CAP^2	0.050	0.007	7.369	<.001
$ROOF^2$	-0.040	0.007	-5.972	<.001
$DEMAND^2$	0.017	0.007	2.559	0.011
$BUILD^2$	-0.089	0.007	-13.169	<.001

Discussion

In this study, demand and supply-side measures were investigated to reduce water consumption among the group of large commercial buildings consuming the most: large hospitals. While the study focused on a single semi-arid region, the methods are generalizable outside of this region.

Part of the analysis required some exploration of rainwater time series. For the region under investigation, no trend was observed; however, seasonality and volatility existed. After exploration of several methods, a neural network rainfall generator was selected.

The results of the simulation demonstrated achievable deductions of external water usage in the 20-30% range without much adjustment of demand behavior. Given the high water-usage of large hospitals, this savings might represents 18,000,000 to 27,000,000 gallons saved per year. Further, the use of RWH is more efficient than using groundwater, as the efficiency of system capture is 75-90% (versus absorption), RWH reduces runoff and non-point source pollution (Texas Water Development Board, 2005), and RWH reduce energy demands for water transport. The associate savings in kWh requires additional investigation.

Not surprisingly, reduction in demand through the adoption of low-flow plumbing, xeriscaping, and other conservation measures proxied as demand reduction proportions were seen to have the most significant effect on external water usage requirements post-installation of an RWH. For new facilities, rainwater capture, xeriscaping, and low-flow devices should be considered as part of the design process. Retrofitting older facilities with RWH may be more challenging depending on the design characteristics, but, the socially responsible solution is to reduce demand and increase internal collection via harvesting where possible. Even without an RWH, reduction in demand should be a sustainability priority in all hospitals, particularly in this semi-arid region. The culture of the organization must support sustainability, though, and this may be the hardest engineering problem to address.

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The Role of Lean in improving the flow efficiency: A Case Study of a Hospital Emergency Department

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ABSTRACT

This paper demonstrates that Lean Health Management increases patient flow efficiency during hospital improvement projects through case study findings. Findings iterate that Lean aids in sustaining shared stakeholder focus upon the concept of patient value during such initiatives. The result is improved efficiencies that serve overall patient flow.

In Oman, innovation in healthcare is encouraged in response to current challenges regarding necessary service expansion and patient quality needs, and government concerns relating to budget limitations, and the sustainability of public services.

The purpose of this research is to demonstrate our findings for improved efficiency, and to compare such with findings from the United Arab Emirates (UAE), where Lean was implemented in a similar context. In this study, the hospital emergency department of one public hospital in Oman was selected to pilot lean improvement projects. Quantitative data, and qualitative interview data was collected, before, during, and after the course of these projects, and analyzed. Published findings from a UAE hospital's emergency department are compared with our findings, and discussed.

Our findings suggest that successful implementations of lean health management significantly decrease patient wait times, moderately improve patient safety, and significantly improve patient satisfaction. Further, the empowerment of hospital staff to innovate and drive change within one hospital department lead to low-level diffusion of lean concepts to areas and departments elsewhere in the case-study hospital. We conclude that greater sustainability and diffusion of interdepartmental lean patient flow requires more publicized leadership commitment and management support, and greater employee involvement through education in lean tools and concepts, and higher levels of collaboration through participation in interdepartmental value-stream mapping sessions.

KEYWORDS: interdepartmental lean, lean health management, lean triage redesign, lean innovation, holistic lean health

INTRODUCTION

The Sultanate of Oman (Oman) and the United Arab Emirates (UAE) are both considered developing nations whose economies are heavily reliant upon the oil and gas sector to subsidize the cost of healthcare provision to their citizens (Al Farsi, et al., 2014; & Abuhejleh, et al., 2015). While increases in healthcare provision costs, and rises in patient expectations regarding the quality of care provided are nothing new globally when it comes to public health (Waring & Bishop 2010), for Oman and the UAE recent economic slowdown, coupled with unmet demand and quality requirements require innovation from healthcare providers (Abuhejleh, et al., 2015). Neither country has the economic resources to sustainably send patients to receive care outside of the country indefinitely, and thus public healthcare providers have begun to support the search for innovative practices at the front-line level of hospitals and clinics (Al Farsi, et al., 2014; & Abuhejleh, et al., 2015).

Innovation, as defined by Dulaimi, et al. (2005) is the creation, development, and implementation of ideas, new to the given organisation, that have practical or commercial benefit. Abuhejleh et al. (2015) accords that this definition also covers the adoption and implementation of tools or processes developed outside of the given organisation. Successful organisations in both public and private sectors often share the defining characteristic of being innovative, or quick to adapt and adopt innovations to improve their industry (Frederick, Lam, & Martin, 2014).

Lean Health Management, also known as the Toyota Production System (TPS), or more simply as *lean*, is one such innovative practice. Lean originated in the manufacturing sector, and over the last decade has increasingly been applied to various areas of hospitals, although holistic, system-wide lean applications in healthcare do not exist as exampled in manufacturing (Young & McClean, 2008). Lean, when applied to the healthcare setting is best described as a process improvement strategy consisting of a set of tools at the operational level, having a set of strategic guiding principles which provide some standards for processes, serving the creation of flow, and decreasing interruptions and potential for errors (Al Balushi, et al., 2014).

The principal of value production for lean in health is customer (patient) based care. This is firstly, the patient's improved health, and secondly, the patient's increased satisfaction. In the lean methodology, all value is created from a process made up of work, or work-functions carried out that form a process (Womack, & Miller, 2005). For any work, work-function, or process to be valuable, it must transform or enhance the service or result in some way, it must be done correctly the first time, and the patient must require it (Womack, & Miller, 2005). If work, a work-function, or a process does not contribute to value generation, then it is termed a waste, and the process or work should be re-designed so that the waste is removed from the patient journey altogether (Womack, & Miller, 2005).

Lean in health requires understanding and use of lean tools in order to empower and involve integral front-line hospital and clinic staff, in order to innovate bottom-up continuous improvement efforts (Ben-Tovim, et al., 2007; Kelly, et al., 2007; Ben-Tovim, et al., 2008; Leraci, et al., 2008; & Schooley, 2008). The generation of value to serve the correct attribution, serves as the foundation for continuous improvement. Dickson et al. (2009) state that healthcare front line staff "have 2 jobs: taking care of patients and finding better ways to take care of patients by constantly improving quality and flow" . Focus on utilizing a department or section's assets (equipment,

clinicians, etc.) is the traditional route taken by hospital management when attempting to improve outcomes and efficiencies (Womack, & Miller, 2005). Lean health management instead focuses upon a department, hospital, or health system's value-creating processes to innovate the most efficient streams of patient flow, making resource flow a secondary focus in how it affects the overall patient journey towards the defined process for their healthcare requirements (Womack, & Miller, 2005).

When introducing the topic of innovation through the implementation of lean to public hospitals and clinics in Gulf Cooperative Council (GCC) region, it is useful to do so from an operation's management perspective. The literature will first review the application of lean health management in Emergency Departments in North America, Australia, the United Kingdom (U.K), and Australia in order to discuss the processes of triage, patient admission, and treatment in lean terms. Using these terms, we will explore the GCC context using the findings of a case study from UAE, before listing the methodology for our own case-study. Following, our findings will be discussed, comparisons drawn, research limitations and implications provided, and our conclusion made.

LITERATURE REVIEW

Emergency Departments, like public healthcare organizations and providers in general, are challenged by high patient expectations regarding the timeliness, quality, and safety of provided care, increased demand (overcrowding), and limited capacity due funding limitations affecting facilities, equipment, and staffing and education/experience levels of the available staff (Derlet & Richards, 2000; Yoon, Steiner, & Reinhardt, 2003; & Hoot & Aronsky, 2008).

More than half (60%) of the American hospitals that have reported implementing lean health management in their hospitals report that they have done so in their emergency departments (American Society for Quality, 2009). While traditional lean used in manufacturing has been criticized for not being conducive to improved flow efficiency in environments with uncontrolled or unpredictable demand levels, such as hospital emergency departments, the literature on lean in health care suggests that the applications of lean in emergency departments is a growing trend despite (King, Ben-Tovim, & Bassham, 2006; Bush, 2007; Poksinka, 2010; & Brännmark, Lindskog, & Halvarsson, 2012).

In fact, regarding the previous, there is research to suggest that when lean principals are applied to triage redesign in emergency departments, times for first contact of a patient with a physician or senior clinicians are significantly improved (Trägårdh, & Lindberg, 2004; Kelly, et al., 2007; Leraci, et al., 2008; Dickson, Singh, Cheung, Wyatt, & Nugent, 2009; Burström, Nordberg, Örnung, et al., 2010;Mazzocato, et al., 2010; Jimmerson, 2010; & Holden, 2011).

The suggestion is that those times may decrease the overall patient stay time in the emergency department and the hospital itself, and may positively impact patient safety and experience (Kelly, et al., 2007; Leraci, et al., 2008; Dickson, Anguelov, Vetterick, et al, 2009; & Burström, Nordberg, Örnung, et al., 2010;). This suggestion is due the literature that evidences how safety and quality of overall patient care are negatively impacted when high demand levels are met with unmatched capacity levels in emergency departments (Trzeciak & Rivers, 2003; Cowan, & Trzeciak, 2004;

Steele, & Kiss, 2008; Bakarman, & Njaifan, 2014). Also, low levels for patient satisfaction are evidenced to be impacted or due long wait times in hospital emergency departments (Bruce, Bowman, & Brown, 1998; Trout, Magnusson, & Hedges, 2000; Bourdreaux, & O'Hea, 2004; Taylor, & Benger, 2004; & Alrashdi, 2012). Further, there is evidence to suggest that negative patient experience due overly long wait times is an influencing factor on patients' decisions to leave without treatment or against medical advice, or to return later for the same complaint (Kane, Maciejewski, & Finch, 1997; Rowe, Channan, Bullard, et al., 2006; Bernstein, et al., 2009; & Kuan, & Mahadevan, 2009).

The majority of lean health literature focusing on the emergency department from outside the GCC and Middle East and North Africa (MENA) regions predominately purpose lean to improve patient flow through decreasing patient wait times from registration or initial triage consultation, to the time of being seen by a physician/senior clinician and/or being admitted for care into the emergency department (Kelly, et al., 2007; Leraci, et al., 2008; Dickson, et al, 2009; Burström, et al., 2010; & Holden, 2011). Some patient flow is further streamlined for improved efficiency based on lean improvement projects that categorize and track admitted patients by condition types, such as cardiac (heart-case) patients (Kelly, et al., 2007; Leraci, et al., 2008; & Abuhejleh, et al., 2015).

Other common lean improvement projects for emergency departments are based on equipment or information flow, such as medical supplies stocks in pharmacies or on-site medical stores, or information flow, such as laboratory test results, in order to aid areas of identified waste otherwise holding up or causing delays in overall patient flow (Dickson, et al, 2009; Holden, 2011, & Abuhejleh, et al., 2015).

In the context of the GCC, both types of lean improvement projects have been evidenced in major public-hospital emergency departments. In Abuhejleh, et al.'s (2015) study carried out in Abu Dhabi, UAE, lean improvement projects aimed to improve specifically the patient flow of cardiac-case-type patients (those suffering from the condition of myocardial infarction with elevated ST-segment), and to improve the efficiency of their emergency department's outpatient pharmacy. Concerning the patient flow for the defined patient group, time goals were established, and processes were changed to reduce the duration of each step in the process (Abuhejleh, et al., 2015). Following, outcomes were tracked, and results were shared with care providers (Abuhejleh, et al., 2015). With the pharmacy "kaizen" project, as Abuhejleh, et al. (2015) term it, root-cause analysis was initially used to determine key wastes, which resulted in physical changes in space and lay-out to make the pharmacy space less confusing to patients, and more efficient for pharmacists. A Plan-Do-Check-Act cycle was adopted, and eventually, beyond impacting equipment flow efficiency, this also caused changes in the patient flow process overall (Abuhejleh, et al., 2015).

In our study, which took place in the emergency department of a major tertiary care public teaching hospital in the capital region of Muscat, Oman, over a three year period, patient flow was targeted for improvement, as well as equipment flow in terms of organizing the department's medical equipment, and medical stores. With patient flow, we focused on improving overall patient flow

through the department, with patients being categorized with set ideal flow times based on triage-case types, rather than following specific condition-types. The priority was improving patient times from entering the emergency department, to being seen by a physician, and from being seen by the physician, to be being classified as stabilized in condition, to exiting the department. In relation to that priority, it was found necessary to improve equipment flow, in order to improve times for admitted patients.

METHODOLOGY
The hospital documented in this study is a public tertiary care teaching hospital. It has a 679 inpatient and ambulatory bed capacity, having had an occupancy rate of 74.9% in 2013. It is managed by 2, 775 employees: 440 doctors, 1196 nurses, 512 technical staff, 347 administrative staff, and 280 support staff.

The hospital provides all types of patient care, which include primary, secondary, tertiary, and in a few specialties, quaternary clinical care. Patients present to various out-patient-department clinics and the emergency department at the selected hospital for both primary and tertiary care. Statistics taken over a five year period reveal an increase in patient demand on the hospital clinical services classified per department or clinic, and in year 2012 the hospital's emergency department presents a 24% increase from 2007, which suggest a heavy load of patient activities in the emergency department in particular.

This section of the paper documents our rationale for studying patient flow through the emergency department and study-type, study design, length of the study, the type of data collection, and methods for analysis of data.

This study, as it was conducted, is a qualitative, pre- and post- lean design study, employing mixed methods for both data collection and analysis of the derived data provided for in the results section of this paper. During the study of the emergency department triage process and structure redesign, lean was the single paradigm for improvement.

Site visits were carried out by the research team prior to lean introduction that consisted of quantitative data collection of times for all steps consisting in the observed processes of patients entering the emergency department, registering, waiting, being seen by doctors or nurses, tests and labs being run, and being treated, to exiting or being transferred from the department. This data was collected along with the observations and impressions of the researchers regarding the emergency department. On one of the site visits, there was no data collection, but impressions and observations of the emergency department's staff were informally elicited and documented.

Following, key stakeholders from the emergency department were identified and invited to attend a two day workshop to introduce them to lean principles and train them how to use lean tools, such

as current and ideal-state process and value-stream mapping (Jimmerson, 2010; & Graban, 2011). Pre-site visits provided examples and material references of lean concepts that related exactly to the front-line work of the emergency department. The workshop was designed based on the literature on lean, lean health, and health change management to train integral persons in lean tools and lean project design for healthcare, and had the objective of the workshop attendees themselves providing direction for the pilot based on their own knowledge of their work.

After the work shop, emergency department staff was asked to categorize the process boxes for our pre-lean data, in order to create value-stream maps that would be useful for their lean improvement projects.

Pre-lean data collection consisted of 30 cases observed from entering the emergency department doors, until exiting the department, either through transfer, referral, discharge, without receiving treatment (WRT) or left against medical advice (LAMA). This data was collected randomly during the month of December 2014, from 8 am until 2pm Saturday through Thursday, and Friday to Saturday at 7pm-1am.

The following efficiency indicators were documented: total length of stay, time from entering the emergency department until registration completed, time from registration to vitals being taken, time from vitals to treatment commencement or patient being seen by physician, time from seen by physician to being admitted or treated and discharged/transferred/referred, time for running tests (such as radiology, and blood work), time consultation request made until consultation occurs, and time of disposition decision until transfer or discharge. Gender, age, and triage category of the patient were noted.

According to lean principles the current-state patient flow process was physically mapped from the above data using the following categorizations: total patient flow, by triage category, and by similar process-flow (such as internal medicine cases, or cardiac cases grouped together, or treatment-and-discharge-but-not-admitted cases grouped together, regardless of triage category). From the current-state process maps, value-quotients could be made. Clinically it was determined by the emergency department staff that the most useful current-state maps were those categorized by similar process flow, although triage categories could indicate overall performance and help design ideal-state maps, and total patient flow was of use to senior executives towards understanding the emergency department's output and demand and capacity levels (throughput).

Value-quotient calculations required every minute of the observed patient's stay in the emergency department to be accounted for and were categorized and calculated by classifying the recorded efficiency indicators by the following: waste, value, or required (thus of value). After compilation of the initial data and completion of the first value-stream maps of the current-state patient flow,

the emergency department initiated a trial redesign of their triage-team and structure based on lean principles.

Previously the triage in emergency department consisted of the registration process, and then the patient moving or waiting for one of two exam rooms for a nurse first/junior physician triage model. The triage model was changed to a predominately nurse first/emergency physician second model, with the occasional physician-led team triage whenever available, and a senior emergency nurse to direct patients to the triage team after registration.

Beyond procedure changes integral to a patient-value-based healthcare, physical changes were made to the Emergency department, with construction of a new entrance for the ambulance bay, and a new location for patient registration. Better signage was introduced, to guide patients, and signage was also implemented to aid doctors and nurses regarding the storage of medical equipment.

An extensive application the 5s lean tool was applied, and the entire medical store system was redesigned and reorganized, leaving the way for a future bar-coding system to take all major re-stocking and ordering responsibility away from nurses. An equipment use survey was undertaken and medical equipment was then assigned a place for storage near to where it was most urgently required or most commonly used. Any equipment found to be inessential or not-in-use was removed from the department. Lettered labels, wherever possible, were placed with pictures, to make identification faster for department staff, and those visiting the department, like nurses-in-training, or consultant doctors.

Following, post-lean data collection consisted of 49 cases observed from entering the emergency department doors, until exiting the department, either through transfer, referral, discharge, left without receiving treatment (LWRT) or left against medical advice (LAMA). This data was collected randomly during the month of July 2014, from 8 am until 5pm Saturday through Thursday, although occasionally two shifts of researchers tracked patients whose stays ranged 24-46 hours, staying through the night on two occasions.

The same efficiency indicators were documented. Gender, age, and triage category of the patient were noted, along with the computerized data entered by emergency department clinicians on the hospital's information system (which was found to differ somewhat from physical observations).

Again, the current-state patient flow process was physically mapped from the post-lean triage redesign data using the categorizations of total patient flow, by triage category, and by similar process-flow. Value-quotient calculations were likewise made. Pre and post lean data was collected and merged into a database using excel, and value quotient calculations along with efficiency indicators were compared.

FINDINGS/RESULTS

From the data value-quotient calculations did provide waste identification and measurements (in minutes) for flows, such as information, medicines, equipment, supplies, patients, and care providers.

Pre-lean triage team and structure re-design, from the time the patient walked in through the emergency department doors, until the time their vitals were taken, was an average of 6.0 minutes, and time to physician consult from patient entering the emergency department, an average of 69.5 minutes (if at all, some cases were seen solely by a senior nurse if they were not categorized as urgent or emergent upon arrival). The lowest time from entering emergency department until being seen by physician in our pre-lean data set was 6.0 minutes (emergent case of amputated trauma).The high in our pre-lean data set, from entering the emergency department until seen by physician was 269.0 minutes. Again, some cases, not classified by the senior triage nurse as emergent or urgent, were never seen by the physician, in the pre-lean data set. This understandably led to some level of patient dissatisfaction, and increased chances of verbal and physical violence in the workplace for the medical staff.

Post-lean triage team and structure re-design, from the time the patient walked in through the emergency department doors, until the time their vitals were taken (and life-saving measures began, only relevant in emergent cases), was an average of 2 minutes, and total time from entering the emergency department to physician consult was an average of 16.9 minutes for urgent, less-urgent, and non-urgent cases, who form the majority of the patients visiting the emergency department. Thus there was an increase in patient satisfaction, and a decrease in patient and patient attendant hostility towards medical staff.

The average time from entering the emergency department until seen by physician for emergent category and resuscitation-required category cases remained constant between pre and post lean data, which is reassuring, that the new triage redesign has not affected emergency responsiveness, and yet is flexible enough to accommodate greater variety in a shorter amount of time. The high in our post-lean data set for urgent, less urgent, and non-urgent cases was 167.0 minutes, which is still 102.0 minutes faster than any case in our pre-lean data set, and in this data set, no case, no matter the category, was not see by a physician.

The lows from our urgent, less-urgent, and non-urgent category post-lean data set also indicate a decrease in time from the pre-lean data set, from pre-lean 6.0 minutes, to post-lean 1.5 minutes, a decrease of 4.5 minutes.

After admission, improvements in equipment flow, such as reducing the loss of doctor's orders on clipboards, or organizing the ultra-sound machine to be easy to find when not in use, cut down significantly on the wastes that occur to patients of similar conditions, such as victims of falls. One patient in the pre-lean data set suffered waiting almost 48.00 minutes longer than a patient in the same condition on the post-lean data set, due to disorganization, and staff not being able to find the equipment required in a timely manner. Also, due to shorter times in the triage, and better signage overall, there was less doctor interruption inside the admitted patient area of the department.

While the Muscat emergency department case study did not specifically look at streaming patients based on condition, as was done in Abu Dhabi we can still compare findings based on overall improvement times. When it came to patient-flow efficiency in Abu Dhabi after using lean in hospital improvement projects, Abuhejleh, et al. (2015) publish sustainable time improvements of 58-98 percent, with a 41.0m-54.m less wait time in the outpatient pharmacy after equipment and lay-out organization. Similarly, in our case study in Muscat we witness 48.0m-60.0m less wait times in the admitted patient areas of the department after the application of 5s and changes in lay-out, whereas our patient flow times improve by an average of 52.6m less in wait times, to improvements in highs of 102.0m, and improvements in lows of 4.5m.

Further, overall reductions of triage categorization and time-to-physician consult wait times impacted the time of patient admission/commencement of treatment in the emergency department triage bay rooms by reducing wait times for emergent and urgent category patients by an average of 48 percent (this especially impacted simple treatment procedures such as the setting of broken bones, the wrapping of wound dressings, and some sickle cell patients that would otherwise occupy beds). Patients in less-urgent categories, who, in the pre-lean data set, were seen by the senior triage nurse rather than a physician, were reduced in terms of the percentage of referrals related to basic care given by physicians in the post-lean data set, which could be explored in future studies, as to how that affects overall patient flow efficiency in the entire hospital, although that goes beyond the scope of this paper.

When comparing findings from Muscat and Abu Dhabi it can be concluded that the lean methodology, when applied to health care, does aid in significant improvements to departmental, and cross-departmental project specific operations, even in departments where demand is unpredictable. However, in order to implement lean in an inter-departmental hospital-wide manner would require more publicized leadership commitment and management support, and greater employee involvement through education in lean tools and concepts. In our observations it was noted that visiting consultants to the emergency department did adopt lean in their own departments to a relative degree, such as obstetrics and gynaecology, and in administrative quarters, some attempting process-mapping in terms of information flow. However, in order to sustain and engender higher levels of interdepartmental lean requires more publicized leadership commitment and management support, and greater employee involvement through education in lean tools and concepts, and higher levels of collaboration through participation in

interdepartmental value-stream mapping sessions, with support in the initial phases to keep projects patient-vale centric, and to avoid bottle-necks attributable to resource-flow that is not equated to patient flow.

Conclusion

This study concludes with relative ease that a physician-led team triage is the best structure for creating value from the patient perspective, which we know, is not a conclusion unique to an operations management perspective, but is a conclusion long ago reached by those in the field of emergency medicine.

However, of interest to those whose profession *is* medicine, are our shared findings from Oman. These findings, similar to those already available from UAE, iterate that the GCC context is conducive to successful implementations of the lean methodology, not unique, one-off experiences, but producing genuine, comparable results of significance. This study determines through our findings, and through comparison with Abuhejleh, et al's (2015) findings, that the lean methodology in the form of principals enacted through lean tools, especially the understanding and rearrangement of processes to be patient-value centric, does increase patient flow efficiency significantly in hospital improvement projects.

Implementation of lean in Oman and the UAE is at a relatively early stage, but both Abuhejleh, et al. (2015) and the authors of this study argue that hospital-wide lean and interdepartmental lean patient flow efficiency is possible, provided leadership support for such is visible, and sustained. Support for lean at the hospital-wide level does entail for education on lean tools and principals, and freeing up staff to educate themselves in such. Further, in order for interdepartmental lean patient flow initiatives to be balanced in patient flow without creating bottlenecks of patients, processes overlapping need to be mapped by both departments, and going beyond the departments, the clinics. These need to be jointly involved in the problem-solving that occurs after value-stream mapping the data, and attributing the process boxes, and wastes accurately.

Finally, in the GCC context, and drawing on examples from Europe, the U.K., Australia, the U.S, and Canada, the high volumes and high fluctuation of demand in the emergency department does in no way mitigate the significant positive impact lean implementations can have on patient wait times and upon patient flow efficiency through emergency departments.

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HOW TO FRAME GREEN MESSAGE?

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ABSTRACT

Green product attributes had been strengthened by the academicians and practitioners recently. However, the products with green attributes are always treated inferior quality than its original product. Relatively little is known about how to frame green attribute message in which affects consumers' attitude toward. As a result, there present a big challenge for the persuasiveness of green attribute message. Therefore, this study attempts to examine the difference of persuasiveness between single green attribute message and double message (green attribute message plus product functional performance), and the effect of double message's sequence. Two 2×2 experimental between-subjects designs were utilized to test the hypotheses. The results of two studies indicate that in contexts where consumers experience double messages they are more responsive to green brand attitude than exposed in single green attribute messages. Then, placing a green attribute appeal in front of a product performance message can also create a relatively high green brand attitude. However, the above effects have significant differences when the green attribute of the product is the centrality attribute. Finally, this study also put forward the meaning of management and practice.

Key Words: double message, message order, green attribute

INTRODUCTION

Eco-friendliness has gained widespread public attention under the ongoing global trend of environmental protection. In response to this trend, numerous branded companies have introduced green products and added green attributes to their existing products or replaced conventional elements with green elements in the products to establish green markets and enhance consumer brand attitude, thereby

incorporating this environmental-friendly action into their competition strategy and corporate social responsibility practices (Orsato 2006; Woolverton & Dimitri 2010). To keep up with the trend of the times, many consumers verbally support green products, although the actual proportion of green products purchased remains produces the "green negative effect" or sustainability liability (Luchs, Naylor, Irwin, & Raghunathan 2010). This constituted the rationale for this study.

Indeed, there has been a significant amount of research conducted into understanding the factors that influence a consumer's attitude toward green product. Beside green products (Chang 2011; Gershoff & Frels 2015; Luchs et al. 2010; Newman, Gorlin, & Dhar 2014), green consumers' characteristics (Kareklas, Carlson, & Muehling 2012; Lu, Chang, & Chang 2015; White & Simpson 2013), and corporate environmental strategies (Berrone, Fosfuri, Gelabert, & Gomez-Mejia 2013; Chen & Chang 2013; Olson 2013[b]), some scholars have called for more research focus on the impact of green marketing communications on consumers' attitude and purchase behavior(e.g. D'souza & Taghian 2005; Grimmer & Woolley 2014; Leonidou & Leonidou 2011; Maignan & Ferrell 2004). Although recently green advertising has received more research's attention (e.g. Green & Peloza 2014; Grimmer & Woolley 2014; Matthes & Wonneberger 2014; Matthes, Wonneberger, & Schmuck 2014; Segev, Fernandes, & Hong 2016), however, they have failed to clarify the green gap and green negative effect. In other words, we still hadn't carry consensus for how green product attributes can be communicated in a right shape that can appeal successfully to consumers and what affects the persuasiveness of green ads.

Further, we found that previous studies on green advertising have mostly used a single green message as their appeal, and consumers generally have an unfavorable opinion about the quality of green products. Matthes & Wonneberger (2014) maintained that advertisements should contain practical information to facilitate consumers' rational judgment, thereby alleviating their concerns about green products. Therefore, the first research question in this study was whether using a double message of green product attributes and product performance in a green ad can enhance attitudes toward green bands, compared with the single green message. Next, under such double message, the problem of the order of the message occurs, and the order of placement of the green message formed the second research question. In addition, the attributes of green product affect consumer evaluation of the greenness of the products (Gershoff & Frels 2015). Green attributes can be central or peripheral, and whether such distinct green attributes mediate between double and single messages was the third research question. The fourth research question was whether green attributes mediate the order effect of double messages.

Therefore, this study introduced double message (green attribute message plus product functional performance), and examined the factors affecting the communication of green- attributes, including the content of the message, the order of the double message, the green attributes, to bridge the research gaps in green product

attributes and to provide reference for green marketing practices.

LITERATURE REVIEW

Green Advertising Appeals

Green advertising, which is one of the approaches used by branded companies to communicate with consumers, refers to an appeal that attempts to satisfy consumers' concerns for the environment and health-related issues (Zinkhan & Carlson 1995). Banerjee, Gulas, & Iyer (1995) proposed that green advertising must meet at least one of the three following criteria: 1) explicitly or implicitly mentioning the relationship between the product or service and the environment; 2) emphasizing that this product or service promotes a green lifestyle; and 3) conveying an environmentally responsible corporate image. Iyer & Banerjee (1993) analyzed 173 print advertisements and reported that green advertising should at least contain information on Earth protection, personal health, or animal conservation. Previous studies have found that consumers' concerns about green advertising appeals include greenwashing (Carlson, Grove, & Kangun 1993), deceptive or fraudulent statements (Segev et al. 2016), agendas (Fowler III & Close 2012), information practicality (Matthes et al. 2014), eco-labels (Atkinson & Rosenthal 2014), and source reliability (Atkinson & Rosenthal 2014; Phau & Ong 2007).

Some scholars have classified green advertising appeals. For example, Carlson et al. (1993) classified green advertising appeals into five types: product orientation, process orientation, image orientation, environmental fact, and combination. Montoro Rios, Luque Martinez, Fuentes Moreno, & Cañadas Soriano (2006) defined green appeals with environmental attributes as product-oriented (environmentally friendly elements/components) and non-product-oriented (potentially recyclable packaging). White & Simpson (2013) explored the circumstances under which injunctive, descriptive, and self-benefit green appeals are the most effective. Fowler III & Close (2012) analyzed advertising campaigns at macro (nonprofit advocacy, such as protecting the Earth), meso (promotion of for-profit brands or products), and micro (green actions that can be adopted through consumer motivation) levels.

Some studies have focused on the framework of green advertising. For example, Grimmer & Woolley (2014) investigated the impact of advertisement types on consumers' purchase intention and designed three distinct types of advertisements: (1) the first advertisement was a typical product advertisement without promoting environmental benefits; (2) the second advertisement promoted benefits at the

Individual level associated environmentally friendly actions; (3) and the third advertisement advocated the environmental benefits associated with environmentally friendly actions. Tucker, Rifon, Lee, & Reece (2012) compared the use of three advertising appeals: (1) strong green product appeal; (2) weak green product appeal; and (3) cause-related marketing appeal (or non-product-related appeal). Schuhwerk & Lefkoff-Hagius (1995) compared two product appeals, one emphasizing environmental attributes and the other promoting cost-saving attributes.

Some studies have focused on the content of green advertising appeals, such as those that compare environmental protection and personal health (Kareklas et al. 2012), whereas others have explored advertising language, such as injunctive, descriptive, and self-benefit appeals (White & Simpson 2013). Moreover, Kronrod, Grinstein, & Wathieu (2012) discussed the rationale behind the typical use of assertive language by environmental appeals. Recently, scholars have also explored environmental threat appeals (Hartmann, Apaolaza, D'Souza, Barrutia, & Echebarria 2014), appeals that imply self-accountability (Peloza, White, & Shang 2013), and non-product-related appeals such as situational impacts (Bodur, Duval, & Grohmann 2015; Green & Peloza 2014; Peloza et al. 2013). Segev et al. (2016) conducted a meta-analysis of the development of green advertising in the past 20 years, reporting high consumer acceptance of green advertising. Carlson et al. (1993) found that the proportion of consumers who believe that green advertising appeals are misleading/fraudulent has declined. However, a 2016 study showed that false information in advertising is mostly product-oriented (Segev et al. 2016).

Green Product Attributes

The term "green" indicates a concern for environmental protection and a noninvasive lifestyle (Iyer & Banerjee 1993), and green products are products designed with recyclable, nontoxic, or decomposable raw materials, or those that use fewer natural resources during production; thus, they cause less harm to the environment (Durif, Boivin, & Julien 2010; Janssen & Jager 2002). Green attributes refer to the attributes given to products or objects whose components or parts are defined as green; for example, packaging materials that are biodegradable and computer sound cards manufactured with less environmental pollution are considered to exhibit such attributes (Luchs et al. 2010; Mackoy, Calantone, & Droge 1995). Araque-Padilla, Montero-Simó, Rivera-Torres, & Aragón-Gutiérrez (2015) stated that products with ethical and moral attributes have explicit social and environmental characteristics.

However, numerous studies on green attributes have suggested unfavorable consumer opinion about the performance of green products (Chang 2011; Lin & Chang

2012; Luchs et al. 2010). Such an impression may be because from the perspective of resource allocation, consumers believe that when developing green products, companies divert resources away from product quality (Newman et al. 2014), or consumers may choose less green alternatives after attribute tradeoff (Olson 2013[a]). In addition, consumers intuitively believe that compared with conventional products, eco-friendly products with ethical attributes have inferior performance, a belief that is even extended to their usage behaviors after purchasing the green products (Lin & Chang 2012). Therefore, to alleviate consumers' concerns about the performance of green products, numerous studies have suggested that marketing managers should strengthen the labels of green products beyond the green appeal by including messages about product performance (Lin & Chang 2012; Luchs et al. 2010). Studies have verified that the quality and valence of a message framework affect performance (e.g., Arceneaux 2012; Liu 2006; Mizerski 1982).

Product attributes are generally divided into central and peripheral attributes. According to theories of attribute centrality, a product attribute refers to the indispensability of a specific attribute to an object; that is, the attribute is a crucial feature of the entire product (Sloman, Love, & Ahn 1998). Hampton, Passanisi, & Jönsson (2011) used Brazilian doves as an example and compared the features of "feathered" and "white," showing that in the view of their respondents, "feathered" possesses greater centrality than "white". Gershoff & Frels (2015) found that respondents' perception of the attributes of a green product is related to the importance of the green components of the product. Therefore, a central or peripheral green attribute affects consumers' initial evaluation of the overall greenness of products such as computers.

Other Green-related Topics

In addition to the aforementioned green advertising, green studies have investigated green products, the impact of consumer characteristics, and corporate environmental strategies. Green product studies have demonstrated that because consumers generally perceive green products to be of high price and low quality (Chang 2011; Luchs et al. 2010), they experience a dilemma between being environmentally responsible and satisfying their personal goals (Meneses & Palacio 2007; Wiener & Doescher 1991). Such dilemma is mostly related to the feature/attribute tradeoffs of green products, such as the tradeoff between the green attributes and conventional attributes of the products (Olson 2013[a]) and the tradeoff between whether categorizing green attributes as centrality or peripheral attributes (Gershoff & Frels 2015). The dilemma also involves consumers' impression that the performance of green products is inferior; this impression may be because the consumer belief that when developing green products,

companies divert resources away from product quality to the design of green attributes (Newman et al. 2014).

Studies on green consumers mainly focused on the consumers' characteristics, including individualism versus collectivism (Laroche, Bergeron, & Barbaro-Forleo 2001; Lu et al. 2015; White & Simpson 2013), ethnicity (Yang, Jiménez, & Yowei 2015), and moral consciousness (D'souza & Taghian 2005; Lu et al. 2015). Motivation is another focus of these studies; for example, they have discussed promotion and prevention regulatory focuses (Chung-Chau & Yu-Jen 2008; Kareklas et al. 2012; Ku, Kuo, Wu, & Wu 2012), the motivation to prepare a shopping bag (Karmarkar & Bollinger 2015), self-construal (Kareklas et al. 2012), and environmental sentiments (Grimmer & Woolley 2014; Matthes & Wonneberger 2014; Tucker et al. 2012). Some studies have explored the negative emotions induced by green appeals—such as discomfort, uncertainty (Chang 2011), doubt (Matthes & Wonneberger 2014; Newman et al. 2014), and neutral perceived consumer effectiveness (Tucker et al. 2012).

Studies on corporate environmental strategies have discussed the factors determining the performance of green products and the decisive factors in green creativity, such as green productivity, green leadership, and green creativity (Chen & Chang 2013). Scholars have also analyzed green innovation in the view of different stakeholders (manufacturers, distributors, consumers, the environment, and the government) (Olson 2013[b]), as well as the factors in green innovation at the organizational level, such as institutional pressure from environmental norms and regulations (Berrone et al. 2013). For many branded companies, the introduction of green products represents the commencement of their green practices, although there remains a wide green gap between consumers' high environmental concerns and their purchase of green products (Bonini & Oppenheim 2008; Diamantopoulos, Schlegelmilch, Sinkovics, & Bohlen 2003; Öberseder, Schlegelmilch, & Gruber 2011; Pickett-Baker & Ozaki 2008).

Order Effect of Message Presentation

People's decisions are related to their sensitivity to the order in which messages presented. Hogarth & Einhorn (1992) conducted literature review to propose the concept of the order effect. The order effect results from the interaction between information processing approaches and task characteristics; it can be divided into primary effect and recency effect. Previous studies have demonstrated that consumers adopt different processing approaches depending on the order of message presentation (Asch 1946).

The order effect is related to the memory impressions stored in the human brain.

If people have a more profound impression of the first message, then, during decision-making, their selection preference is subject to the earlier message. This tendency is referred to as the primacy effect. Conversely, the recency effect indicates that the impression of the second message is stronger than that of the first message; that is, the selection preference is influenced by the later message. The order effect is a type of judgment bias, because the two messages provide the same content regardless of their presentation sequences, and the same judgment should be formulated theoretically, although the differing sequence in fact produces distinct effects.

The prevalent impression among consumers is that green products have inferior performance. On the basis of this rationale, a message with green attributes and product performance can be seen as conveying inconsistent information and can thus be defined as a double message. Hogarth & Einhorn (1992) explored the relationship between the order of inconsistent information and policy makers' belief adjustment and proposed the belief-adjustment model. The authors argued that people integrate each received piece of information sequentially into their original concept and continuously adjust their original beliefs, with the level of belief adjustment depending on the adjustment weight, which is related to their beliefs at earlier stages. Tubbs, Gaeth, Levin, & Van Osdol (1993) conducted a study through the belief-adjustment model and found that combining inconsistent messages leads to the recency effect, and inconsistent messages that are farther away from subjective values are more likely to result in such effect. Trotman & Wright (2000) noted that respondents receiving negative evidence before positive evidence are more likely to experience the recency effect than otherwise; therefore, presenting positive evidence after negative evidence can produce greater positive persuasiveness.

HYPOTHESIS DEVELOPMENT

Impact of Message Content

Previous studies have shown that consumers generally associate green products with poor quality and performance (Chang 2011). Thus, some studies have suggested that marketers should enhance the functional performance of products to alleviate consumers' concerns. However, conventional green advertising appeals mostly adopt single messages and focus only on green attributes. Thus, this study integrated the product performance appeal into the green attribute appeal to produce a double message.

The most important factor determining consumers' intent to purchase a product is their satisfaction with product performance. An inconsistency between the ethical

attributes of the green product and the product performance attributes pursued by consumers becomes a liability/unfavorable condition in consumers' preference (Luchs et al. 2010). Matthes & Wonneberger (2014) found that fulfilling consumers' information needs by providing practical information in advertisements can help them make informed judgments instead of relying solely on emotional judgments. Therefore, when consumers are uncertain about the green attributes of a product, the additional information provided on product performance can enable consumers to make more rational judgments about the product, thereby influencing their cognitive attitudes. In addition, the product performance appeal may help neutralize/counteract consumers' negative association regarding the green attributes of products. Therefore, this study hypothesized that the impact of double message on the green brand attitude is significantly higher than that of the single green attribute appeal, and Hypothesis 1 is formulated accordingly:

> H1: Compared the single green attribute appeal, the double message appeals of green attributes and product performance enhance the green brand attitude.

Role of Green Attributes

The centrality or peripherality of green attributes of a product affects consumers' green perception of the product (Gershoff & Frels 2015), and consumers typically consider centrality attributes when deciding whether to purchase products manufactured by a brand. If the centrality attribute is a green attribute, based on consumers' impression that green products have inferior quality, a single message with green attributes as its centrality attribute results in a more negative green brand attitude among consumers. If a double message is employed, the message with product functional performance compensates for or improves consumers' initial impression that green products have inferior quality, and such fluctuation in consumer perception widens the difference between double and single messages. Conversely, when green attributes are peripheral, their negative effect on product quality is relatively small. Moreover, because peripheral attributes are generally not the centrality values that consumers are concerned with when purchasing a branded product, the double message may result in limited changes in consumer perception. Under such circumstance, there may exist nonsignificant differences between double and single messages. Therefore, this study proposed the following hypotheses:

> H2a: If green attributes are the centrality attributes, the impact of the double message appeal on the green brand attitude is significantly higher than that of the single message appeal.

> H2b: If green attributes are the peripheral attributes, there exists no significant

difference in the impact on the green brand attitude between the double message appeal the single message appeal.

Impact of the Double Message Order

Under double messages, which comprise green attribute and product performance messages, whether the green attribute or product performance message should be used as the first message should be determined. The problem of the message order can be addressed using the order theory (Hogarth & Einhorn 1992) through its proposition of the primacy effect (green attributes as the second message) and the recency effect (green attributes as the first message). From the comparison of the green attribute message and product performance message, consumers should perceive higher novelty for the green attributes of a brand than its product performance. Therefore, using the green attribute message as the first message may produce higher attraction and attention with a stronger primacy effect, and the subsequent product performance message can compensate for the negative effects of its previous counterpart, thus yielding a more favorable green attitude among consumers toward the brand. Conversely, if the product performance message, which has lower novelty, is presented first, and the negative effects of the green attribute message, which has higher novelty, are not resolved, such inconsistent message results in a greater recency effect (Trotman & Wright 2000; Tubbs et al. 1993) and thus a decline in consumers' green brand attitudes. Therefore, this study proposed the following hypothesis:

> H3: In double message appeals, presenting green attributes before product performance yields a greater impact on the green brand attitude than presenting product performance first.

In double messages, green attributes may mediate the message order. When green attributes are central, their novelty results in greater consumer attention and thus strengthen the primacy effect. However, consumers' green brand attitude is enhanced by the balancing of the negative effect of green attributes by the subsequent product performance message. Conversely, presenting the product performance message and then the green attribute message does not resolve the negative effect of central attributes and thus strengthen their recency effect. Consequently, the double message appeal with an initial green attribute message has a significantly higher impact on the green brand attitude than does that with an initial green product performance message. When green attributes are peripheral, the primacy effect caused by the initial green attribute message and the recency effect caused by the subsequent product performance message are weaker than when green attributes are central; thus, the difference between the two message orders may be nonsignificant. Therefore, this study hypothesized that green

attributes interact with the order of message presentation, and the following hypotheses were proposed:

H4a: When green attributes are central, the double message appeal with an initial green attribute message followed by the product performance message has a significantly higher impact on the green brand attitude than does that with product performance as the first message.

H4b: When green attributes are peripheral, the impact of the double message appeal with an initial green attribute message followed by the product performance message on the green brand attitude differs nonsignificantly from that of the appeal with product performance as the first message.

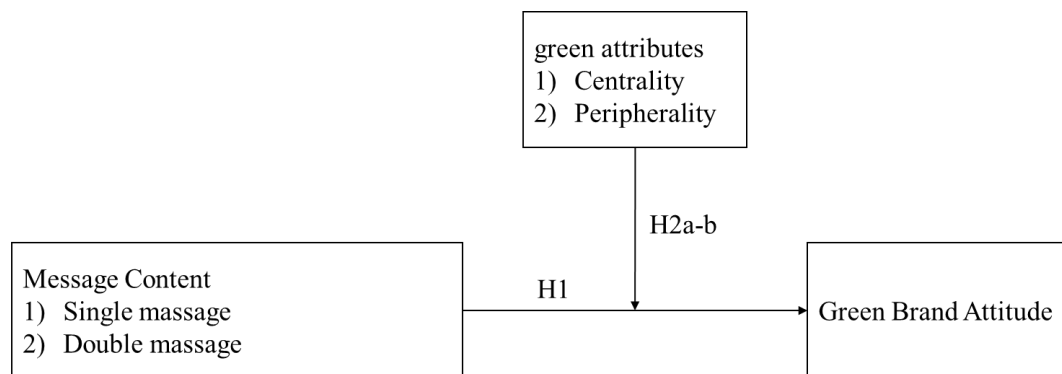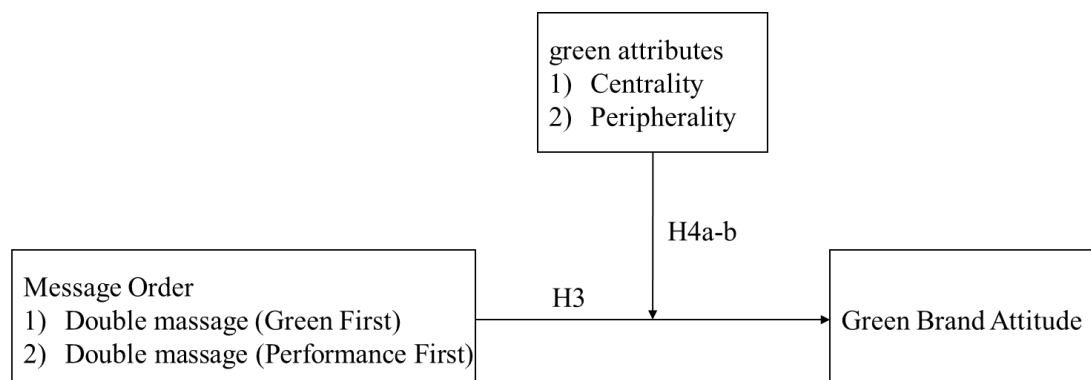In summary, the research framework is shown in Figure 1 and 2.

Figure 1

Figure 2

STUDY 1

This study tested Hl, which postulated that the double message appeals of green attributes and product performance would enhance the green brand attitude than single green attribute appeal. In addition, green attributes can be divided into both centrality attributes and periphery attributes. We also investigated H2a and H2b, which postulated how different green attributes (i.e., centrality attributes versus and periphery attributes) interact with message content to predict green brand attitudes.

Design and Sample

This was a 2(message content: single vs. double message) × 2(Green attributes: centrality vs peripheral) between-subjects design. The experimental participants were 131 undergraduate students (76.3% female) enrolled in management or business courses at a large university in Taiwan.

Stimuli advertisement

Graphic advertisement served as the stimulus to examined participants' evaluations of a green brand of shampoo called "Denee". We chose shampoo as the subject matter of the study because shampoo products are easy to get, often used consumer products for the student audience. In addition, the shampoo products on the market are already made by using the regenerative components. Therefore, the Participants is less likely to doubt the authenticity of the experimental situation. In addition, the subject product of this study uses a fictitious brand name¬ "Denee", based on two considerations. One is to separate the previous experiences with consumers who may exist in the brand and the other to prevent consumers from being confused by the name of the brand that already exists on the market.

Procedure

Participants were given one of the purpose designed advertisements. After the participants is sent an invitation email containing an online experiment link, clicking on the link first will be asked to view an advertisement as an experimental stimulus, followed by a questionnaire assessing their green brand attitudes. We also collected demographic information from the participants and checks of our manipulations. In order to make sure that the participants were restrained by this experiment, we measure their attentiveness with a question to eliminate weed out inattentive participants (Berinsky, Margolis, & Sances 2012). The item is [Denee shampoo contains 100% natural plant formula / 100% bottle can automatically break down?]. Only those who

can correctly answer the test participants can only stay in the sample, the final number of samples for analysis is 131.

Independent Variables

There are two experimental factors in this study. The first one is message content, which designed to two conditions: single message with only green attributes or double messages with green attributes and product performance messages. The second experimental factor is green attribute belongs to the centrality attribute or the peripheral attributes.

Extant research has shown that green attribute (Gershoff & Frels 2015) can be manipulated using product's element. In our study, green attribute was manipulated by using how importance of the green element toward shampoo product. That is, the formula of the shampoo product represents the centrality attribute, and the packing bottle represents the peripheral attributes. To assess our manipulation of green attribute, participants were asked the extent to which their thoughts at the time that how importance of [ingredient formula / packing bottle] toward shampoo products, on 5-point Likert scale, 1 = very unimportant, 5 = very important. As predicted, the ingredient formula condition achieved higher mean scores than the packing bottle condition, $M_{formula}$ = 4.53 versus M_{bottle} = 3.60; $F(1,129)$=36.11, p =.000 < .001. These results suggest that our manipulation of green attribute were successful.

Dependent Variables

Green brand attitude is the dependent Variables in this study. This variable was measured by four, seven-point scales developed by Voss, Spangenberg, & Grohmann (2003), anchored at 1 = "very disagree" and 7 = "very agree," measured a participant's thought toward " Denee shampoo is good; Denee shampoo is pleasing; Denee shampoo is attractive ; Denee shampoo quality is good ". The internal validity of this scale was acceptable, at α = .89.

Results

Message Content effects. To address our primary research question (i.e., the impact of the message content on participants' green brand attitudes), a ANOVA was conducted using attitude toward the brand as the dependent variable, Results showed the green brand attitude in double message condition was significant higher than in single message condition ($M_{double\ message}$ =5.09 vs. $M_{single\ message}$ = 4.66; $F(1,129)$=10.16, p = .002 <.05). The analysis showed that double message within green appeal was better than single message. That is, H1 was supported.

Green attributes on Message Content. H2a and H2b suggest that double Message with be moderated by the green attributes. According to the results of ANOVA revealed that when green attributes was described as included ingredient formula, participants judged double message ad to be higher green brand attitude ($M_{centrality-double}$ = 5.23) than single message ad ($M_{centrality-single}$ =4.53, $F(1,62)$ = 13.59, p=.000 < .05. Conversely, when the target product was described as used green packing bottle, the green brand attitude between single message and double message showed no significant difference ($M_{periphery-single}$ = 4.79 vs. $M_{periphery-double}$ = 4.97, $F(1,65)$ =.838, p = .36 > .05). Figure 3 illustrates the findings from this study. These results showed that message content for centrality attribute condition, the green brand attitude was based on the product performance messages, that is the benefit which consumer seek. Conversely, the message content effect didn't appeared in periphery attribute condition. These results were consistent with H2a and H2b.

The findings of Study 1 support the basic hypothesis that the effect of single versus double message on an individual's perception of the brand attitude of a green product and it is moderated by differences in green attributes. Green ads with double appeals generally favored brand attitude that emphasized their greenness in the centrality attributes. In contrast, for those appeals focus on peripherality attributes, we don't found the same message content effect. The results suggest that with regard to centrality attributes, a claim of greenness with product performance—will be seen as an asset by green ad. In the next study, we build on these findings related to centrality attributes by including an additional manipulation consistent with prior research on factors that affect centrality. In Study 2, we further investigated which serial-position within green appeal and product performance would be better.
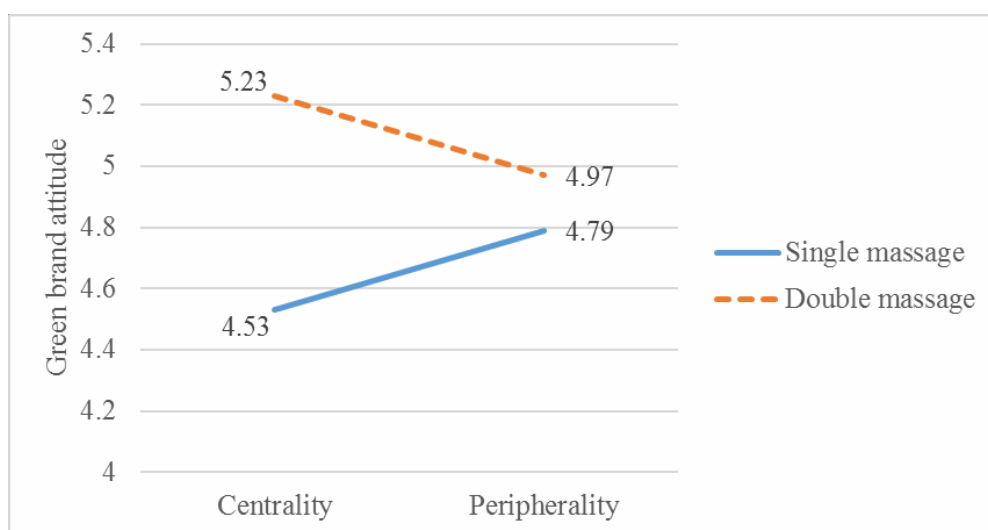

Figure 3

STUDY 2

The purpose of this study was to examine the interactive effects of message order of double message and green attributes on consumers' attitudes toward green brand of shampoo. This study tested H3 and H4, which predicts that in the case of double message, framing the green appeal in earlier-presented information will be more persuasive than framing it in the later. Because impressions are formed on the basis of sequentially presented information, called recency effect, so that consumers' green brand attitude may be enhanced by the balancing of the negative effect of green attributes by the subsequent product performance message.

This was a (message order: green appeal first vs. product performance appeal first) × 2(green attributes: centrality vs peripheral) between-subject design. The experimental participants were 156 undergraduate students (80.8% female) drawn from the same sampling frame that was used in Study 1.

The procedure of Study 2 follows that of Study 1, with one modification. Participants were randomly assigned to one of four experimental conditions. We used the same procedures as in the first study, with the only exception that we now used double appeals rather than single message in total of the four ad treatment conditions.

Independent Variables

There are also two experimental factors in this study. The first one is message order, which designed to two conditions. To manipulate the serial-position of double appeals, we separated double messages into two conditions: green appeal first and product performance appeal latter, and the opposite condition is product performance appeal first and green appeal latter. The remaining elements of the advertisements and did not vary. The second factor is green attribute (as mentioned above), we refer ingredient formula as centrality attributes, refer packing bottle as peripherality attributes.

Consistent with our expectations, compared with participants in the packing bottle condition ($M_{packing\ bottle} = 3.63$), participants who were exposed to the ingredient formula condition ($M_{ingredient\ formula} = 4.42$) reported latter having higher levels of importance toward shampoo product, $F(1,154)=32.03$, $p = .000 < .001$. These results suggest that our manipulation of green attribute were successful.

Results

Message Order effects. According to the analysis of ANOVA, the green brand attitude

in green appeal first condition was significant higher than in product performance appeal first condition ($M_{\text{green first}} = 5.09$, $M_{\text{performance first}} = 4.75$, $F(1,154) = 6.98$, $p = .009$ $<.05$). Therefore, as we predict in H3. We found the order effect was better for green appeal first and product performance appeal latter. We conclude that, it might be the latter product performance reduced the product green doubt.

Green attributes on Message Order. For understanding the mediating role of green attributes, we compared the difference between green appeal first and product performance appeal first for both centrality attribute and peripheral attribute conditions. In centrality attribute conditions, the analysis of ANOVA indicated that green appeal first was significant higher than product performance appeal first on the attitude toward green brand ($M_{\text{centrality-Green first}} = 5.23$, $M_{\text{centrality-Performance first}} = 4.72$, $F(1,70)=8.27$, p $= .005 <.05$). However, when the green attribute is the perimeter attribute, the influence of the message order on the green brand attitude has no significant difference ($M_{\text{Periphery-Green first}} = 4.97$ vs. $M_{\text{periphery-performance first}} = 4.77$, $F(1,82)=1.08$, $p = .303> .05$). These results indicated that H4a and H4b were supported. We found the order effect of green appeal first for was garter in the centrality attribute condition, but not for the perimeter attribute (Figure 4).

The results of Study 2 show that green advertising with double message presented green information first would capture recency effect. Since participants' impressions are formed on the basis of sequentially presented performance information. Although participants were more likely to generate negative attitude by green-related appeals, especially in centrality attribute condition. But immediate filled with the product performance massage after green appeal is an effective treatment to decline green negative effect.
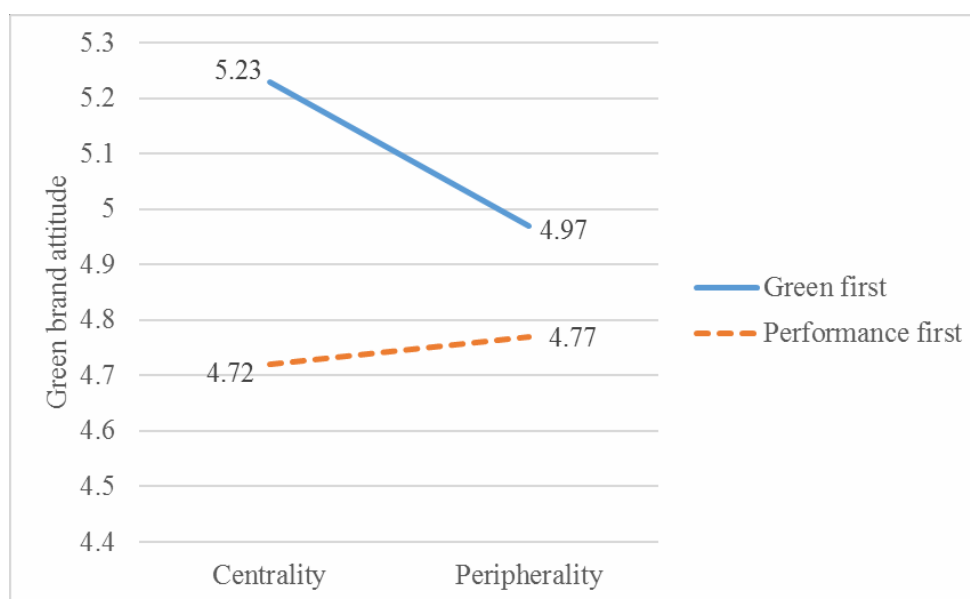

Figure 4

CONCLUSIONS

The appeals encoded in advertising messages, as a key element of advertising strategy. Previous research on green advertising has shown that green appeal has "green gap" and "green negative effect." among consumers (Chang 2011). That means people hasn't satisfied by green advertising which been expect to communicate with consumers. Our study examined the suggests of existing literature for green appeal (Luchs et al. 2010; Matthes & Wonneberger 2014), which contain practical information to facilitate consumers' rational judgment, as a framework for analyzing consumers' responses to single versus double message advertising appeals.

In this research, we investigate how to frame green message could be effective. We draw from extant research (Luchs et al. 2010; Matthes & Wonneberger 2014) to examine whether single message or double message would be better? In Study 1, we found that for product with green centrality attribute had better consider using double message appeal, that means appeal including green message and product performance message. The results show that consumers are more attuned to green brand attitude for double messages instead of single message. While the message content effect has no significant difference for periphery attribute condition, it's consisted with existing literature (Newman et al. 2014; Olson 2013[a]), which posit centrality attribute general yield more green negative effect due from quality concerns. It's make sense that provide product performance information within double message could been a choice to mediate green negative effect. When consumers are uncertain about the green attributes of a product, the additional information provided on product performance can enable consumers to make more rational judgments about the product, thereby influencing their cognitive attitudes. In addition, the product performance appeal may help neutralize/counteract consumers' negative association regarding the green attributes of products.

Study 2, we demonstrate that the double message effect was garter in the centrality attribute condition, but not for the perimeter attribute. Again, we found product performance appeal may help to reduce consumers' negative association regarding the green attributes of products. We also demonstrate that using the green attribute message as the first message may produce higher attraction and attention with a stronger primacy effect, and the subsequent product performance message can compensate for the negative effects of its previous counterpart, thus yielding a more favorable green attitude among consumers toward the brand. But the order effect only appeared are limited to the fact that green attributes are of product importance that is the case of the centrality attributes. When a product's green attribute is a perimeter attribute, there is no significant difference between the two message sizes and the single message. Moreover, there is no significant difference between the green

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attribute and the product performance message in theDouble message. This study found that when the green attribute of the product is not of importance (peripheral attributes) does not affect consumers' evaluation of double messages. As we recall, existing research has confirmed that consumers will attribute the trade-off between the conventional and green attributes of a product (Olson 2013[a]), going green makes consumers to generate negative rating (Newman et al. 2014), green has a negative effect on consumer preference (Luchs et al. 2010). Therefore, when the green attribute of the product is the peripheral attribute, since the green attribute does not have the importance of the product to the consumer, the influence of the Double message is not much different. Conversely, when the green attribute of a product is importance (centrality), the argument about product performance becomes very compelling because the product performance message balances the consumer's original perception of the green product Poor performance of the doubts.

Managerial Implications

Green product attributes had been strengthened by the academicians and practitioners recently. Firms are always asked that they should do the green innovation for environment protection in order to fulfill its social responsibility. Consumers will be recognized as responsible and diligent citizen if they prefer to use green products. However, the products with green attributes are always treated inferior quality than its original product. Thus, consumer is willing to support green product in verbal only, but not in real attitude and behavior, result to so called "green gap," which crate a big challenge for single green product attribute on persuasiveness. Therefore, this study attempts to examine the difference of persuasiveness between single green attribute message and double message (single plus product functional performance), and the effect of double message's sequence. Green attribute centrality also been put into as moderators.

The findings of this paper have significant practical implications for marketing and advertising planners. First, the studies reported here offer evidence that the double message appeals of green attributes and product performance could enhance more green brand attitude than the single green attribute appeal. The inference for advertising strategy is that fulfilling consumers' information needs by providing practical information in advertisements can help them make informed judgments instead of relying solely on emotional judgments. Therefore, when consumers are uncertain about the green attributes of a product, the additional information provided on product performance can enable consumers to make more rational judgments about the product, thereby influencing their cognitive attitudes. In addition, the product performance appeal may help neutralize/counteract consumers' negative association regarding the green attributes of products.

Second, these findings offer practical insights into the tailoring of advertising appeals and claims to consumers' green brand attitude. Marketers should encode green appeals in terms of periphery-related attributes but not centrality-related attributes in their advertising messages, to convince consumers that the product has conventional attributes benefits. However, centrality-related attributes appeals should be communicated carefully, its deployment in advertising messages can convey the functional utility of the product, therefore tend to respond to positive outcomes and to value " performance " as a product attribute.

Third, given the finding that presenting green attributes before product performance yields a greater impact on the green brand attitude than presenting product performance first, through its proposition of the recency effect (product performance as the second message) could been a useful tactic.

Limitations and Future Research

In sum, the current research demonstrates that consumers respond more positively to appeals that plus the product performance message follow to green attributes appeal. Although we believe that our results can be generalized to many other product categories in which product performance are valued, but we do not expect a similar inference about it, because prior studies suggested (Luchs et al. 2010) that sustainable products may be association between ethicality and gentleness. For those seek non-strength-related attributes consumers, single green message products may be considered more natural and less aggressive than plus performance message product. Further research can more forward investigate the boundary conditions of double message in which green consumers' characteristics.

Follow the above point, although our studies didn't ask especially female participant, however, female was high percentage of the responsive. Despite the gender ratio of sample did not affect studies result and above analysis, it suggested that the female is superior concern green product context. Consist with recent research (Brough, Wilkie, Ma, Isaac, & Gal 2016), that there is gender gap within sustainable consumption. It's a non-intention result. We aren't surprised to see more female than men which pay attention for green advertising. This is just another strong evidence to support the sex ratio in the green issue. But most green products don't product for one sex (female), further research should have more need to consider type of appeal in assessing the effectiveness of green marketing communications for men.

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Problem Analysis of Urban logistics in Metz city center: A Case Study

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Abstract: In this paper, we present a case study supporting urban freight and waste management in Metz city, France. Based on this case, we analyze the deployment of logistic platform as a solution for delivery problems. Existing solutions for logistics platforms require a big investment in terms of budget and operational cost. In doing so, we discuss the approach of combining direct and reverse flow in an urban area. Subsequently, we propose a mathematical model based on urban logistic location problem supporting both direct and reverse flows; while having as objective to maximize profit with regards to environmental and societal goals. As revenue, we will have the resale of returned products to re-manufacture and the resale of recyclable waste sent to centers for waste recycling. Finally, the profit deduction will depend on several costs such as transportation cost in urban environment, logistic cost, pollution cost, and residents' acceptability.

I. INTRODUCTION

Cities are the heart of the economy with a lot of trading and goods delivery. In this context, congestion is continuously increasing due to significant number of pedestrians, car drivers and public transport. Therefore, there is a need to optimize all flows moving on cities while keeping attractive places to live and work [1].

Urban logistics is a global management presenting different means for economic and social development in modern cities. The analysis of urban logistics is extremely complex because of multiple and various components: housing, economic activities, urban management, and transport [2] [3]. Several studies and pilot software have been made to help public authorities in order to organize urban logistics. These studies have as a main goal to decrease congestion and pollution derived from this sector. Moreover, they support public authorities in urban freight planning and decision [4].

Urban logistic is essential to modern cities when dealing with operations such as supply chain, construction transport, waste collection, etc. It presents several challenges in different contexts (e.g. politic, economic, and environment). Goods delivery presents several drawbacks for residents because of noise and traffic. It has also a negative impact on environment due to pollution and waste. Moreover, freight cost in urban areas, frequently called the cost of last mile, is among the most expensive and most polluted step in the logistic chain [5].

In this article, we will focus on two kinds of flows in urban logistics: urban freight delivery and reverse flow. Urban freight delivery has been discussed in several researches where various studies focused on assessing and optimizing goods delivery flows [6] [7]. Goods delivery for business and private customers causes traffic issues. This is explained by the amount of vehicles: small vehicles for express delivery and trucks for stores deliveries. Deliveries numbers increased due to the just-in-time management, the evolution of e-commerce and the emergence of new types of delivery (home delivery, drive and delivery lockers) [8]. Just-in-time service involves providing the customer with the exact amount ordered in time. This causes complexity related to the delivery of goods which negatively affects the traffic of vehicles and public transport causing traffic jams. Cities must have an appropriate infrastructure with functional, technical and geographical features for urban freight transport such as urban logistic platform [9].

Urban Waste Management (UWM) presents one of the biggest issues for modern city council because it has an impact on its social, political and economic aspects. From a social perspective, UWM helps with environmental preservation against pollution. From a political perspective, UWM is important for citizens and for other institutions in city because it contributes to the quality of life improvement. From an economic perspective, a good waste management can generate more recyclable resources [10]. The main objective of UWM is to recover the remaining value of returned products by integrating them into a supply chain [11].

In this paper, we present a real world scenario of city distribution in the city of Metz, France. We have conducted this scenario within a collaboration between Metz city council and our research laboratory in France. This study aims at ensuring sustainable development of logistic flow. In doing so, we run a three years project in order to minimize traffic congestion, improve the quality of life for residents, and minimize pollution generated by goods delivery. At the first stage, we mainly focus on optimizing goods delivery by presenting a diagnosis of the current state and, then, choosing best solution and practices. In the next stage, we look at enriching our solution using a new concept: reverse flow. The idea is based on a reverse flow approach developed using best practices from a waste collection project.

The paper is structured as follows. Section 2 presents the context and problematic. In section 3, we introduce our delivery case study and detail each part of the urban freight example in Metz city center. We discuss reverse logistics framework for waste collection in section 4. In section 5 we discuss combining forward and reverse flow in urban logistics platforms where we propose a mathematical model for this design. Conclusion and future work are presented in section 6.

II. CONTEXT AND PROBLEM STATEMENT

In cities, traffic jam is continuously increasing which generates congestion problems, in addition noise and pollution. In this traffic, we can mention urban logistics which has known a growing development due to increasing demand, e-commerce, home delivery, growing urban population/ For example around 75% of the population in Europe lives in urban area. For this reason, urban logistics has received growing attention in recent years [12]. Indeed, a lot of scientific and professional projects took place to minimize transport cost, congestion and pollution. Therefore, an efficient urban logistics in cities can positively affect economy and quality of life. For that end, urban logistic must be sustainable with collaborative models. Indeed, the European commission proposed to reduce CO_2 emissions by using new vans which respect EURO 5 norm and EURO 6 norm [13]. This kind of vehicles will gradually enter the fleet in these upcoming years. However, the fuel quality can reduce gas emission by 6% until 2020. In addition, the European Commission has proposed to work on legislation by mandating the deployment of alternative fuel in the upcoming years [1]. Therefore, the main objective of city logistics is to deliver and collect goods in an efficient way without disturbing the mobility or affecting the environment.

In this context, N. Geroliminis et al. [14] present several examples of sustainable city logistics schemes, listed in the table below:

Table 1:Examples of sustainable city logistics schemes [14]

Country	City	Solution for sustainable city logistics	Category
Denmark	Copenhagen	City goods for capacity management	Restriction zones
Sweden	Stockholm, Gothenburg, Malmoe, Lund	Environmental zones	
UK (United Kingdom)	London, Bristol, Nottingham, Edinburgh	Low emission zones	
Belgium	Brussel	Lorry dedicated routes	
Netherland	Rotterdam	Electrical vehicles city distribution system	Clean vehicles
Japan	Osaka	Electrical vans	
Swiss	Zurich	Cargo tram	
Germany	Berlin	Goods traffic Platforms	Coordinated transport
Sweden	Stockholm	Logistical center for coordinated transports	
Spain	Barcelona	Multiple use Lanes, on line parking information	Congestion mitigation
France, Spain and Italy	Paris, Barcelona, Rome	Night delivery schemes	
UK (United Kingdom)	London	Congestion charging	Charging
Germany	Germany	Truck toll system	
USA and Canada	New York and Vancouver	Internet port information systems	Information system
Japan	Tokyo	Advances information systems	

Netherland	Amsterdam	Floating distribution centre	Water use
Italy	Venice	Waterborne traffic management decision support system	

In table 1, we observe that solutions, which can make city logistics sustainable, can be in different ways: restriction zones, using clean vehicles, coordinated transport, congestion mitigation, charging, information system and water use. For the first category "restriction zone", we can list Copenhagen example, which consists of given certification (green, yellow and red) with requirements on capacity utilization and engine technology. The goal is to reduce the environmental impact and to make streets more accessible. The second category "clean vehicles" presents the project deployed in Rotterdam named "Electrical vehicles city distribution system (ELCIDIS)". This project requires using hybrid and energy efficient electric vehicles cleaner than diesel engine. For the third category "coordinated transport", Berlin has deployed a goods traffic platforms solution to handle traffic in a best sustainable and environmental manner by reducing the frequency and combination deliveries. This solution assembles different stakeholders like local administrative bodies, shops, police and the local chamber of commerce. The objective is to reduce the rate of deliveries. The fourth category "congestion mitigation" is about Barcelona example. The City Council of Barcelona created multiple lanes. These lanes must be adapted to circulation space, load/unload services and resident parking taking account hourly demand. For the fifth category "charging", congestion charging scheme, introduced in London in 2003, is an £11.50 daily charge for driving vehicle within the charging zone between 07:00 and 18:00 from Monday to Friday. For sixth category "information system", we can list the internet port information systems used in New York and Vancouver. This goal of this scheme is to meet the operational needs of regional intermodal freight service providers and their customers. This system makes information available from all stakeholders. Moreover, it helps by reducing the truck queues and unnecessary trips. The last category is about "Water use" in Venice, Italy. They use a waterborne traffic management decision support system in order to manage increasing levels of boat traffic and prevent damage. The goal is to control boat traffic [14].

Capgemini and GCI (Global Commerce Initiative) have conducted a study in 2008 titled 'Future supply chain 2016' with recommendations about anticipating new collaborative models for city distribution and to create an appropriate infrastructure managing and organizing consolidated flows in the city [9]. In the following, we list specifications of future supply chain from the aforementioned report:

- Integration of multi-partner information sharing between stakeholders: consumers, suppliers, manufacturers, logistics service providers, and retailers;
- Products will be shipped to collaborative warehouses to be stored
- Products will be delivered from collaborative warehouses to city hubs and to regional consolidation centers
- Distribution to stores and collecting points and homes using consolidated deliveries in urban and non-urban areas

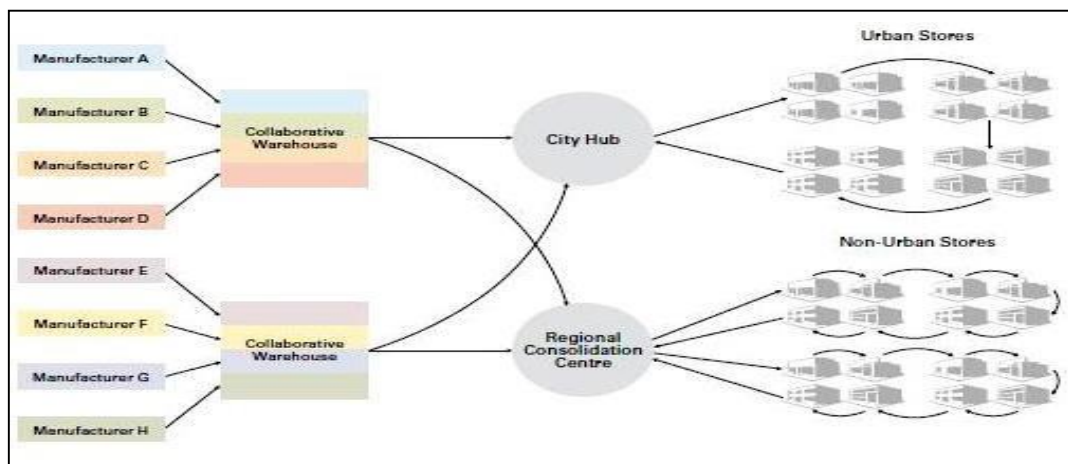*figure 1:A new model for enhanced Supply Chain Collaboration proposed by Capgemini and GCI [9]*

Through this study, Capgemini and GCI proposed a new model to enhance supply chain collaboration including warehouse, city distribution and non-urban distribution collaboration with information communication between stakeholders. In figure 2, stakeholders are represented by retailers and four manufacturers sharing a collaborative

warehouse. The retailers do not have their individual distribution centers. In this case, products will be cross-docked by either a city hub for urban areas, or by a regional consolidation center for non-urban stores. Subsequently, delivery and transport will be shared and delivered to the stores of the different retailers, where truckloads will be realized easily [9].

In the following, we present a case study about city distribution in Metz (France). The goal is to optimize flows in the urban area in order to reduce total truck kilometers, emission of negatives externalities, cost of last mile, cost handling, and delays in lead time. To do so, we use a scientific approach proposing a method and modeling tool/ simulation/ analysis.

III. URBAN FREIGHT CASE STUDY IN METZ CITY

The city center of Metz in France presents a pedestrian shopping zone (more than 500 stores). Stores, in large part retailers, are recipients of commercial deliveries, as well as the residents of the neighborhood. Therefore, commercial density of this area requires a large number of daily deliveries from Monday to Sunday. Indeed, the large number of deliveries, regular passing of city buses and movement of residents cause great discomfort in the pedestrian area (noise, pollution, and congestion) and may cause danger for pedestrians.

Metz Metropole Development agency asked an expertise from our laboratory 'Laboratoire de Génie Industriel, de Production ET de Maintenance' (LGIPM) of the University of Lorraine to study the existing situation and to suggest improvements supporting logistic flow in Metz.

The main objective is to make sure that Metz city will play a key role in sustainable development by improving the mobility of goods, minimizing congestion, reducing the number of vehicles, improving living conditions for residents, reducing the cost of transport, collecting recyclable waste. The study was conducted in two steps:
1. Improving urban freight delivery in Metz city center
2. Improving urban waste collection in Metz city center

The first part took place in four stages: stage 1 consists of making observations and an audit of the current situation by visiting the downtown pedestrian and using questionnaires to stores and transporters. Stage 2 creates a data flow modelling of pedestrian space of Metz. Stage 3 consists of simulating and validating this model using a management scorecard. Finally, we proposed, in stage 4, solutions and analyze their behavior in the tool management scorecard.

The second part took place in three stages. Stage 1 analyzed the real waste collection in Metz. In stage 2 we made an international audit of best. Finally, in stage3, we proposed best solutions adapted with Metz situation.

A. Research methodology

The first step in this research consists on collecting different information concerning deliveries in pedestrian area. We also consider data on all existing physical flows in the pedestrian area such as the movement of city buses and residents. To analyse this information, a questionnaire was distributed to all stores to know all details about their deliveries (number of packages, volume, date and time of delivery). According to the questionnaire, we distinguish that 70 % of transporter made deliveries. Regarding reverse flows, we asked for collecting packaging (box and pallet) and we notice that 77 % of them were recovered by local collect and suppliers recovered the rest. These results support and are relevant to the goal of this project. The second step consists of creating a deliveries model. This model will use the data collection in order to describe the situation of deliveries in city center by creating a management dashboard (see figure 2).
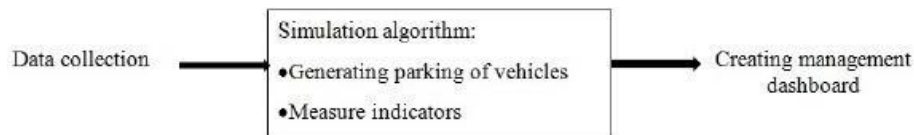
figure 2:Stages to create the management dashboard

Many hypotheses are used to generate the position of each transporter in the parking to analyse congestion. We use VB.net to place randomly transporters vehicles based on schedule of deliveries. We take as a hypothesis one vehicle for each transporter. Moreover, each area has longitudinal and transversal dimensions in order to know capacity of each of them. Then, the model will precise the occupation rate of each area for each time range (5 min) to take the best decision on parking transporters. These results will be stored in a matrix. Using the proposal simulation model described above, we calculate three key indicators:

- Congestion indicator for each street: we count the number of each unit of time during street congestion.
- Temporal indicator congestion, for each day or time range, we count the number of street having a delivery vehicle parked.

E $(z,t)=1$ if area is saturated, 0 else

For each day: $saturation(j) = (\sum_{z=1}^{120} \sum_{t=i1(j)*96}^{95*(i1(j)+1)} E(z,t)) + \sum_{t=i2(j)*96}^{95*(i2(j)+1)} E(z,t))/(80*1344)$ (1)

For each time range: $saturation(time\ rage) = (\sum_{z=1}^{120} \sum_{i=0}^{13} \sum_{t=(12*j)+(96*i)}^{(96*i)+(12*j)+11} E(z,t)/(120*14*12)$ (2)

- Environment impact indicator: this indicator is divided into three sub indicators. This is to calculate the CO_2 emissions for each carrier, for every street and then for each day of the week.

All of these indicators are depicted in figure 3. The right side of this figure indicates the different carbon emissions for every transporter/day. On the left side, we observe the daily congestion. It goes from green to red color. The latter one indicates high congestion. The management scorecard has produced similar results to the real situation. Conducted experiments have helped in validating the tool simulator. We propose different solutions for the delivery in pedestrian area while ensuring the improvement in economic, environmental and societal levels.

All of these indicators are depicted in figure 3. The right side of this figure indicates the different carbon emissions for every transporter/day. On the left side, we observe the daily congestion. It goes from green to red color. The latter one indicates high congestion.The management scorecard has produced similar results to the real situation. Conducted experiments in our laboratory have helped in validating the tool simulator.
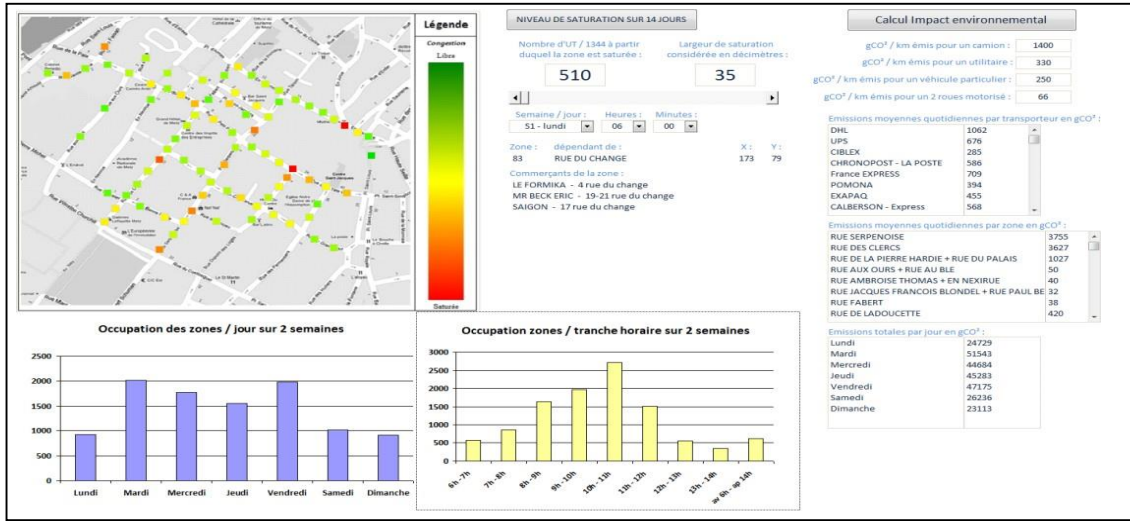

Figure 3. The management scorecard

B. Logistics platforms results

Boudouin et al. define logistic platform as "the place of meeting of everything that concerns the logistics efficiency, receiving logistics zones undertakings and infrastructures of transport and storage, improving the competitiveness, making possible the logistics activities, de-bureaucratizing and hastening trade operations". The term of logistic platform varies from country to another according to different constraints [15]. The introduction of a logistics platform for the distribution of goods has a strong impact on the economic, environment and society balance. It allows acting on two major parameters: the organization of the distribution and on the fleet and types of vehicles used [11] [12].

The platform of Marseille city in France called Arenc, in partnership with SNCF, includes 4 buildings having an area of warehouse equal to 41 362m² in the city center and near from the Old Port of Marseille. In addition, it has a direct access to the city center and to the terminals port. Multimodality is also provided by the direct link to the motorway network that optimizes the flow of vehicles.

ELCIDIS platform of Rochelle city in France has been operational since 2001 and was created in an old warehouse near the city center to distribute 1300 stores using electric vehicles. The service offered by this platform was delegated to Veolia Transport in 2006 in the context of a public service delegation. But unfortunately, the major problem of development of a logistics platform in urban areas is the lack of real economic model to achieve financial balance [14].

1) Functionalities and limitations

In this scenario, there are several decisions to make. Indeed, the number of platforms, generally related to number of product classes, is an important factor. Moreover, the volume in order to predict the storage space, the number of vehicles and their kind can change and affect the cost. The study was structured as follow:

- Audit of transporters

- Estimate of the volume
- Calculating the cost of operation

The audit of transporters has provided the volume of deliveries. This exercise was the opportunity to question these transporters on the difficulties that could appear from the realization of logistics platforms. Then, our laboratory LGIPM wanted to focus on the most influential transporters in terms of deliveries number. As to the second phase, the survey completed by the transporters indicating the volumes delivered per day and per week for a year helped us to project volumes to cover all the needs depicted by the simulation with the following results:

- $2520m^3$ weekly or 360 m^3 daily for dry goods
- $462m^3$ weekly or 69 m^3 daily for fresh foods
- $244m^3$ weekly or 35 m^3 daily for frozen foods

In the fourth phase, LGIPM has analyzed several cases of logistics platforms located in France: La Rochelle, St Etienne, Defense, Marseille, Monaco, Bordeaux and Lyon. The operating costs of these platforms are very heterogeneous, but we were able to draw a synthesis.

Moreover, the cost of operating logistics platforms dealing with fresh and frozen products are higher since the treatment of these products is more complicated and from the storage area previously determined for each product family, here is the corresponding operating cost:

- Dry products: 1516m², annual operating cost: 469960€
- Fresh products:585m², annual operating cost: 263250€
- Frozen products:147m², annual operating cost: 88494€

With these results for each product family, we can estimate that the overall annual operating cost to ensure the operation of platforms and delivery of last mile is equal to 821 704€

LGIPM then proposed to create two logistics platforms, one dedicated to dry product and one for food and cold product, outside the pedestrian center of Metz and the last mile deliveries will be delegated to one transporter that can mobilize up to five vehicles for delivery. The implementation of this solution in the simulator has created benefits such as the minimization of the management through important grouping flow of deliveries.

IV. URBAN WASTE COLLECTION MANAGEMENT

The second part of the project "reverse logistics for waste collection in Metz city" involves improving and evaluating waste collection process. The waste abandoned by stores in the street generates noise and pollution (see figure 6). Thus, we review in this part reverse logistics focusing on waste management issue. Subsequently, we will present an international audit of best practices. Then we will present recommended solutions to improve the waste collection management.

Reverse logistics, is an emerging concept, which manages flow of returned material, good, or equipment from customer for reuse, recycling or disposal. It is motivated by the need of companies to structure returns. Witt, in a former study, mentioned that sales will increase in the coming year and estimated that 15% of these purchases will be returned [17]. In the literature, we find many definitions listed as follows:

- Thierry et al. named reverse logistics like "Product Recovery Management" and they said "*All those activities that encompass the management of all used and discarded products, components, and materials that fall under the responsibility of a manufacturing company."* The objective of product recovery management is to recover as much of the economic (and ecological) value as reasonably possible thereby reducing the ultimate quantities of waste" [18]

- The Council of Logistics Management defined "The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements" [19].

Reverse logistics add new characteristics on the supply chain management because of the presence of new functions and new participants such as the location of collection, testing and sorting, or recovery center. Furthermore, many studies in location problem or reverse logistics systems are discussed in the literature. Bloemhof-Ruwaard et al. present a two level distribution and waste disposal problem [20]. According to Barros et al. there is a network for recycling sand and propose two-level location model of two types of intermediate facility [21]. Jayaraman et al. define a mixed integer programming location model for remanufacturing/distribution center [22]. Lu et al. propose a two-level of location problem for remanufacturing network (RMN) taking into account forward and reverse flow with three types of facilities [23]. For an efficient reverse logistics, it is necessary to redirect returned products by a good management and planning activities. These activities can be the collection, the evaluation, the sorting, the dismantling, the redistribution and also the inventory management.

The waste abandoned by stores in the street generates noise and pollution. Thus, we review in this part reverse logistics focusing on waste management issue. We present an international audit of best practices. Then we present recommended solutions to improve waste collection management. Urban Waste Management (UWM) presents one of the biggest issues for modern city council because it has an impact on its social, political and economic aspects. From a social perspective, UWM helps with environmental preservation against pollution. From a political perspective, UWM is important forcitizens and for other institutions in city because it contributes to the quality of life improvement. From an economic perspective, a good waste management can generate more recyclable resources Ghiani et al. (2014). The main objective of UWM is to recover the remaining value of returned products by integrating them into a supply chain Ramos et al. (2014).

In November 2008, the European Parliament and the Council created a directive on waste and repealing certain directive. This directive presents a waste hierarchy that is precedence order in waste management as follows:

- Prevention of waste
- Recovery
- Re-use and recycling
- Disposal

In 2012, the European Parliament had classed 27 state members through several criteria associated on recycling waste quantity, setting prices of waste disposal. Among the best state is Austria where important measures were implemented in order to be at the head of the rankings for the best state in the waste management. These measures were (Agency (2013)):

- The ALSAG Act (ALTSANIERUNGSGESETZ-Act on the Remediation of Contaminated Sites) which had introduced a tax on landfilled waste. This tax allows financing the remediation of contaminated sites. Moreover, it provides incentive on treating and recycling waste.
- The separate collection, introduced all over Austria in 1992, between packaging and biogenic waste.
- Prohibition on reactive waste landfilling since 2004.
- Increasing of the landfill tax (in 2004) and of the incineration (in 2006).
- Austrian Waste Prevention and Recycling Strategy in 2006.
- A fast development in collection paper and other fractions due to mandatory separate collection at households (Herczeg, 2013).

We present an audit of the waste management in Metz city centre. Waste collection was realized by a public community technical center. Note that stores did not have special invoices since there is no difference between collecting waste from citizens or from stores. In doing so, several meetings have been organized with responsible from Metz waste collection centre. Thanks to these exchanges, we have obtained a clear vision based on qualitative and quantitative analysis of collected data. The waste center basically collects household waste and non-household waste. The waste centre has developed a collecting technique. After collecting waste, it is treated by a public institution named HAGANIS. It ensures selecting waste in order to be recyclable and incinerating residual garbage to produce energy. The weaknesses observed in the waste management has generated many discussions and reflections based on international best practices. We think that integrating distinction between flows (type, weight, frequency, etc.) from stores or particular can simplify management and helps on having traceability. Actually, we propose using colour bags in order to ensure distinction between two flows. To avoid throwing bin bag in front of stores and to improve city cleanliness, we can add several mobile wastes as a temporary deposition of waste at the end of working hours every day during a small period.

Moreover, we propose waste collection services during working hours. In this case, each store notify the need of collection waste via telematics system (internet, mobile, etc.) or by a system like traffic light which shows the urgent need by red light and no waste by green light. This solution will ensure environmental goals by avoiding noise and minimizing pollution. To raise awareness among sustainable collected waste for stores, we propose to realize a weighed for waste sorted per category to compute stores invoices.

V. COMBINING FORWARD AND REVERSE FLOW IN URBAN FREIGHT AND MODEL FORMULATION

A. *Problem description*

Using logistic platforms for urban deliveries has several advantages. It guarantees a good delivery quality from both perspectives time and performance. With logistic platforms solutions, we manage to have an optimized number of electrical vehicles for delivery. This will keep away noise and congestion from pedestrian area.

For shopping stores and retailers, we select one transporter in charge of the final routing "last mile". This allows the possibility to make single appointment a day instead of multiplying deliveries with so many transporters.

However, this scenario has a negative economic impact. It is very expensive to implement and to operate. On the one hand, it often requires a significant investment (platform construction, equipment fleets). On the other hand,

it has a high operating cost which may not convince stakeholders to take such solutions. Stores will have a greater improvement on their deliveries; but are not willing to have additional fees. Transporters may appreciate avoiding delivery in pedestrian areas, however they might be reluctant due to the profit loss when delegating this delivery. Logistic projects depend a lot on public budget to cope with such expenses. In our example, the logistic flow study in Metz has indicated that the implementation of this solution would cost around 820,000 €/year. Moreover, the existence of the platform (including the delegation of the final routing) presents regulatory issues. We have to ensure delivery accountability/responsibility, and the interoperability of information systems between transporters to ensure complete traceability to final destinations.

Dealing with these issues, we extend our work with additional investigations in order to determine logistics solutions to meet these costs, particularly through a rational valuation of flows from **reverse logistics**. In addition, we use the pooling of transport and economic valuation returned products (boxes, packaging, remanufacturing). Reverse logistics add new features for supply chain management. It uses new functions and new participants such as locating collection, testing and sorting, or recovery centre. Subsequently, reverse logistics helps in ensuring environmental requirements by recovering returned product that might be recycled later on. We had this reflection based on best practices from another project using reverse logistics framework for waste collection. Waste collection traffic has a negative impact in Metz city center. The main goal is to identify shortcomings and to suggest improvement for collecting waste. Collection presents a financial problem because it has not a special billing for stores. This case study will help us to have best practices and can be a solution to cope with financial problem of logistic platform discussed previously. This can be done by billing the services to stores and transporters and by selling returns to remanufacturing centers and waste sorting center. Recovering these products will reduce cost. Nevertheless, integrating reverse flow in logistic platforms is not an easy task. We need to consider many constraints related to the platform location and their size. In addition, there are the delivery recommendations such as the number and type of vehicles, their planning, etc. This presents new research directions and, in this paper, rise our interest on location problem specially.

To the best of our knowledge, these aforementioned works did not investigate the management of forward and reverse flows by a collaborative logistics platform in the urban area. In doing so, we investigate the Hub Location Problem (HLP) which has been addressed in several works [24]. Hub location model can be applied when the objective is to determine the location of hubs and the allocation of the non-hub node to hub nodes. Hub Location Problem can be defined like Allocation-Location Problem [25]. O'Kelly has presented a mathematical model and solution method in discrete hub location problem. After that, he proposed a quadratic model for the single allocation p-hub median problem [25].

We do believe that integrating this reverse flow management aspect (treatment, optimized value recovery, recycling, sorting) will help in addressing the logistics platform localization problem. In figure 4, we explain the working process. A collaborative management will be achieved added to financial gain. As for reverse flow, the returned products will be retrieved by retails or/and will be sold to remanufacturing center. Regarding recyclable waste, it will be sold to waste sorting center. We will have also as revenue the collection cost paid by transporters and stores.
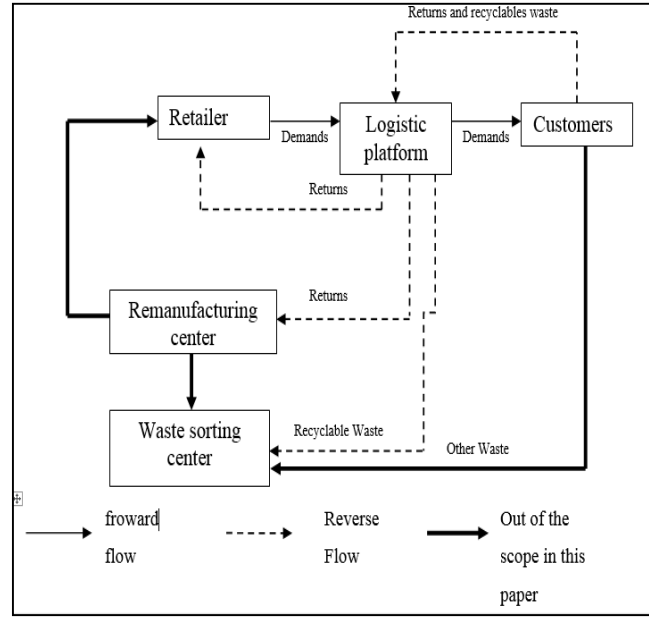
Figure 4: Global sypply chain neworek in urban area

B. Mathematical model setting

In our approach, we base our work on a delivery and collecting system in urban area. The system is composed of city hubs, customers, retailers; remanufacturing center and waste sorting center (see figure8). The stores have product demands, returned products and recyclable waste. The city hubs have the responsibility for delivering new products and collecting returned products and recyclable waste. Thus, we can distinguish two kinds of flow. On the one hand, these hubs work on cross docking for forward (direct) flow. On the other hand, a reverse flow will allow hubs to stock returned product and waste.

As for reverse flow, the returned products will be retrieved by retailers or/and will be sold to remanufacturing center. Regarding recyclable waste, it will be sold to waste sorting center. In our model, we have also as revenue the collection cost paid by retailers and customers where city hubs aren't charged to transport collected product to remanufacturing centers, retailers and waste sorting centers.

In our approach, we assume that the product demands are known and deterministic and are satisfied by retailers who are charged to deliver them to city hubs. Once the demands received from retailers, the city hubs are charged to ensure flows consolidation and to redirect them to the costumers in order to satisfy them. During the delivery process, product retailers and recyclable waste are shipped back to city hubs.

Our modeling approach aims to optimize hubs localization. To that end, hubs are considered incapacitated, where every type of vehicle used for vehicle routing has three kinds of capacities: capacity in products, capacity in returned products, and capacity in recyclable waste. Regarding the solution domain of candidate hubs, it is discrete and the number of hubs to locate is exogenous (the number is primarily specified) likewise this number of hubs can be single hub or multiple hubs.

1) Notation

The following parameters are used in the mathematical formulation of our model:

$i \in I$	Index of customers
$l \in L$	Index of potential location sites for city hubs,
$d \in D$	Index of retailers
$r \in R$	Index of remanufacturing center
$s \in S$	Index of waste sorting center,
$p \in P$	Index of type of product and waste,
$z \in Z$	Index of area

v ∈ V	Index of type of vehicle
t ∈ T	Index of period,
Dipdt	Demand of customer i in product p of retailer d during the period t
pvrpt	Sale price of product p to remanufacturing center r during the period t
pvspt	Sale price of product p to waste sorting center s during the period t
fdlt	Collection cost paid by retailer d to site l during the period t
filt	Collection cost paid by customer i to site l during the period t,
Cfl	Operating cost of site l
Bl	Building price of site l
Il	Cost of installation of site l
Tl	Property tax of site l
Cav	Purchase price of vehicle v
ɵv	Depriciation rates of vehicle v
CapaNv	Capacity of vehicle v in product
CapaRv	Capacity of vehicle v in returned product
CapaSv	Capacity of vehicle v in recyclable waste
Caplv	Cost of pollution in monetary unit associated to the veicle purchase on type v
Cpolv	Cost of pollution in monetary unit associated to transport goods by vehicle v per kilometer
dlz	Distance per kilometer between the site l and
dij	Distance per kilometer between customer i and customer j
Ct	Ttransportation cost in monteary unit of product per kilometer
Cpollt	Cost of pollution in monetary unit associated to the construction of site l
Caccl	Accessibility cost of resident in monetary unit associated to the site l,
Caccvz	Accessibility cost of resident in monetary unit associated to the passage of vehicle v in the area z
Chpl	Cost of breaking bulk in monetary unit of products type p in the site l
Cmv	Cost of maintenance in monetary unit of vehicle v
Celt	Cost of energy spend in monetary unit in the site l during the period t
Msl	Cost of payroll in monetary unit during the period t

2) Variables:

Ul=1 if city hub located at potential site l is open, 0 otherwise.

Wdlt=1 if retailers d has recovered returned products from city hub at potential location during the period t, 0 otherwise.

Wilt = 1 if customer i has chipped back returns or/and waste to city hub at potential location l during period t, 0 otherwise.

Wrlt =1 if remanufacturing center is allocated to city hub at potential location l during period t, 0 otherwise.

Oklzt =1 if the area z is allocated to city hub at potential location l during vehicle routing k and period t, 0 otherwise.

Okij=1 if customer i and customer j belong to vehicle routing k, 0 otherwise.

Xplt : Amount of goods p treated in hub at potential location l during the period t .

Xdlpt: amount of product delivered by retailers d to city hub at potential location l on product type p during the period t.

Xplit : Amount of products type p delivered from city hub at potential location l to the customer i during the period t.

Ypilt : Amount of products collected of type p from customer i and transported to city hub at potential location l during the period t.

Ypldt : Amount of returned products recovered by retailers d from city hub at potential location l during the period t.

Yplrt : Amount of returned products recovered by remanufacturing center r from city hub at potential location l during the period t.

Qpilt : Amount of recyclable waste type p collected from customer i to city hub at potential location l during the period t.

Qplst : Amount of recyclable waste recovered by waste sorting center s from city hub at potential location l during the period t.

Nbvl : Number of vehicles existing type v in city hub at potential location t.

Nbzlt : Number of areas allocated to city hub at potential location l during the period t.

The objective of our model is to found the best location of city hubs which maximize profit therefore our decision variable is Ul.

3) Objective function

The objective of our model is to maximize city hub's profit. It is obtained by the difference between generated revenue from the reverse flow and the total cost resulting from city hubs location. Regarding revenues, it is calculated by the sum between the resale of returned products and recyclable waste (Eq.3) and collection cost paid by customers for collecting recyclable waste and retailers for collecting returned products (Eq.4).

As for the total cost, it is calculated by the sum between five kinds of cost: fixed cost, transportation cost, logistic cost, pollution cost, and societal cost. Concerning fixed cost (Eq.5), it means operating and amortization cost of city hub and the cost of buying vehicles and its amortizations. As for transportation cost (Eq.6), it is about transport goods to client as well as the cost of their returned products and waste. Besides, we assume that the vehicle has three types of capacities to contain goods, returned products, and waste in the same routing vehicle. As for logistics cost (Eq.7), it is the sum of offloading cost, staff logistic cost, power cost, and maintenance cost. Finally, the pollution cost (Eq.8) defines the cost linked to hubs and vehicle emission (at purchasing and transport in urban area).

We formulate our problem as follows:

$$\text{Maximize}(\sum_p \sum_l \sum_r \sum_t Y_{plrt} * pv_{rpt} * U_l + \sum_p \sum_l \sum_s \sum_t Q_{plst} * pv_{spt} * U_l \quad (3)$$

$$+ \sum_d \sum_l \sum_t \sum_k f_{dlt} * W_{dlt} + \sum_i \sum_l \sum_t \sum_k f_{ilt} * W_{ilt} \quad (4)$$

$$-(\sum_l \sum_t (Cf_l + 0{,}05 * B_l + 0{,}1 * I_l + T_{lt}) * U_l + \sum_v \sum_t Ca_v(1 + \theta_v) * Nb_{vt} \quad (5)$$

$$\sum_t 2 * (\quad Nb_{zlt} \quad * \sum_k \sum_z \sum_l O_{lzt}) * C_t * U_l + \sum_i \sum_j \min d_{ij} * C_t * O_{ij} \quad (6)$$

with $\dfrac{\sum_l \sum_z d_{lz}}{}$

$$\sum_l \sum_v \sum_t Cm_v * Nb_{vtl} * U_l + \sum_l \sum_t (Ce_{lt} + 0{,}15 * Ms_{lt}) * U_l \quad (7)$$

$$\sum_l \sum_t Cpol_{lt} * U_l + \sum_v \sum_t Capl_v * Nb_{vtl} + \sum_i \sum_j \sum_k d_{ij} * Cpol_v * O^k{}_{ij})) \quad (8)$$

4) Constraint

Solving the above problem will allow us to find the best location of one or multiple city hubs which maximize the profit. In addition, we can assess the benefit generated by taking into account reverse flow. Equation (eq.9) stipulates that every area can be linked at most to L city hubs. Moreover, equations (10), (12) and (13) demonstrate that no delivery and returns can be made by non-open city hubs. Regarding eq. (12) and (15), they stipulate that

every retailer and remanufacturing center can be linked at most to one city hub. The following four equations define conservation of inputs and outputs flows, eq. (15) and (18) present the conservation of product flow. Eq. (16) and (17) define also respectively the conservation of returned product and recyclable waste flow. For eq. (19), (20), (21), (22), they stipulate that products, returned products and recyclable waste should not exceed the capacity of the vehicle to store these categories. Finally, eq. (23) and (24) define respectively positive variables and binary variables.

$$\sum_l O_{lzt}^k \leq \sum_l U_l \qquad \forall z \in Z, \forall t \in T, \forall k \in K \ (\mathbf{9})$$

$$\sum_k \sum_z O_{lzt}^k - K * Z * U_l \leq 0 \quad \forall l \in L, \forall t \in T \quad (\mathbf{10})$$

$$\sum_l W_{dlt} \leq 1 \quad \forall d \in D, \forall t \in T \quad (11)$$

$$W_{dlt} \leq U_l \qquad \forall d \in D, \forall l \in L, \forall k \in K, \forall t \in T \quad (\mathbf{12})$$

$$W_{rlt} \leq U_l \qquad \forall r \in R, \forall l \in L, \forall k \in K, \forall t \in T \quad (13)$$

$$\sum_l W_{rlt} \leq 1 \ \forall r \in R, \forall t \in T \ (14)$$

$$\sum_d \sum_l \sum_p X_{dlpt} = \sum_p \sum_l X_{plt} \quad \forall t \in T \quad (15)$$

$$\sum_p \sum_l \sum_r \sum_t Y_{plrt} + \sum_p \sum_l \sum_d \sum_t Y_{pldt} = \sum_p \sum_i \sum_l \sum_t Y_{pilt} \quad (16)$$

$$\sum_p \sum_i \sum_l \sum_t Q_{pilt} = \sum_p \sum_l \sum_s \sum_t Q_{plst} \quad (17)$$

$$\sum_p \sum_i \sum_l X_{pilt} = \sum_i \sum_p \sum_d D_{ipdt} \quad \forall t \in T \quad (18)$$

$$\sum_i \sum_p \sum_d D_{ipdt} \leq \sum_l \sum_v Nb_{vl} * CapaN_v \quad t \in T \quad (19)$$

$$\sum_p \sum_i X_{plit} \leq \sum_v Nb_{vl} * CapaN_v \quad \forall l \in L, t \in T \quad (20)$$

$$\sum_p \sum_i Y_{pilt} \leq \sum_v Nb_{vl} * CapaR_v \quad \forall l \in L, t \in T \quad (21)$$

$$\sum_p \sum_i Q_{pilt} \leq \sum_v Nb_{vl} * CapaS_v \quad \forall l \in L, t \in T \quad (22)$$

$$p \qquad i \qquad\qquad v$$

$X_{plt} \geq 0$, $X_{dlpt} \geq 0$, $X_{plit} \geq 0$, $Y_{pilt} \geq 0$, $Y_{pldt} \geq 0$, $Y_{plrt} \geq 0$, $Q_{pilt} \geq 0$, $Q_{plst} \geq 0$, $Nb_{vl} \geq 0$, $Nb_{zlt} \geq 0$ $\qquad \forall p \in P, l \in L, t \in T, d \in D, i \in I, r \in R, s \in S, v \in V, z \in Z$ $\qquad$ (23)

U_l, W_{dlt}, W_{ilt}, W_{rlt}, O^k_{lzt}, $O^k_{ij} \in \{0,1\}$ $\forall l \in L, d \in D, t \in T, i\,et\,j \in I, r \in R, z \in Z,$

$k \in K$ (24)

In this section, we deal with the competition model to evaluate our mathematical models. For this, we introduce an example showing four location possibilities including at most 400 customers. We aim to compute the best location among these possibilities. Each location possibility has three criteria:

1. Distance between platform and customers

2. Impact on the environment (pollution)

3. Grade service

In addition, we assume that there is only one type of vehicle having three kinds of capacity (maximum capacity of product, maximum capacity of returned product, maximum capacity of recyclable waste). Furthermore, we consider eight product categories:

1. Fresh product

2. Dry product

3. Frozen product

4. Dry product returned

5. End of life cycle of product

6. Box

7. Packaging

8. Other kind of waste

To do this, we used FICO Xpress 7.9 version to ensure optimization. Furthermore, we consider that demands and distances are randomly generated by FICO Xpress and Excel. Thus, we will have the optimal number of vehicle for rent in each period and the best logistic platform in order to have the best result. Therefore, we obtain as a result the profit for each number of customers (NC) and for each duration knowing that the resolution gives usually the opening of the second platform, which give the best profit. In the figure below, we measure the profit:

Profit

	NC=10	NC=50	NC=100	NC=200	NC=300	NC=400
30	-12027,6	-10855,3	-8113,32	-3037,37	1981,97	7074,96
90	-37172,9	-32640,7	-24738,2	-9380,22	5738,7	21196,1
360	-148564	-130448	-99471,7	-39081,4	21003,1	82622
720	-296999	-260869	-198897	-78620,1	41862,1	164306
1080	-445515	-391021	-298622	-117894	63329,2	246701

number of customers

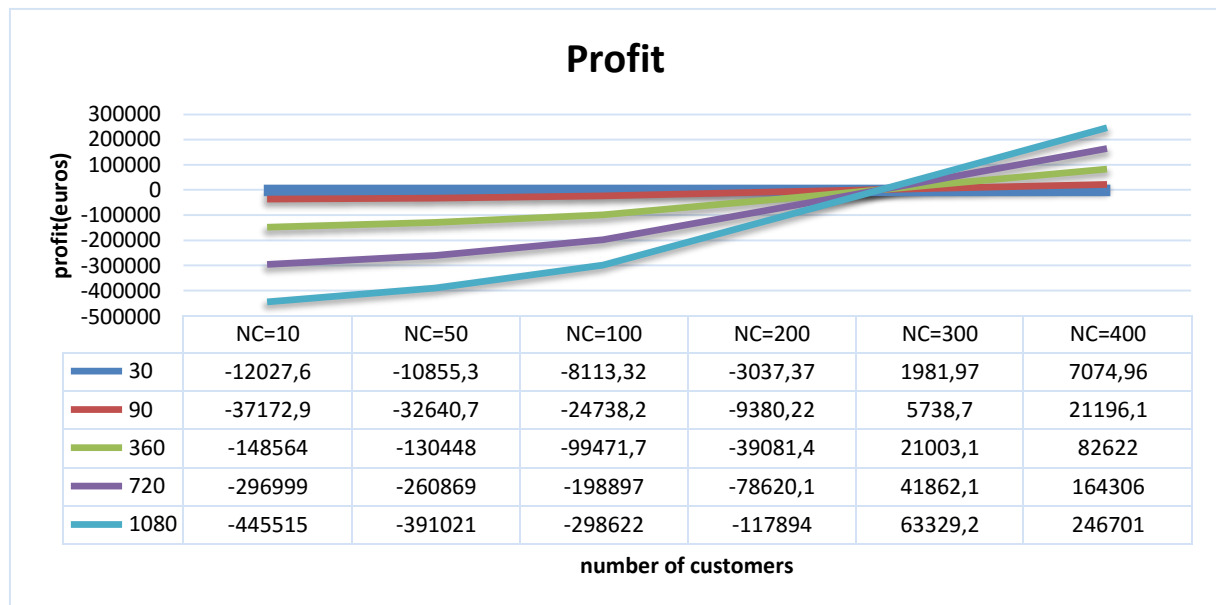*figure 5:Results resolution of the model*

The curves mentioned in figure 4 describe that the profit increases proportionately with the number of customers. This proofs that the model works correctly and that reverse flow added a gain to the system. We remark that all curves have an intersection point, whatever the number of period, where a profit is equal to zero (NC (number of customers) =265customers).

Table 2:Quantitative evaluation of logistics platforms

	1		2		3		4	
Distance	10.23	*	7.58	***	8.09	**	7.57	****
Pollution	16200	****	27000	***	27000	***	81000	*
Grade service	5313	*	17711	****	17711	****	8855	**
Total		6		10		9		7

According to the results mentioned in table 2, we are able to conclude that quantitative and qualitative evaluations have the same results validating our model. Synthesis Managing logistic platforms using direct and reverse flows seems to be the best solution when dealing with goods delivery in city center. In doing so, both delivery and return flows (e.g. returned goods or waste) will be treated by a single operator; thereby following a standardized process.

Moreover, pedestrians will have less traffics with a more organized and unified waste collection process. This can be observed based on the decreasing numbers of vehicles, the selection of ecological transport, and the management of such process by only one operator. Such improvements will have immediate impact on both environmental and societal aspects.

From an economic aspect, it will present, however, an issue due the operational cost. This may be a burden to invest in such platforms. For that reason, we have developed the aforementioned model. Our mathematical model will maximize profit by helping in choosing platform's location and their numbers. In addition, we define contracts between stores and platforms to agree on deliveries quantity with variant fees on waste collection. This will encourage stakeholders to be more environmental-aware and produce less waste.

VI. CONCLUSION

Urban Logistics is a global management presenting different means for economic and social development in modern cities. In this paper, we present an urban freight case study in the context of logistic platforms. We introduce different solutions relevant to urban city requirements. Moreover, we discuss potential improvements in order to reduce logistic platforms cost. We do believe that reverse flow is a promising approach presenting several advantages to make logistics solutions more attractive. To that end, we propose a mathematical model of logistics platforms location taking into account both direct and reverse flows. In this model, we find the best location for logistic platform(s), which allows maximizing benefit. Moreover, we consider the fixed cost, cost of transportation in the urban environment, logistic cost, cost of pollution and cost of acceptability of residents. As revenue, we will have the resale of returned products to re-manufacturing and the resale of recyclable waste to their disposal.

In future work, we will integrate reverse flow requirements in logistic platforms and assess their performance and maturity. Moreover, we will investigate additional features such as direct and reverse flows helping in logistic platforms location. In near future, we aim to compute the best location for each location platform, limit the number of vehicles, manage stakeholders' assignment, and determine objective values.

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Critical Skills for Cybersecurity Degree Programs

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Abstract

This paper examines our techniques for evaluating the critical skills needed in academic programs and outlines a methodology to develop localized curriculum leading to entry level jobs for undergraduate students. The authors outline a plan for institutions interested in the development of Cybersecurity degrees specific to their primary employers/region and discuss the main components which should be present in Cybersecurity degrees at the Undergraduate level regardless of the region.

RECONCILING TRANSNATIONAL JURISDICTION:

A COMPARATIVE APPROACH TO PERSONAL JURISDICTION OVER FOREIGN CORPORATE DEFENDANTS IN US COURTS

Dr. Gerlinde Berger-Walliser, University of Connecticut

ABSTRACT

After decades of inactivity, the issue of personal jurisdiction over foreign corporate defendants with no or little physical presence in the forum state has resurfaced on the agenda of the Supreme Court and is attracting attention from the legal community within and outside of the United States. Until recently, American courts have treated personal jurisdiction generously to say the least. Since International Shoe Co. v. Washington most lower and state Supreme courts have asserted personal jurisdiction over foreign or domestic out-of-state corporate defendants whenever the corporation had engaged in "sufficiently substantial continuous activity" in the forum state. These broad criteria, while difficult enough to apprehend in domestic cases, prove particularly daunting in the international setting.

Foreign corporations face lawsuits before U.S. courts in cases with—in their eyes—little connection to the forum state, in situations where their own domestic courts would typically deny jurisdiction. Combined with special features of U.S. procedural and substantive law such as class actions, contingent fees, discovery, and punitive damages, the Supreme Court's "minimum contacts rule" exasperates foreign companies and has spurred protest from foreign governments. Though consternation over the U.S. legal system may sometimes be exaggerated or emanate from false or incomplete information, studies indicate, foreign companies doing business in the United States rank "fear of legal liability" among one of their top concerns. They discern "the legal system as a drawback regarding investment in the United States" and are concerned with the high legal costs and a perceived lack of predictability and litigation fairness, which put the United States at a competitive disadvantage.

The United States is not alone, however, in providing "exorbitant" jurisdiction. European countries allow plaintiffs access to their courts based on criteria, which are deeply concerning from an American perspective. Legal commentators have called the difference in opinions and concepts a "justice conflict" between the United States and mostly (but not limited to) European civil law jurisdictions. The dissension has impeded international treaty negotiations, prevents mutual recognition of judgments, and places economic burden on plaintiffs and defendants. Recent Supreme Court decisions suggest that this is about to change.

In a series of cases decided between 2011 and 2017, the Supreme Court appeared to take steps toward gradually restricting personal jurisdiction over corporate defendants in general—and foreign corporations specifically. In Daimler AG v. Bauman, probably the most publicized out of the series of personal jurisdiction cases—at least from an international perspective—the Court limited general personal jurisdiction over alien corporations—except for "exceptional case[s]"—to their "place of incorporation and principal place of business," and attempted to bring U.S. rules more in line with international approaches. In J. McIntyre Machinery, Ltd. v. Nicastro the Court, in a highly controversial opinion, limited specific jurisdiction in a product liability case requiring the plaintiff to show that defendant intended "conducting activities within the forum State" where the injury had happened, thereby denying personal jurisdiction, where ironically European courts would have granted it.

The two most recent personal jurisdiction cases confirm the trend toward an increasingly narrow and more formalistic approach to personal jurisdiction over (foreign) corporate defendants. In BNSF Railway Co. v. Tyrrell, the Court, using its "comparative contacts test" developed in Daimler, found BNSF's contacts to the forum in no way substantial enough to form an "exceptional case", nor "of such a nature as to render the corporation at home in that State." In Bristol-Myers Squibb Co. v. Superior Court of Cal., San Francisco City., the Court held that a state court has jurisdiction over a nationally operating corporation only if all

plaintiffs were injured in the forum state, de facto limiting nation-wide class action lawsuits to the corporation's place of incorporation or principal place of business.

While the earlier decisions have already produced considerable commentary, the most recent cases have not. It is yet unclear whether the decisions indeed revolutionize personal jurisdiction rules as some have claimed, clarify precedent previously inconsistently applied by lower courts, or raise more new questions than questions answered. The role of international law for jurisdictional rules has barely been addressed in either case law or scholarly commentary. Policy consideration as expressed by Justice Sotomayor in her dissenting opinions in Daimler, BNSF and Bristol-Myers could serve as a future point of contention on the Court and suggest that the question of personal jurisdiction over foreign corporate defendants before U.S. courts is far from being resolved.

Based on a comparative analysis of jurisdictional rules in the United States and Europe, this article discusses whether the renovated U.S. paradigm of personal jurisdiction is apt to govern personal jurisdiction in global market realities in an equitable and effective manner. The article analyzes how the most recent decisions contribute to further defining jurisdiction over foreign corporate defendants and in how far they help—or hurt—reconciling opposing views in and outside of the United States. It argues that the Supreme Court's decisions since 2011, though importing certain elements of EU law into U.S. jurisprudence, remain deeply grounded in the traditional U.S. paradigm of jurisdiction, leading to inconsistent results and a lack of a theoretically sound personal jurisdiction doctrine. The article suggests that, in order to improve confidence in the U.S. judicial system internally and internationally, an entirely different approach, which breaks with traditional notions, may be needed. One way to achieve this goal could be to adopt the formalistic model of the EU Brussels regulation, and limit general personal jurisdiction, while expanding specific jurisdiction in a way that is predictable but compatible with U.S. values and constitutional requirements of due process.

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To this effect Part I discusses the meaning and function of personal jurisdiction in the United States and European Union and analyses the role of international law as a source for jurisdictional rules. Part II reviews the development of Supreme Court precedent and identifies the main sources and characteristics of U.S. personal jurisdictional rules. It summarizes the recent decisions in BNSF Railways and Bristol-Myers and places them within the earlier Supreme Court precedent. This part also examines policy concerns raised by the minority opinion in Daimler, BNSF Railways and Bristol-Myers. Part III compares the U.S. approach to that of the European Union and selected individual EU countries, particularly Germany, where much of the academic literature on the alleged U.S. – EU justice conflict originates. Part IV concludes.

Improving the Robustness and Transparency of Supply Chain by IoT Innovation

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Abstract

In this paper, we first describe and analyze the evolution of supply chain briefly. Then, we conduct a systematic research on the characteristics of supply chain system in IoT context and analyze how to realize the innovation of supply chain system in IoT context in detail. Moreover, we investigate the feasibility and effectivity of blockchain technology which to rebuild supply chain system based on the studies of trust mechanism in supply chains. Furthermore, a case study is adopted to illustrates how blockchain-orientated trust mechanism in agricultural supply chain assist supply chain supply and demand sides to enhance supply chain productivity and reduce transaction costs. At last, we make summarization and prospects for the realization of blockchain technology – orientated and IoT-based supply chain system.

Introduction

One obvious characteristic of contemporary social and economic development is the competition being more intense and the development of technological progress being more rapid, prompting enterprises to make a series of changes in the field of logistics and purchasing and more companies to adopt the thoughts and methods of Supply Chain Management (SCM), which not only can reduce the operating costs of enterprises, raise the speed of response to market demand, but also can improve the competitiveness of enterprises in market competition. Nevertheless, there are still certain issues of concern in the operation of supply chain management, such as the low level of intelligentization of SCM, poor visual management, high degree of uncertainty, low automation of certain industries, frequent manual errors, serious industry losses, difficulties in tracing products after sales, and etc. The research and development of Internet of Things (IoT) bring new opportunities to the innovation of SCM.

After the advent of computer, Internet and mobile communications, IoT is another revolutionary development of information industry. From perceptual layer, network layer to application layer, IoT involves a wide range of fields including standards, core technologies and products, as well as the integration and collaboration among various technologies, systems, products, networks and applications. With its long industrial chain and wide application, it is indeed omnipresent and all embracing. Therefore, research of IoT has been highlighted in recent years, its related research and development has also drawn great attention of a variety of countries.

Research of IoT

In 2005, in "ITU Internet Report 2005: Internet of Things" released by International Telecommunication Union, the concept of Internet of Things is mentioned (ITU., 2005). According to the report, goal of information and communication technology has developed from connecting anyone with anytime and anywhere to the phase of connecting anything, and the connection of everything forms Internet of Things. In September 2009, the EU Group released the "IoT Strategic Research Roadmap", which considers Internet of Things as an integral part of the future Internet (Saint-Exupery., 2009). In 2011, in "Building the Internet of Things using RFID: The RFID ecosystem experience", Welbourne Evan proposed the idea of establishing IoT through RFID, pointing out the importance of RFID in constructing IoT (Evan,W. et al., 2001).

In 2014, when energy crisis being more and more severe, Roselli,L. explore how to apply IoT technology in the field of energy and develop RFID technology, wireless power transmission and green electronic products to conserve energy, this can be also referred to in the application of IoT technology in other fields (Roselli, L. et al., 2014). As network technologies being applied in more and more ranges, through comparing the security of IoT with traditional network, Jing, Q. makes exploratory analysis on solutions to security issues of IoT, at the same time, warns applications of IoT technology, emphasizing that security issues and problems of IoT technology should also be focused (Jing, Q. et al., 2014).

The evolution of supply chain

The development process of supply chain concept has gone through three phases, which are Logistics Management phase, Value Chain phase and Supply Chain Network phase. With the changes of supply and demand context and continuous advance of information technology, emphasis of supply chain concept has been varied at different stages, and this concept is gradually improved. In this paper, we use the definition of Supply Chain Network phase, defining supply chain as a value added chain that comprises all the participating node enterprises in supply chain, starting from the supply of raw materials, the manufacturing process, product sales, and to end users. Logistics, information flow and cash flow are all covered (Christopher, 2011).

SCM is to use integrated resource integration concept, advanced information technology and control technology to manage and coordinate the supply chain network commencing from original supplier to ultimate customer so as to satisfy supply chain members, enhance the efficiency of the whole supply chain, follow the cost-effectiveness principle to the greatest extent and meet customer demands.

Factors Affecting supply chain

For manufacturing companies, if R&D is the foundation of gaining competitive advantage and sustainable development, then, Supply Chain is the engine and accelerator of becoming prosperous and abound. A good supply chain management can reduce commercializing and operating costs and ensure shipping speed, that is directly supporting enterprises to enhance their core competitiveness.

However, with the continuous deepening of the division of labor in the global economy, supply chains of modern enterprises have been continuously prolonged and fragmented, complicated and geographically dispersed. This poses a great challenge to supply chain management. some fundamental challenges existing in it are still apparent and unavoidable, which are reflected in the following aspects:

There is always a two-way flow of information among suppliers, manufacturers, distributors and customers in supply chain. Since information cannot be effectively shared, information regarding supply and demand is often distorted or amplified step by step, resulting in greater demand information fluctuations, which is also the typical bullwhip effect in supply chain (Udenio, 2015). Due to the multi-level information transfer in supply chain, it is impossible to eliminate the bullwhip effect, which inevitably raises supply chain cost and lowers supply chain efficiency.

Counterfeit and shoddy products appear in market ceaselessly; product quality problems frequently occur; and supply chain members lack basic trust (Capaldo, et al., 2015). When problems occur, suppliers and manufacturers usually tend to clarify their responsibilities and attribute fault to upstream or downstream suppliers, resulting serious disruption of market order (Singh, et al., 2016). To eliminate counterfeit and shoddy goods and ensure the rights and interests of customers being protected, every link of supply chain have to be strictly inspected and supervised so as to establish a supply chain which is transparent, mutual trust, and take the initiative to comply with agreement.

In essence, supply chain is to achieve earnest cooperation and coordinated development among enterprises through information sharing (Khan, et al., 2016). Nevertheless, as a result of the short-term and temporary interests among the nodes in supply chain, information can barely be shared among the members in supply chain (Kim, et al., 2017). The crisis of trust among supply chain members is reflected in the asymmetry of trust between upstream and downstream enterprises and the absence of trust mechanism in supply chain.

For their own interests, individual enterprise strictly keep their own business information confidential or even share false information, resulting in information asymmetry between upstream and downstream enterprises in the supply chain, poor communication, coordination difficulties in business activities, high costs, the lack of controllability, and the reduction of supply chain efficiency.

Hence it is imperative to solve these problems existing in the development of supply chain, rebuild supply chain system through Blockchain technology, and make profound changes in the context of Internet of Things (IoT).

Introducing Blockchain

Definition of Blockchain

Blockchain technology and its application is currently a topic in the spotlight. It generally refers to the application platform based on blockchain technology. Each functional entity of the blockchain (including blockchain application and blockchain service platform) jointly maintains one or more distributed peer-to-peer ledgers, and the data in the distributed ledger is encrypted and stored, making it hard to be rewritten or forged (Swan, et al., 2015). Blockchain technology is highly anticipated and considered to be a trusted, accountable, transparent and efficient trading application (Maria-Lluïsa, 2017). It can be applied in the fields of financial services, healthcare, government, manufacturing, retail, media and entertainment, supply chain and logistics.

In this section, some characteristics of blockchain technology and blockchain thinking will be briefly analyzed, and approaches to optimize IoT network and service platform through utilizing blockchain will be introduced.

Bitcoin is a source code based on peer-to-peer and decentralized networks (Nakamoto, 2008). Blockchain, as the underlying technology of bitcoin, is a new distributed architecture and computing paradigm that applies cryptography to encrypt data transmission and access (Noguchi, 2017). In Bitcoin system, the problem of double payment and Byzantine issues are innovatively fixed. In detail, the double payment problem refers to utilizing the digital nature of money to complete multiple transactions by paying "one sum of money"; the problem of Byzantine general refers to the fact that in the absence of third-party trust institutions, it is difficult to establish mutual trust mechanism. And in Bitcoin system, the above two problems are both resolved.

Basic Framework Model of Blockchain

Blockchain transformed "digital currency" into "smart contract". In blockchain 2.0, added benefits include the support of multiple consensus algorithms, ease of distributed application programming, and fast transaction speed (Kshetri, 2017). Generally, the basic framework consists of four layers: The first one is the basic awareness data layer, including data blocks, chain structures, timestamps, hash functions, Merkel trees, asymmetric encryption and other technical components. The second one is the virtual awareness network layer, concluding P2P network and transmission mechanism. The third one is the consensus layer

of core awareness, which upholds various consensus algorithms such as PoW, PoS and DPoS. The last one is the application layer of realistic awareness, involving blockchain finance, block supply chain, and etc.

Reshaping Supply Chain System with Blockchain Technology

In the context of big data and IoT, utilizing blockchain technology to the collection and application of key information in various aspects such as warehousing, logistics, distribution and retail in the supply chain allows the optimization of the entire business process for supply chain and the realization of real-time dynamic tracking of goods flow information in supply chain. In detail, these include:

Establishing Identification of Items

At the source of supply chain, with the application of Internet of things and Internet's RFID radio frequency, fingerprints and sensors, wearable devices such as aids management technology which can identify all items, suppliers are able to make real-time record of all the information regarding production and circulation to blockchain, and within the entire network, it is impossible to be tampered. Through programmable language, blockchain input key information of supply chain flow, and also contribute to the source tracing of supply chain for relevant enterprises.

Solving Problems of Safety and Trust

Blockchain is able to record real life trajectory of every item in supply chain as a result of its high credible consensus and unforgetable characteristics (Kshetri, 2018). Therefore, consumers can use smartphone or tablet to scan the purchased products so as to trace the source, finding out the manufacturer, place of production, origin of raw materials and other related information of production, ensuring that the goods are genuine, and the possibility of purchasing fake and shoddy goods can be greatly diminished. With the identification of source, the recording of production, logistics, sales and after sales throughout the entire cycle is significantly facilitated. Meanwhile, the tracing of goods and the grasp of goods flow ensure the interests of consumers can be protected and demands of consumers can be better satisfied.

Dentsu's Blockchain-Based Traceability System

The company of Information Service International-Dentsu, which deals with system construction, to utilize benefits of difficult tampering for food traceability (tracking production history). In March 2017, they carried out selling experiments on organic vegetables at Morning Market held in Roppongi, Tokyo, Japan.

QR code is given to one vegetable such as Komatsuna and carrot cultivated in Aya-chu, Miyazaki Prefecture. When the consumer reads the QR code on the smartphone, information such as the place of production, date and time of harvest, use of pesticide, is displayed. "It seems to be safe because not only the production

area but also the process of production is visible", the evaluation of the visitors was superior. From the viewpoint of safety, food specially requires strict logistics management. Why was a producer of vegetables proclaimed that "information is correct"? And why did consumers trust that "sales talk"? This is a crucial part of blockchain.
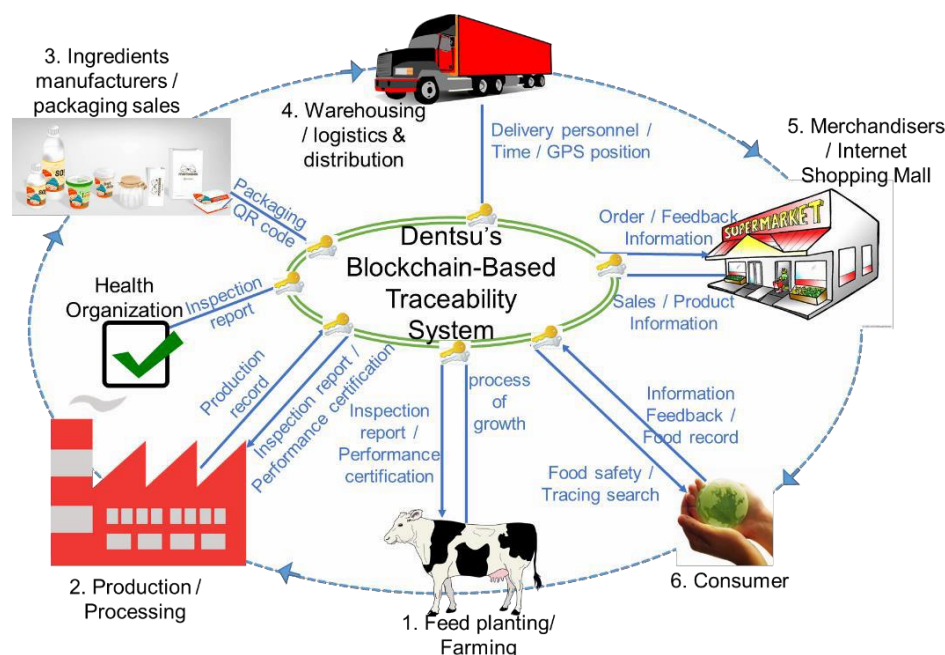
Figure 1. Dentsu's blockchain-based Traceability system

In this experiment, data was written at the stage when producers planted vegetables, weeded, and harvested the fields (see Figure 1). Not only the growth situation, but also soil condition will be upgraded sequentially with photos. When the production farmer's writing reaches a certain amount, data can be blocked. After that, the data is shared with the computer owned by each producer via the Internet. Then, everyone always monitors whether the written information is correct or not.

In the mechanism of blockchain, it is decided whether data is correct by majority vote between computers. Therefore, when trying to tamper with data, it is necessary to take over a majority of the computers connected to the network at the same time and rewrite the data. Even if one producer wants to disguise pesticide usage later, it is impossible in reality. On the other hand, in a conventional information system, when a server that centrally manages data is hijacked, the reliability of data is lost. According to the manager of Information Service International-Dentsu, since March in 2017, "Inquiries from other vegetable origin and livestock farmers increased". Blockchain seems to be attractive for those who are cultivating crops properly.
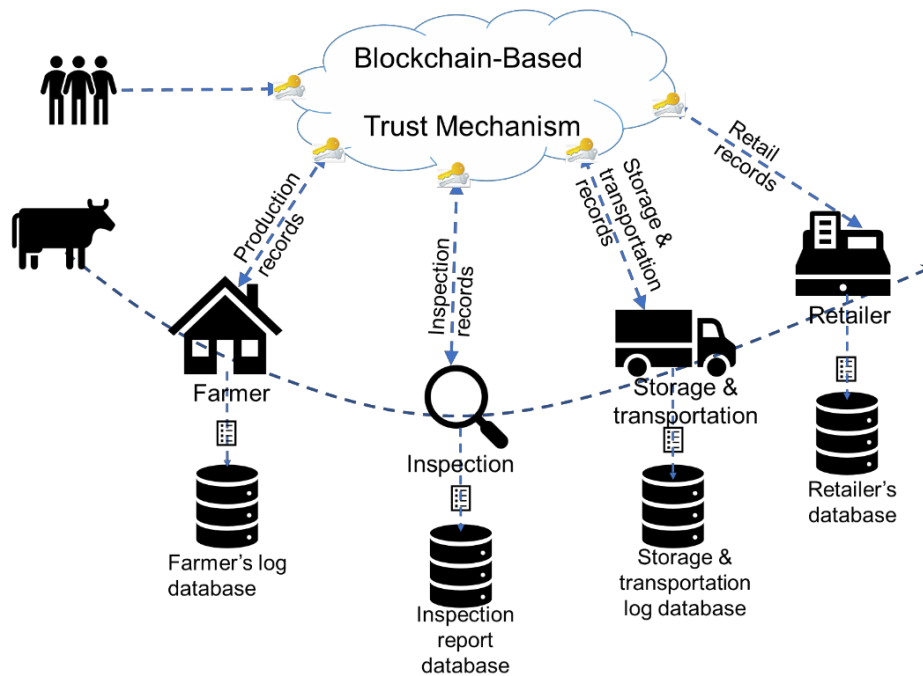
Figure 2. Blockchain-based trust mechanism in agricultural supply chain

Building Blockchain-Based Trust Mechanism for Improving Supply Chain Robustness and Transparency

Far distance between production place of agricultural products and consumption, consumers' very little understanding of the pesticides and fertilizers used by producers as well as the information on transportation, the additives used in processing, and etc, resulting in the diminishment of consumers' trust in products. The agricultural product traceability system based on blockchain technology can record all the data on the ledger and realize the full-course traceability of the quality of agricultural products and the main entities of transactions, hence enable the information to be more transparent, and the traceability service on quality and utility can be actualized.

On the one hand, the safety of agricultural products is ensured, with the resilience of agricultural supply chain being enhanced and fake and shoddy products being cracked down and eliminated. On the other hand, the quality, price fairness and effectiveness of agricultural supply chain itself are ensured. Meanwhile, the level of innovation and R&D of entire agricultural supply chain, as well as the quality and efficiency of utility can also be improved.

The introduction of blockchain technology enables all supply chain node companies to accurately grasp data and information, forming a smooth and transparent information flow in blockchain-orientated supply chain trust mechanism, and problems existing in operation process can also be timely detected and solved. At the same time, the time-stamped blockchain data and information can resolve the disputes among entities

in supply chain and improve supply chain resilience by absolute information sharing among entities (see Figure 2).

Conclusions

The competition in 21st century is no longer the one between individual enterprises, but the one among supply chains. In recent years, with environmental pollution, lack of resources and frequent occurrences of product quality problems, supply chain is in urgent need of enhanced resilience. Meanwhile, as blockchain technology gradually develops and booms, nearly all the industries are embarking on the development and application of this technology. In the era of big data and IoT, how to apply blockchain technology to solve problems in order to improve supply chain resilience? This is one of the trends in the development and innovation of supply chain.

In this paper, firstly, describe and analyze the evolution of supply chain and And then we conduct a systematic research on the characteristics of supply chain system in IoT context and analyze how to realize the innovation of supply chain system in IoT context in detail

Moreover, we investigate the feasibility and effectivity of blockchain technology which to reshape supply chain system based on the studies of traceability system in agricultural supply chain with a Japanese case study. In the end, we make summarization and prospects for the realization of blockchain technology – orientated and IoT-based supply chain system.

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Keywords: IoT Innovation, agricultural Supply Chain, Blockchain.

Gender, Exogenous Institutional Factors and the Performance of MFIs

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ABSTRACT

This paper examines the role of females as borrowers and loan officers in supporting the dual MFI goals of performance and socio-economic developmental goals. Financial performance is measured by traditional financial measures that project MFI stability. Following Scott (2014), the institutional variables classified as normative, regulatory and cultural-cognitive, will be examined to understand socio-economic factors that influence MFI performance and its relation to the effectiveness of females in MFI performance. Specifically, the research considers exogenous institutional factors, such as culture and female education (Cognitive), corruption and inequality (Normative) and legal systems and property rights (Regulatory) in the financial performance of such MFIs. Results suggest that gender and socio-economic factors do impact MFI performance, although the role of financial measures in adverse socio-economic environments (Corruption and Inequality) may suggest the potential of MFI mission drift (Battilana & Dorado, 2010). While female education does influence performance, the relationship of female education and performance also calls into question whether MFIs fully avail of their opportunities for social development. Other variables that proxy for outreach, specifically loan size, present complementary results that also highlight the need to manage MFI growth and operations, but did not provide evidence of mission drift.

INTRODUCTION

MFIs have increasingly formed part of the established policy to address poverty through providing incentives for self-improvement and developing entrepreneurial abilities of the poor to become self-sufficient (Ledgerwood, Earne, & Nelson, 2013). While the overall results of MFIs have been mixed and often meet with criticism, MFIs nevertheless continue to thrive, and have been found to also have the potential to address social issues such as the role of women in society (Hartarska, Nadolnyak, & Mersland, 2014). Specifically, given that females form the larger proportion of borrowers, it is also a means to address the important role of empowerment, upliftment, and enablement of women to reach their potential given the factors that often play a role in determining and limiting their role in society.

Despite limitations posed by uncertainty of outcomes, funding for micro-finance

policies (Mayoux, 2000). An optimism about the implicit empowerment potential of credit and savings pervades most donor statements on microfinance. Donors and NGOs tend to expand their micro-finance activities generally rather than support more explicitly empowerment-focused interventions for women. At the same time, microfinance is being promoted as a key poverty alleviation strategy to enable poor women and men to cope with the adverse economic and social impacts of structural adjustment policies and globalization

While there is a shared understanding and general consensus on the functions of microfinance institutions (MFIs), their potential for the empowerment of women has been much debated (Kulkarni, 2011). Studies have indicated both the promise of MFIs and the challenges they present for women's empowerment. In this context, various factors – economic, organizational, political and cultural – have been emphasized. As much as donors like to see an immediate impact on empowerment and poverty, they are at the same time concerned about the financial self-sufficiency of the intermediary. Funding for microfinance is increasingly dependent on progress towards financial self-sustainability within a given time-frame. The cost-cutting measures in micro-finance programs may have potentially negative implications for poverty-reach and contribution to women's empowerment (Mayoux, 1998; Mayoux, 2000). Thus, the role of MFIs strikes a delicate balance between the banking and development logics, so as to avoid "mission drift" (Battilana & Dorado, 2010).

Nevertheless, growth of variations and changes in practice continue to increase. This paper considers female potential in MFIs, first as borrowers and then as lenders (loan officers) in contributing to the MFI financial stability. Then, as in Boehe & Cruz (2013), we consider how institutional factors, cultural cognitive, regulatory and normative, would influence the effectiveness of MFIs. While the female borrowers form a significant proportion of total MFI borrowers, their contribution to financial stability is crucial in their long-term upliftment and empowerment. The role of the MFI lenders would also play a role, first in their own independent contributions to MFI stability, and in their support of female borrowers. Institutional variables play a role in either supporting or constraining female effectiveness. Thus, this paper extends Boehe & Cruz (2013) by both considering the female borrower and lender, and integrating institutional theory by investigating cognitive and regulatory institutions in MFI female effectiveness in supporting financial stability. This paper provides a deeper and more extended view, including regulatory, normative and cognitive aspects of institutional theory to interpret the

cultural context that influences their lives and hence their MFI performance. Constraining factors could also thwart the effectiveness of female role.

Overall, the goal is to understand how performance is affected by a combination of factors that have impact on managing MFIs (cultural factors) and others that have extraneous impact (women's education, legal systems). Cognitive-Cultural components play an important role in enabling female entrepreneurs to reach their potential. Cognitive constructs, specifically the educational environment, form another construct on what could influence female initiatives, while cultural constructs (drawn from Hofstede) form one way of measuring and indicating how environment shaped by such dimensions (Hofstede, 1980) influence female contribution to MFI performance. Legal systems, specifically common law and code law (La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1997) may also make it possible to engender initiatives and influence performance. Normative factors that may have ambiguous influence as social norms allow or seek to constrain widespread inequality or corruption would also influence MFI effectiveness.

Results suggest that female borrowers and loan officers do positively impact financial performance, and may contribute to the stability of MFIs. Female education did lead to stronger MFI financial outcome, although, results appeared to suggest that female education was inversely correlated with female borrowings, and also had low correlations with loan officers. Results also suggest that normative factors such as corruption and inequality were related to higher MFI financial performance. These results were ambiguous, as it was not clear whether the institutional environment enabled the MFIs to play a developmental role, or whether there were more opportunities to avail of financial benefits from opportunities presented. Overall, financial performance by themselves did not provide sufficient evidence of whether MFIs fulfilled their developmental mission. To further examine the question of mission drift, loan size, a proxy for depth of outreach (a developmental goal) was examined. The results appeared to suggest that female borrowers were able to avail of smaller loan sizes. Overall, these results were consistent with the development goals of MFI.

Overall, the paper builds on MFI literature, particularly recognizing the influence that extraneous factors may exert on MFI agents that results in MFI performance leads to research questions, specifically, contributions of female borrowers and loan officers in financial stability, and the role of such institutions in enabling effectiveness. The next section provides an overview

of the theory on gender, institutional theory and MFIs, followed by the hypothesis development. This is followed by the sections on methodology and models, and results analysis. Finally, the last section presents conclusions.

GENDER, INSTITUTIONAL THEORY AND MFIs

A significant portion of the world population experiences some form of poverty, with women often bearing the brunt of the problems. Microfinance has emerged as a potential tool to improve the livelihoods of poor and vulnerable people. The core function of a microfinance program is to provide financial services, to reach poor women and men and give them access to savings and credit (Hartarska et al., 2014). However, the potential of microcredit goes beyond the provision of such financial services, and has begun to occupy a central position among the policies related to poverty reduction in the developing world (Galak, Small, & Stephen, 2011). Microfinancing, or small uncollateralized loans to entrepreneurs in the developing world, has recently emerged as a leading contender to cure world poverty. The concern that follows from this is: how microcredit can be an effective intervention/strategy of poverty alleviation. A key area that can help enhance the effectiveness of microfinance as an anti-poverty intervention is the role and influence of MFIs on women.

MFI and Gender

Women are vulnerable from different perspectives; as individuals, they may lack access to banking services, have low paid employments, including significant domestic work, may be less educated and have lowered confidence to assert political and legal rights. Likewise, within households, they may have disadvantages in relation to jointly owned properties, including liquid assets, and within the larger social system, may lack access to markets from lowered mobility, legal rights to household items ill-defined, and lowered opportunities through financial intermediaries such as banks, who may not view them as a potential market (Ledgerwood et al., 2013). In the face of such ongoing handicaps, the overall impact of poverty reduction requires addressing the issues related to this weak link that stands as a barrier to significant changes in poverty.

The opportunities arising from the developments in MFI form crucial opportunities for the upliftment and development of women, while serving to bring them out of poverty. However,

women also can play a key role in bring change and upliftment, and creating a stabilizing environment for their families when given the opportunity. Therefore, it is important to gain an understanding of women's role in MFI performance, and factors that could influence that performance. Studies show that women manage money differently from men and have different leadership styles. Thus, in credit unions and financial firms, female and male managers achieve different results. Women can operate in different areas within MFIs, as borrowers or as part of MFIs, as lenders, loan officers and CEOs. The focus of this paper is on gender role in MFIs as borrowers and loan officers, in the context of the institutional environment in which they operate. This distinction helps design microcredit programs more effectively, because while the smooth functioning of microfinance is dependent on the stability of economic institutions such as banks and moneylending organizations, the potential of microfinance is dependent on the health of social and socio-economic institutions such as social norms, patriarchy and education. As women are the key actors in the microfinance system, this distinction becomes not just important, but necessary.

Regarding the stability of MFIs, key aspects relate to financial stability or sustainability from consistent profitable financial outcomes. Research suggests differences in outcomes regarding effectiveness of females in MFI in a variety of different areas, as well as the impact of MFI on female empowerment. D'Espallier, Guérin, & Mersland (2011) for example, find that a higher percentage of female clients in MFIs is associated with lower portfolio risk, fewer write-offs, and fewer provisions, all else being equal. Interaction effects reveal that, while focus on women is generally associated with enhanced repayment, this trend is stronger for nongovernmental organizations, individual based lenders, and regulated MFIs. Others appeared to suggest that female presence was not always positive. Hermes & Lensink (2011) find that MFIs that have more women borrowers as clients (a measure of the depth of outreach) are less efficient than others. Afrane & Adusei (2014), examining data from Ghana, find that in general females are more likely to default on their loans than males. In a similar vein, research has found that MFIs did provide female entrepreneurs the opportunity to reduce poverty in Pakistan (Mahmood, Hussain, & Matlay, 2014). However, some research highlighted levels of ambivalence in outcomes in such areas as income, savings, expenditure, and the accumulation of assets, as well as non-financial outcomes including health, nutrition, food security, education, child labor, women's empowerment, housing, job creation, and social cohesion using MFIs from

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Sub-Saharan Africa (Rooyen, Stewart, & de Wet, 2012). Weber & Ahmad (2014) examine whether microfinance supports the empowerment of female borrowers in Pakistan, while others such as Narita, Rojo, & Marquez (2014), find that demands of female clients that are transitioning into the small business segment, especially in Latin America and the Caribbean, rarely integrated a gender focus and thus lacked developing value propositions tailored to that growing female clientele. However, some researchers have questioned how far microfinance benefits women (Goetz & Gupta, 1996) while some argue that the attention and the resources of donors from alternative, and possibly more effective means of alleviating poverty (Rogaly, 1996).

MFI research has also examined the role of female management and female loan officers. This is important given the need for greater gender focus, given the large proportion of female borrowers. Narita et al. (2014), for example, find that demands of female clients that are transitioning into the small business segment, especially in Latin America and the Caribbean, rarely integrated a gender focus and thus lacked developing value propositions tailored to that growing female clientele. Strøm, D'Espallier, & Mersland (2014) find female leadership to be significantly associated with larger boards, younger firms, a non-commercial legal status, and more female clientele. Furthermore, they find that a female chief executive officer and a female chairman of the board are positively related to MFI performance, though the result did not appear to be driven by improved governance. Hartarska et al. (2014) find that gender diversity on the board of MFIs is beneficial, and loans authorized by female loan officers have lower default rates. Specifically, they find that MFIs with female CEOs have significantly higher outreach efficiency than MFIs with male CEOs. Overall, the results suggest that promoting gender diversity at the top levels of MFI management is likely to have both social and financial benefits. These results are also consistent with that of Adams & Ferreira (2009) who find results suggesting that the presence of women on corporate boards strengthens monitoring, while Mersland & Strøm (2009) find that firm performance improves with the presence of local directors and a female CEO. Further, Beck, Behr, & Guettler (2013) find that loans screened and monitored by female loan officers in Albania had a lower likelihood to turn problematic than loans handled by male loan officers. While this performance gap always existed for female borrowers, results appeared to show that only female loan officers with experience gained a performance advantage with male borrowers. Further, Galak et al. (2011) investigate the

characteristics of borrowers that engender lending and find that lenders favor individual borrowers over groups and also borrowers that were socially proximate to them across three dimensions of social distance (gender, occupation, and first name initial). Specifically, they find that female lenders preferred to lend to female borrowers. However, Agier & Szafarz's (2013) analysis detects no gender bias in loan denial, but do find a gender gap in loan size that increases disproportionately with respect to the scale of the borrower's project. The results are insensitive to the loan officer's gender. They also found that female loan officers were more reluctant to grant loans and they supply smaller ones, regardless of the applicant's gender.

Institutional Theory and MFIs

Institutional factors provide further insights into the role of MFIs, which are dependent on the health of social and socio-economic institutions such as social norms, patriarchy and education. As women are key actors in the microfinance system, as well as in the poverty reduction endeavors, this distinction becomes not just important, but necessary. The importance of the cultural and social environment in which women live and work is necessary to understand influences on the effectiveness of female involvement in MFI as either borrowers or loan officers (Kulkarni, 2011; Boehe & Cruz, 2013). Institutional theory provides a basis to understand the socio-economic factors that influence the relationship between female membership in MFIs and MFI performance. While there is no universally agreed definition of an 'institution' in the institutional school of thought, they are generally recognized as social structures that have attained a high degree of resilience (e.g., Scott, 2014). Hence, resilient aspects of social structure that emerge when schemas, rules, norms, and routines become established as authoritative guidelines to give stability and meaning to social life and behavior and would form institutions (Scott, 2004). Further, such institutions have been classified as composed of cultural-cognitive, normative, and regulative that operate at different levels of jurisdiction, from the world system to localized interpersonal relationships (Scott, 2014, pp. 56-57).

Regulatory institutions, foundational to institutional theory, consist of rule-setting, monitoring and sanctioning activities. Regulatory processes involve the capacity to formulate rules, inspect conformity to rules and manipulate sanctions (rewards and punishments) to influence future behavior. Regulations can facilitate markets where such institutions lead to stability and predictability (lower uncertainty) and reduce transactional costs (Scott, 2014). This

paper specifically considers the legal systems that differentiate in the way that laws are implemented, and the extent of protection through the regulations, particularly the role that stakeholders have in this implementation. Law supports and protects the rights of property and develops other means to enable MFIs to develop and protect funding sources. Where such laws strengthen markets, they can also be effective in filling institutional voids. The distinction between code law and common law may reflect various aspects of the regulatory system, for example, on rule setting versus rule implementation. Where rule setting becomes the focus, law is governed by governments, and the nature of such laws may be governed by the rational choice perspective where individuals craft laws that potentially advance their interests, while conformance to laws seeks attendant rewards or avoidance of sanctions. Such motivation driven by consequences of enforcement can motivate action, but rules must be interpreted and disputes resolved, incentives and sanctions must be designed, and costs of surveillance must be assessed, as also the consequences of violations of laws. Where law itself is determined through processes that examine its validity, rightful application and extensively judicial processes, this leads to checks to safeguard property rights. In a strong institutional environment, the legal framework, particularly the rule of law and property rights, works efficiently and has built-in safeguards to prevent opportunistic behavior that can undermine these rights (e.g., through corruption). This efficiency means that property rights can be effectively defended against illegitimate expropriation because courts and law enforcement act quickly and vigorously to resolve disputes (North, 1991). In contrast, in weak institutional environments, lawfully acquired rights can only be claimed through time-consuming, bureaucratic, and often corruption-prone procedures, if they can be claimed at all. This paper considers legal systems from the La Porta perspective, distinguishing the implicit nature of common law and code law systems and their implications on the legal environment that supports female MFI management and entrepreneurial activity.

The second component, normative institutions, are viewed as imposing constraints on social behavior while also empowering and enabling social action. The normative pillar consists of the moral or obligatory dimension that includes prescriptive guidance. Scott (2008) depicts two alternative approaches to normative behavior, first based on what was appropriate given the situation and the role of the actors in that environment, and the second, "instrumental" or "reactive approach" that consisted of external institutions that were adapted based on actors' preferences. From the macro perspective, socially widespread approaches and outcomes have

moral overtones that shape society. Moral obligations are embedded within the social context. In understanding what was appropriate, widely accepted behaviors could become normative as it gains widespread acceptance, while it may be driven by more powerful forces that have control on outcomes. Thus, to varying degrees, they become internalized by actors and roles are formally constructed. Such roles can have varying access to material resources, and can emerge informally as, over time, through interaction, differentiated expectations develop to guide behavior.

Where there are differences in roles and their access to resources, what are the implications of such differences and what forms of incentives do they provide? What are the strengths of norms in place and how can they be accommodated to alternative logics? Institutions are transmitted by various types of carriers, including symbolic systems, relational systems, routines, and artifacts. To further explore the role of normative influences, this paper examines two aspects that may impact women and their poverty reduction role, specifically, inequality and corruption in society. While moral institutions depict appropriateness, the norms in place may be adversarial in nature for the poor – where failures in such morality infect the social systems, their influence on society impact gender and their role. For example, in democratic societies, Dion (2013) highlights the negative impact of corruption on democracy and ethics diminishes social trust and downgrades support for democracy. The coexistence of corruption and democracy is visible, for example, in Mexico and India, which are ranked 72nd and 85th respectively on the Transparency International's Corruption Perceptions Index 2008 (Transparency International, 2008). Widespread corruption could lead to a quasi-state (or "shadow state") that reduced the legitimacy of the official state. Thus, both demand and supply of bribes increase, further subverting governance structures. Corruption would impact MFI lenders and borrowers directly, where expectations or demand side permeates social fabric. The borrower would also face the challenges of functioning in a society where the entrepreneurial abilities would be constrained by the ability to overcome hurdles in place from such corruption. Additionally, social environments also reflect the implications of capitalism without hedges to protect the rights of the vulnerable, leading to widespread inequality that may also result from lower industrialization and changing business opportunities.

Cultural-Cognitive Institutions have two components that have merged, the first, the cognitive, which depicts symbolic representations or expressions such as words, signs, gestures

that shape meaning to objects and activities (e.g., Boehe & Cruz, 2013). This cognition or frames of thinking form a full range of information processing activities, determining what information to process, what to retain, how it is to be interpreted, impacting judgements, evaluations, predictions, and inferences (Scott, 2014, p. 67). This cognition element is supplemented by the cultural framework, that presents patterns of thinking embodying the "way we do things." Cultural beliefs can vary with individuals or groups, and over time, with change and emergence of contesting views. Those connected with the culture will have greater certitude and stay connected, in contrast to those who are at odds with the culture. Overall, cognitive-cultural element consists of knowledge systems that emerge from agents observing the world, and organizing their ideas to gain acceptance within the context of their environment. Such cognitive institutions are culturally supported and embedded. Education levels form one important cognitive institution in society. In addition, cultural aspects such as patriarchy or individualism (Hofstede, 1980) could impact how businesses and institutions lend and borrow, and conduct business. Such cultures develop different forms of interactive schemas that become institutionalized. Thus, education would be useful and effective in the context of cultural factors within that society. The cultural variable forms another aspect of the cognitive-cultural institution.

The research theoretical foundation leads to the research questions, as further elaborated below.

HYPOTHESIS DEVELOPMENT

The theoretical development leads to key elements of the hypothesis. The potential of MFIs is realized through stability, first of economic institutions such as banks and moneylending organizations, and more broadly, the health of social and socio-economic institutions such as social norms, patriarchy and education. Thus, poverty alleviation intervention is embedded within the larger social system, the economic, political, ideological and cultural categories, that exercise influence over them (e.g., Kulkarni, 2011). To understand the role of MFIs in uplifting women, it is necessary to therefore understand the influence of institutions on women and their ability to use loans in development and empowerment at the organizational levels to ensure sustainable development. Hence, while the focus of the hypothesis is gender influence on MFIs, the research examines the resulting financial stability and outreach goal in the context of the larger institutional environment, such as the regulatory and cultural-cognitive (e.g., Boehe &

Cruz, 2013). The role of women can be stabilizing, given their facilitating relationship orientation and decreased mobility can make relationship-based exchanges smoother. However, women are also more vulnerable to external factors such as a patriarchal society with higher power differences and lowered opportunities in education opportunities.

Women can operate in different areas within MFIs, as borrowers or as part of MFI, as lenders, loan officers and CEOs. The focus of this paper is on gender role in MFIs as borrowers and loan officers, in the context of the institutional environment in which they operate. Such external factors include institutions that are manifested in cultural norms, gender identities, and values that can help explain the relationship between microfinance and women's empowerment is revealed. The key hypotheses are:

Female Borrowers Hypothesis

Women, who form the majority of borrowers, manage money differently from men and have different leadership styles (Hartarska et al., 2014). Weber & Ahmad (2014) examine whether microfinance supports the empowerment of female borrowers. Results of studies analyzing microfinance and empowerment in Pakistan delivered mixed results. They found that women in a higher loan cycle were more empowered, suggesting that MFIs did impact indicating that than those regarding their empowerment. The available evidence shows that microfinance does harm, as well as good, to the livelihoods of the poor. Others suggested that MFIs did provide female entrepreneurs the opportunity to reduce poverty. Mahmood et al. (2014), for example, presents results that suggest that microfinance can help reduce poverty amongst women entrepreneurs in Pakistan.

An important question that arises is the influence of women borrowers on the effectiveness of MFIs. Hermes & Lensink (2011) find evidence that MFIs that have more women borrowers as clients (a measure of the depth of outreach) are less efficient, while Afrane & Adusei (2014) examine the question of loan repayment using data from the microfinance industry in Ghana and find that in general, females are more likely to default on their loans than males which presupposes that males are better borrowers. D'Espallier et al. (2011) use large MFI data set in 70 countries to examine whether women were better credit risks in microfinance than men. The results confirm that a higher percentage of female clients in MFIs is associated with lower portfolio risk, fewer write-offs, and fewer provisions, all else being equal. Interaction

effects reveal that, while focus on women is generally associated with enhanced repayment, this trend is stronger for nongovernmental organizations, individual based lenders, and regulated MFIs.

Additionally, the economic management skills and more conservative natures of women are most likely assets in contexts that are characterized by crises and high costs of doing business. Overall, women can be seen as more stable borrowers and therefore, more likely to repay loans in a timely manner. This would influence financial stability and performance; hence the first hypothesis may be stated as:

Hypothesis 1: Women borrowers form more effective customers in reducing costs of loan loss and therefore, higher financial performance outcomes

Female Loan Officers Hypothesis

MFI research has also examined the role of female management and female loan officers. Strøm et al. (2014) find female leadership to be significantly associated with larger boards, younger firms, a non-commercial legal status, and more female clientele. Furthermore, they find that a female chief executive officer and a female chairman of the board are positively related to MFI performance, though the result did not appear to be driven by improved governance. Hartarska et al. (2014) find that gender diversity on the board of MFIs is beneficial, and loans authorized by female loan officers have lower default rates. Specifically, they find that MFIs with female CEOs have significantly higher outreach efficiency than MFIs with male CEOs. Overall, the results suggest that promoting gender diversity at the top levels of MFI management is likely to have both social and financial benefits. These results are also consistent with that of Adams & Ferreira (2009) who find results suggesting that the presence of women on corporate boards strengthens monitoring. Mersland & Strøm (2009) examine the relationship between firm performance and corporate governance in microfinance institutions (MFI) and find that financial performance improves with local rather than international directors, an internal board auditor, and a female CEO. The results underline the need for an industry specific approach to MFI governance.

However, it is at the loan officer level that the real connection between the female lender and borrower is manifest. The importance of this relationship is displayed in the role of the female loan officer. Galak et al. (2011) use an individual lender (Kiva) to investigate the

characteristics of borrowers that engender lending and find that lenders favor individual borrowers over groups and borrowers that were socially proximate to themselves across three dimensions of social distance (gender, occupation, and first name initial). Specifically, they find that female lenders preferred to lend to female borrowers. However, Agier & Szafarz (2013) analysis detects no gender bias in loan denial, but uncovers disparate treatment with regard to credit conditions. They find that there was a gender gap in loan size that increases disproportionately with respect to the scale of the borrower's project. The results are insensitive to the loan officer's gender. They also found that female loan officers were more reluctant to grant loans and they supply smaller ones, regardless of the applicant's gender. Beck et al. (2013), find that loans screened and monitored by female loan officers in Albania had a lower likelihood to turn problematic than loans handled by male loan officers. While this performance gap always existed for female borrowers, results appeared to show that only female loan officers with experience gained a performance advantage with male borrowers with experience.

> *Hypothesis 2: Female loan officers serve to increase opportunities for personal interaction and therefore, higher financial performance outcomes*

Regulatory Institutional and Legal Systems hypothesis

Regulatory institutions consist of rule-setting, monitoring and sanctioning activities which manifest processes that involve the capacity to formulate rules, inspect conformity to rules and manipulate sanctions (rewards and punishments) to influence future behavior. Regulations can facilitate markets where such institutions lead to stability and predictability (lower uncertainty) and reduce transactional costs. There are perspectives on the development of regulation, for example, the rational choice perspective, where individuals craft laws that potentially advance their interests, while those conforming to the laws seek attendant rewards or avoidance of sanctions. Thus, the goals of regulatory institutions form key elements that motivate agents, where such institutions serve as incentives or as mechanisms of avoidance of particular actions.

Prior literature highlights the importance of legal systems that influence the protection of contracts instituted by the firm with key stakeholders, particularly the investors (La Porta et al., 1997). Countries generally have adopted legal systems that have been categorized as common-law and civil (or code)-law systems, while some have a mixed law, that includes a mix of

common law and code law, reflecting their legal origin. Common-law countries emphasize the importance of judicial independence to protect individual rights, while civil-law countries emphasize the roles of state and bureaucracy in the crafting and implementation of law (Mahoney, 2001). Given that contractual relationships form the basis for the existence and activities of firms (Jensen & Meckling, 1976), legal systems play a crucial role in the protection of such contracts and contractual relationships between the firm and stakeholders. This contrast is pertinent to the protection of transactions and the economic environment. For example, as La Porta et al. (1997) propose, financial development was promoted by the common-law regimes which protected outside investors against appropriation by insiders. In contrast, countries with a civil law system typically exert high political influence on such areas as setting accounting standards and practices, thereby limiting the free flow of information as necessitated by free markets. The government enforces the civil law, and criminal penalties can be assessed for civil law violation. In contrast, common law evolves through the judiciary system as legal precedents and practices become generally accepted and assume the status of a law. Thus, the legal and institutional factors are related to whether the country has a civil law or a common law system in place, which also affects corporate forms and corporate governance mechanisms in those countries (also see La Porta et al., 1997). These legal regimes also influenced how capitalist models operated, providing a basis for "objective measure of different types" (La Porta, Lopez-de-Silanes, & Shleifer, 2008, p. 302).

Given the role of legal systems in supporting and protecting property rights and therefore, the MFI sources and use of funds, the laws would therefore strengthen markets. Boehe & Cruz (2013) highlight the regulatory perspective on the relationship between female membership in MFIs and debt repayment rates. Their perspective distinguishes between strong and weak institutional environments, distinguished between the rule-based exchanges, as is common in advanced Western economies, in contrast to exchanges through dense social networks that are more common in developing and transitional economies. This distinction impacts property rights and their enforcement, building blocks of institutional economics and reflect the quality of formal regulative institutions. This paper applies the La Porta institutional framework on legal systems, highlighting that strong institutional environments that have built-in safeguards to prevent opportunistic behavior that can undermine these rights can effectively defend against illegitimate expropriation because courts and law enforcement act quickly and vigorously to

resolve disputes (North, 1991). In weak institutional environments, however, lawfully acquired rights can only be claimed through time-consuming, bureaucratic, and often corruption-prone procedures, if they can be claimed at all. In practice, this legal inefficiency implies that sellers of services, goods, or property are either insufficiently or not at all protected against buyer opportunism, and vice versa. This has implications on female entrepreneurs, who would be more dependent on legal protection of property rights and the ability to have wider legal justice in their transactional activities.

> *Hypothesis 3 - Regulatory Institutional Hypothesis: Will legal systems that protect property rights provide more female participation?*

Normative Institution Hypothesis

Norms or values that become widely held belief systems begin to influence how members behave. Beliefs are not simply anticipations or predictions but prescriptions, on how specified actors were supposed to behave. The expectations are held by other important agents in the situation, and are external to the actor. However, they become internalized to varying degrees, and roles are formally constructed. Such roles can have varying access to material resources, and can emerge informally as over time, through interaction, differentiated expectations develop to guide behavior. Thus, normative systems typically viewed as imposing constraints on social behavior also empower and enable social action. Widely accepted forms of behavior would be a reflection of "appropriateness" logic, what is accepted as ethical norms. In the absence of institutions or from the pressures of alternative factors, such norms begin to take shape that are widely acceptable, not necessarily from an ethical perspective.

In the environment in which MFIs operate, the roles of borrower and lender are influenced by the implications of these norms. Where such norms can constrain action, it would lead to reduced effectiveness, while the potential for harnessing interpersonal strengths of female stakeholders would lead to improved outcomes. Two forms of normative aspects are considered.

Inequality: Inequality is an outcome of policies and often forms of capitalism that have limited means to inclusive outcomes. Women often bear the brunt of such inequality in many societies. For example, even in developed European countries, women are generally at higher risk of poverty than men as they are less likely to be in paid employment, tend to have lower pensions, are more involved in unpaid caring responsibilities and when they are in work, are

frequently paid less even for the same job.[1] The nature of inequality is such that it leads to norms of behavior and also, business opportunities, access to resources, and the ability to avail of various factors provided in social settings. Where such inequality is widespread, it could well influence values and inculcate fears, inhibitions and related emotions that could influence actions and incentives to seek change. It could also impact genders differently, particularly in how it could impact entrepreneurial opportunities. Can there be a stabilizing role for females to play in such inequitable environments?

> *Hypothesis 4A - Inequality hypothesis: Can females participate effectively where inequality is higher compared to other countries?*

Corruption: Corruption – while moral institutions depict appropriateness, the norms in place may be adversarial in nature for the poor – where failures in such morality infect the social systems, their influence on society impact gender and their role. For example, in democratic societies, Dion (2013) highlights the negative impact of corruption on democracy and ethics that diminishes social trust and downgrades support for democracy. The coexistence of corruption and democracy is visible, for example, in Mexico and India, which are ranked 72nd and 85th on the Transparency International's Corruption Perceptions Index 2008 (Transparency International, 2008). Widespread corruption could lead to a quasi-state (or "shadow state") that reduces the legitimacy of the official state. Thus, both demand and supply of bribes increase, as a result, further subverting governance structures. Corruption would impact MFI lenders and borrowers directly, where expectations or demand side permeate social fabric. The borrower would also face the challenges of functioning in a society where the entrepreneurial abilities would be constrained by the ability to overcome hurdles in place from such corruption.

Where normative factors begin to erode, there is also the possibility of increased corruption that may be reflected in the demand or supply side demand for bribes. The impact of such an environment may have adverse effects on the effectiveness of MFIs, but could the presence of women in the role of borrower and/or loan officer have an impact on reducing the impact of corruption?

> *Hypothesis 4B - Corruption Hypothesis: Can females participate effectively where corruption is widespread?*

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[1] http://www.eapn.eu/what-is-poverty/causes-of-poverty-and-inequality/

Cultural-Cognitive Institutional Hypothesis

Mediating between the external stimuli and individual responses includes internalized symbolic representations of the world. Such symbolic representations include words, signs, gestures that shape meaning to objects and activities. This cognition or frames of thinking enter into the full range of information processing activities, determining what information to process, what to retain, how it is to be interpreted, impacting judgements, evaluations, predictions, and inferences (Scott, 2014, p. 67). This cognition element is supplemented by the cultural framework, suggesting that internal interpretive processes are shaped by external cultural frameworks, that presents patterns of thinking embodying the "way we do things." Cultural beliefs can vary with individuals or groups, and over time, with change and emergence of contesting views. Those connected with the culture will have greater certitude and stay connected, in contrast to those who are at odds with the culture.

Cognitive - Education: Boehe & Cruz (2013) highlight the nature of cognitive institutions, defined as shared knowledge, such as the scripts, schemas, and types that influence how phenomena are interpreted. The education level of the female population would be a measure of the abilities of female borrowers to understand the benefits and avail of opportunities for entrepreneurship (Dolinsky, Caputo, Pasumarty, & Quazi, 1993; Robinson & Sexton, 1994), thereby increasingly the likelihood of debt repayment. On the other hand, institutional contexts that are characterized by low educational levels can lock the poor into a vicious cycle of low education – few opportunities – low income – low education. Due to their family and community obligations, women are more likely to be trapped in this vicious cycle because they tend to be less able to relocate to towns, regions, or countries where they can find better opportunities. Education levels form one important cognitive institution in society, particularly in the context of information processing and interpretation functions that help decipher symbols and translate it into action. Education becomes the basis for acquiring and internalizing scripts, concepts and symbols, that evolve to provide information processing capabilities, interpreting such information and evaluating and drawing inferences that support actions. This would equip them to be more effective in developing and implementing entrepreneurial projects.

Hypothesis 5A - Cognitive Hypothesis: Women's education and overall literacy: does increased education provide an environment where females can operate more effectively?

Cultural: Internal interpretive processes are shaped by external cultural frameworks that provide context to interpreting symbols, thereby guiding action. Trust building by means of a capability process involves a creditor's willingness to trust based on an assessment of the borrower's ability to pay interest and repay the loan. Establishing trust through a calculative process involves an analysis of the extent to which the benefits of cheating do not exceed the costs of being caught. Hofstede has presented several cultural measures, two of which pertain to the efficacy of how females can operate, namely, masculinity/femininity dichotomy and the individualism/collectivism.

The Masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material rewards for success. Society at large is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life. Society at large is more consensus-oriented. In the business context, Masculinity versus Femininity is sometimes also related to as "tough versus tender" cultures. Religion and ethnicity can also affect the ability of women to access services. For example, in some cultures women are home-bound for religious reasons and unable to meet with providers outside the home or to form groups with other women. Similarly, some cultures prohibit male staff from visiting female clients. Gender-based rules and norms can have a significant impact on both the financial service needs of women and their ability to access and use services (Ledgerwood et al., 2013, p. 23). However, there are frequent problems with land title and property rights for small holder families, especially women-headed households that often do not have title to land (in some cultures women are not allowed, either formally or informally, to own land) (Ledgerwood et al., 2013, p. 233).

The second construct, the individualism/collectivism forms an environment in which MFIs operate (Ledgerwood et al., 2013). The high side of this dimension, called individualism, can be defined as a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families. Its opposite, collectivism, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty. A society's position on this dimension is reflected in whether people's self-image is defined in terms of "I" or "we." Institutions dedicated to providing poor women

with financial services often hire large numbers of women. This is particularly important in cultures where it is uncommon for men and women to engage in professional or interpersonal activity outside of the home. If a provider cannot hire a sufficient number of women, it is important to screen male applicants for their attitudes toward women (Ledgerwood et al., 2013, p. 356)

> *Hypothesis 5B - Cultural Hypothesis: Higher femininity and collectivism are traits in social environment that project strengths of women and enable them to be more effective in both harnessing entrepreneurial opportunities and being capable of meeting repayment schedules.*

METHODOLOGY AND MODELS

Microfinance data was extracted from the Microfinance MIX database. Macroeconomic variables are available from public sources such as World Bank, Penn World Table, Transparency International, Barro-Lee, and the Heritage Foundation. For the cultural variables Individualism/Collectivism and Masculinity/Femininity, the measures used were those developed by Geert Hofstede.

The overall model was as:

Performance Measures = (GENDER; COGNITIVE_CULTURAL; NORMATIVE; REGULATORY; CONTROL)

Dependent Variables:

Profit Margin Ratio (PMR), Return on Assets (ROA), Operational Self-sufficiency (OSS)

Independent Variables:

GENDER – Female borrowers and Female loan officers

COGNITIVE_CULTURAL – Education (Percentage of Complete Secondary and Tertiary Schooling Attained in Population); Hofstede (Individualism, Masculinity)

NORMATIVE – Inequality; Government Integrity (Freedom from Corruption)

REGULATORY – Legal Systems

CONTROL – Control Variables (Loan loss reserve ratio, Total expense/assets, Average loan balance, Gross loan portfolio, Equity, Yield on gross portfolio, Gross loan portfolio/total assets, Debt to equity ratio, Cost per borrower, Disclosure Rating, Property Rights)

The dependent variables, control variables (except property rights), and the independent variables, Female lenders and Female Loan Officers were derived from the MIX database. Other independent institutional variables were derived from different publicly available sources. Property rights was derived from Heritage Foundation's Index of Economic Freedom. Cognitive Cultural:

Education (Female): Education increases the opportunities to use funds. The Barro-Lee educational attainment data was used to extract the Percentage of Complete Secondary and Tertiary Schooling Attained by females.[2]

Cultural: For Individualism/Collectivism and Masculinity/Femininity, the measures used were those developed by Geert Hofstede.[3] Individualism is the level of integration of individuals with their societal groups. Masculinity is the level of assertiveness, competitiveness, and values based on gender roles. A higher index indicates more Individualism and more Masculinity. Normative:

Inequality is measured by the GINI index. We use the net GINI index, which takes redistributional measures into account and thus corresponds more closely to our theoretical motivation than its gross counterpart. The index is increasing in inequality and ranges from 0 to 100. GINI index measures the degree of inequality in the distribution of family income in a country. The more nearly equal a country's income distribution, the lower its GINI index, e.g., a Scandinavian country with an index of 25. The more unequal a country's income distribution, the higher its Gini index, e.g., a Sub-Saharan country with an index of 50. If income were distributed with perfect equality the index would be zero; if income were distributed with perfect inequality, the index would be 100. Data is taken from World Bank's World Development Indicators.[4]

Corruption: Transparency International's Corruption Perception Index (CPI) aggregates data from different sources that provide perceptions of business people and country experts of the level of corruption in the public sector.[5] The Heritage Foundation's Index of Economic Freedom integrates the CPI into its Freedom from Corruption component now known as

[2] http://www.barrolee.com/
[3] http://geerthofstede.com/research-and-vsm/dimension-data-matrix/
[4] https://data.worldbank.org/data-catalog/world-development-indicators
[5] https://www.transparency.org/research/cpi/

Government Integrity.[6] The index increases in freedom from corruption and ranges from 0 to 100. The higher the index, the higher the freedom from corruption.

Regulatory:

Legal Systems broadly classified as Common Law, Code (Civil) Law and Mixed legal systems were derived from the CIA World Factbook.[7]

RESULTS AND ANALYSIS

The results of the Summary Statistics are presented in Table 1.

-------------------------------Insert Table 1 about here------------------------

MFI sample size drops for ROA, compared with PMR and OSS. Female loan officers are significantly lower in number than female borrowers, as expected. While sample size for high school and tertiary education is the same, the percentage of high school education is 32.12, as opposed to tertiary, which is only 5.85. GINI Inequality Index sample is significantly lower than that of Government Integrity. The correlation coefficients are provided in table 2.

-------------------------------Insert Table 2 about here------------------------

Some points to note include that the relationship between female borrowers and higher secondary/terirary educaton is low and inverse, while that between female loan officers and secondary/tertiary is low and direct. There is low and positive correlation between inequality (GINI Index) and Government Integrity.

The first two hypotheses related to gender. Regarding the question of whether women borrowers form more effective customers in reducing costs of loan loss and therefore, higher financial performance outcomes, the results were positive and significant for all the three measures of financial performance. Further, with regards to female loan officers, the results also appeared positive and significant. When both variables were considered together, only female loan officers were significant and positive for all measures, while female loan borrowers were

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[6] http://www.heritage.org/index/explore
[7] https://www.cia.gov/library/publications/the-world-factbook/fields/2100.html

not significant and were directionally, mixed. These results were consistent with the overall hypothesis, although the interaction of female loan borrowers and female loan officers was positive but not significant. The results are provided in Parts A and B of Table 3.

Regulatory Institutional Hypothesis: Will legal systems that protect property rights provide more? This paper applies the La Porta institutional framework on legal systems, highlighting that strong institutional environments that have built-in safeguards to prevent opportunistic behavior that can undermine these rights can effectively defend against illegitimate expropriation because courts and law enforcement act quickly and vigorously to resolve disputes (North, 1991). Results from Part C of Table 3 suggest that overall, legal systems appear to contribute positively to MFI financial performance. Specifically, common law, civil law and mixed law systems were significant (for PMR and OSS) and positively related to MFI performance. The interaction variable with Female Borrowers was generally positive (except for OSS for civil law and mixed), but were not significant for any.

-------------------------------Insert Table 3 about here------------------------

The normative and cognitive-cultural institutional hypotheses are next examined. The results are presented in Table 4.

-------------------------------Insert Table 4 about here------------------------

The normative hypotheses consisted of inequality and corruption (or government integrity). Inequality hypothesis: Can females participate effectively where inequality is higher compared to other countries? There is a positive though insignificant relationship between inequality and financial performance, the possibility of MFIs playing a role in either reducing inequality with higher performance, or using the environment to be able to increase financial returns. The interaction between female borrowers and inequality was negative but not found to be significant (Table 4, Part A). This may suggest that female borrowers in countries with more inequality may not lead to higher financial performance, though the results were not significant.

The results for corruption (government integrity) were negative and significant, suggesting that MFI financial performance was inversely related to government integrity. This

result was counter to the hypothesis that corruption in government would lead to lower MFI performance. Overall, these results suggest that MFI performance is directly related to inequality and inversely related to government integrity. The negative relationship is confirmed in the interaction of the female borrower and government integrity, though it is not significant. These results may also highlight some aspects of MFI operations, and that MFI financial performance is not necessarily aligned with environments where social aspects are more conducive to business in general and also that such socio-economic factors may provide MFIs with short-term advantages that could reduce the overall benefits to the key stakeholder, i.e., the poor. While incremental impact of government integrity over female borrowers was also negatively associated with performance, it was not significant. These results are available in Parts A and B of Table 4.

Cognitive-cultural institutional hypothesis considered female education and culture (Hofstede variables). Two measures of female education, secondary and tertiary education, were considered. The correlation coefficients (Table 2) indicate that female borrowers have low negative correlation with education (secondary and tertiary) suggesting that borrowers have lower education levels compared to the population. However, for female loan officers, the relationship for both forms of education is low but positive, suggesting that there is a positive relationship with the population, with higher officers having higher education that is more closely aligned with that of the population. Nevertheless, the secondary education also had positive incremental information for MFI financial performance (Part C of Table 4), though not significant, except in the incremental information for Profit Margin Ratio (10%) and Operating Self-sufficiency (1%). The interaction with female borrower was also positive and significant. Significance of coefficient estimates for Female Borrowers and tertiary education changes when interaction is included. This interaction was positive and for ROA, significant above 1% level. With reference to female loan officers, the results suggest that secondary education provides incremental significant information of a positive association, though the interaction (loan officers and secondary education) does not provide significant information. Regarding tertiary education, results show that the variable provides incremental positive and significant information for female borrowers but not for female loan officers. Hence, it may be concluded that loan officers present a sufficient proxy for tertiary education. However, interaction terms (with tertiary

education) does not appear significant for either female borrowers or loan officers. This information is provided in Part C of Table 4.

The cultural hypothesis, specifically represented by Hofstede's masculinity/femininity and the individualism/collectivism dichotomies, provide insights into how such cultural institutions impact MFIs and the overall influence of females. The masculinity variable has an incremental and inverse relationship with MFI performance in the presence of the interaction term, while the interaction term (MAS and Female borrower) is also negative and significant. This suggests that Masculine cultural traits are inversely related to success in the case of MFIs, and also, where such traits intersect with the female borrower. Individualism has a direct, though insignificant relationship with financial performance, and the interaction term (with female borrowers) is also not significant. This information is provided in Part D of Table 4.

To further examine the question of mission drift, the variables were examined with Average Loan Size (ALBG) as the dependent variable (Table 5). ALBG is a proxy for MFI outreach, given that lower size loans played a role in the lives of the poor, while they were also expensive to process and manage. Where mission goals were aligned with the developmental goals, it would be expected that such small loans were would be made available for the poor. Table 5 presents information on the regression of the independent variables from the equation in the hypothesis section. Female borrowers have a negative and significant relationship with loan size, suggesting that female borrowers were associated with smaller loans. This is consistent with the overall mission. Higher levels of inequality (GINI) was associated with smaller loan size, again consistent with the developmental mission. Government integrity was positive but not significant. Interestingly, common law systems also indicated negative and significant relationship with loan size, suggesting that this legal environment was more proactive to the developmental goals of MFI. Overall, these results suggest that developmental mission was not violated, based on this analysis.

-------------------------------Insert Table 5 about here------------------------

CONCLUSIONS

MFIs have increasingly formed part of the established policy to address poverty through providing incentives for self-improvement and developing entrepreneurial abilities of the poor to

become self-sufficient (Ledgerwood et al., 2013). While the overall results of MFIs have been mixed and often meet with criticism, nevertheless, MFIs continue to thrive, and have been found to also have the potential to address social issues such as the role of women in society (Hartarska et al., 2014). Given these priorities of MFI growth, it is important to examine the functioning and policies in this broader institutional perspective; specifically, how does MFI operate within and influence environments where poverty, social and cultural issues constrain development of the potential, opportunities and living standards of large proportions of populations, particularly female. Kulkarni (2011) points out that unless empowerment is an integral part of the planning process, the rapid expansion of micro-finance is unlikely to make more than a limited contribution to female empowerment.

According to Kulkarni (2011), while the smooth functioning of microfinance is dependent on the stability of economic institutions such as banks and moneylending organizations, the potential of microfinance is dependent on the health of social and socio-economic institutions such as social norms, patriarchy and education. As women are the key actors in the microfinance system, this distinction becomes not just important, but necessary. Nevertheless, there have been ambivalent opinions on the role that MFIs can play in women's empowerment (Mayoux, 2000). These range from optimism that such programs will potentially empower women world-wide, while others have been less optimistic, and point out that the role of MFIs does enable poverty reduction, but empowerment requires other means.[8]

This paper highlights these factors that may be important in developing greater effectiveness in women empowerment. Specifically, while education is crucial, motivating and enabling women involvement in MFIs to provide success stories and enable them to not only play the role of borrowers that meet MFI goals but more importantly, women empowerment and poverty reduction goals, are crucial to make MFIs resource use justifiable. Thus, MFIs need to be designed not as an economic model, but as a holistic approach to development, where cultural aspects relevant to women and their role in society are addressed. A combination of education, patriarchy, inequality, culture and other related factors may influence female involvement and development. Developing an MFI program requires a recognition of factors that need to be

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[8] There are others who recognize the limitations to empowerment, but explains those with poor program design, while some who see micro-finance programmes as a waste of resources. The evidence and issues are discussed in greater detail by the author elsewhere (Mayoux, 1998); (Mayoux, 2000).

addressed at the organization level, for example, in enabling MFI officers, particularly female, to play a significant role in developing systems of empowerment. These systems should recognize the social matrix in which such borrowers operate, for example, that which could limit their role and also make MFI a source of further exploitation, where patriarchal, corruption and cultural and financial inequality is widespread. Financial performance by itself would not be a sufficient measure, as MFI mission drift to financial goals could obscure such inherent problems and omit the wider policy implications of the role of MFIs.

Overall, the results of the paper point to the need for further investigation into how emphasis on policy and development of measures and management systems that consider institutional environments could make it possible for MFIs to address factors that empower women, considering the social matrix within which women's everyday lives are embedded.

Table 1: Descriptive Statistics

Variable Name	Variable	Observations	Mean	Std. Dev.
Profit margin ratio	pmr	10,897	.0759	.2713
Operational self-sufficiency	oss	11,140	1.1668	.3454
Return on assets	roa	9,491	.0205	.0803
Female Borrowers %	ffbrwr	9,518	64.9477	27.9995
Female Loan Officers %	fflo	2,480	32.1288	30.7060
Legal Systems	lgsy	12,752	3.0929	.65825
Secondary Schooling %	lsc	11,256	20.4219	14.6576
Tertiary Schooling%	lhc	11,256	5.5702	5.5334
GINI Inequality Index	GINI	5,821	43.2849	9.0714
Government Integrity	GI_CRP	12,335	18.0193	8.0250
Individualism	IDV	6,581	26.7197	13.2383
Masculinity	MAS	6,581	51.7137	11.3804
Loan loss reserve ratio	llr	9,244	.0871	4.7223
Total expense/assets	tear	9,496	.2508	.2182
Average loan balance (log)	lalbg	11,534	-1.1538	1.3326
Gross loan portfolio (log)	lglp	12,446	14.8950	2.1778
Equity (log)	lequ	11,710	13.9314	2.0998
Yield on gross portfolio (real)	yglpr	7,385	.2468	.1862
Gross loan portfolio/total assets	glpar	11,994	.8006	2.3476
Debt to equity ratio	der	11,428	7.3629	212.1119
Cost per borrower	cpb	8,852	210.3853	505.1812
Disclosure Rating	disc	12,634	3.2336	1.2865
Property Rights	Property	12,335	7.2203	2.6551

Table 2: Correlation matrix

```
             |     pmr      oss      roa   ffbrwr     fflo     lgsy      lsc      lhc     GINI   GI_CRP      IDV      MAS
-------------+------------------------------------------------------------------------------------------------------------------
         pmr |  1.0000
         oss |  0.9176   1.0000
         roa |  0.8847   0.8183   1.0000
       ffbrwr| -0.1145  -0.0944  -0.0485   1.0000
         fflo|  0.1262   0.1288   0.0910   0.0392   1.0000
         lgsy|  0.0820   0.0661   0.0454  -0.4442   0.2499   1.0000
          lsc|  0.0029   0.0014  -0.0412  -0.2406   0.2243   0.4016   1.0000
          lhc|  0.0601   0.0649   0.0775  -0.2713   0.1410   0.3807   0.2967   1.0000
         GINI|  0.1556   0.1533   0.1258  -0.4108   0.2265   0.7894   0.3157   0.3554   1.0000
       GI_CRP|  0.0190   0.0505   0.0495   0.0152  -0.0182   0.0454   0.1690   0.2716   0.1766   1.0000
          IDV| -0.2146  -0.1753  -0.1615   0.4646  -0.0891  -0.5057   0.0074  -0.1455  -0.5113   0.1911   1.0000
          MAS|  0.0407   0.0260  -0.0090   0.0591   0.0843  -0.0918   0.0616  -0.3316   0.0823  -0.5374  -0.0262   1.0000
          llr| -0.1970  -0.1796  -0.1990  -0.0335  -0.0070   0.0128   0.0673   0.0172  -0.0334   0.0827   0.1028  -0.0658
         tear| -0.4389  -0.3753  -0.4568   0.1761   0.0333   0.1247   0.1592   0.0333   0.0573   0.1073   0.2638  -0.0759
        lalbg|  0.2208   0.1477   0.1612  -0.6476  -0.0161   0.2885   0.1043   0.1466   0.2110  -0.1187  -0.4222  -0.0475
         lglp|  0.3016   0.2480   0.2720  -0.2652   0.0449   0.1062   0.2439   0.0628   0.1452   0.0059  -0.1734   0.1402
         lequ|  0.3604   0.3251   0.3430  -0.2258   0.0834   0.1231   0.2060   0.0370   0.1829   0.1022  -0.1907   0.0829
        yglpr| -0.0966  -0.0561  -0.0849   0.0498   0.0846   0.3103   0.2446   0.1712   0.2324   0.1462   0.0234  -0.1006
        glpar|  0.1384   0.1507   0.1159   0.0459   0.0342   0.0478   0.0824   0.0133   0.1010   0.0622   0.0886   0.0130
          der| -0.2093  -0.1367  -0.0693  -0.0706  -0.0648   0.0089  -0.0203   0.1039  -0.0413  -0.0696   0.0497  -0.0484
          cpb| -0.0784  -0.0959  -0.0666  -0.3861   0.0038   0.2089   0.1052   0.2666   0.1616   0.2155  -0.0593  -0.2300
         disc|  0.1974   0.1382   0.1547  -0.1979   0.0235   0.0584   0.2137  -0.1394   0.0970  -0.1224  -0.1653   0.1481
     Property|  0.0178   0.0512   0.1003   0.2170  -0.0850  -0.2661   0.0037   0.1706   0.0359   0.8227   0.4171  -0.2481
```

```
             |     llr     tear    lalbg     lglp     lequ    yglpr    glpar      der      cpb     disc Property
-------------+-------------------------------------------------------------------------------------------------
          llr|  1.0000
         tear|  0.3533   1.0000
        lalbg| -0.1307  -0.5131   1.0000
         lglp|  0.0668  -0.2264   0.3977   1.0000
         lequ|  0.1060  -0.1907   0.2670   0.9017   1.0000
        yglpr|  0.3240   0.7548  -0.3810  -0.0914   0.0210   1.0000
        glpar| -0.0457  -0.0028  -0.0117   0.1388   0.0578  -0.0695   1.0000
          der| -0.0211  -0.0522   0.0814  -0.0581  -0.2411  -0.0925   0.0127   1.0000
          cpb|  0.0653   0.0170   0.4313   0.0864   0.1020   0.0262  -0.0355   0.0353   1.0000
         disc| -0.0273  -0.1164   0.2445   0.3982   0.3622  -0.0408   0.0221  -0.0787   0.0366   1.0000
     Property|  0.0912   0.0633  -0.2768   0.0238   0.0994   0.0710   0.0919  -0.0555   0.0410  -0.1555   1.0000
```

See Appendix for Abbreviations

TABLE 3

Part A

	PMR	OSS	ROA
ffbrwr	.00072***	.00074***	.00028***
	(.00019)	(.00024)	(.00006)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

Part B

	PMR	OSS	ROA
fflo	. 00043***	.00049***	.00009**
	(.00014)	(.00018)	(.00004)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. fflo=Percentage of female loan officers. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

	PMR	OSS	ROA
ffbrwr	-.00002	-.00037	.00008
	(.00025)	(.00035)	(.00008)
fflo	.00047***	.00057***	.00010**
	(.00015)	(.00019)	(.00005)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; fflo=Percentage of female loan officers. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property.

- ffbrwr's sign of coefficient estimate changes for PMR, OSS when included with fflo, and coefficient estimates are not significant.

With interaction:

	PMR	OSS	ROA
ffbrwr	-.00005	-.00041	.00004
	(.00031)	(.00042)	(.00010)
fflo	.00040	.00049	.00003
	(.00042)	(.00054)	(.00013)
ffbrwr#fflo	.00000	.00000	.00000
	(.00000)	(.00000)	(.00000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; fflo=Percentage of female loan officers. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property.

- Interaction of ffbrwr and fflo is not significant.

Part C

	PMR	OSS	ROA
lgsy2	.17238**	.22634**	.03576
	(.07986)	(.10188)	(.02574)
lgsy3	.16777**	.22700**	.03397
	(.07845)	(.10009)	(.02530)
lgsy4	.14870*	.20843**	.02616
	(.07922)	(.10107)	(.02555)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. lgsy=Legal systems (2=Common law, 3=Code(Civil) law, 4=mixed). Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

	PMR	OSS	ROA
ffbrwr	.00079***	.00083***	.00029***
	(.00020)	(.00025)	(.00006)
lgsy2	.16221**	.21284**	.03244
	(.07987)	(.10306)	(.02546)
lgsy3	.18343**	.24178**	.03859
	(.07841)	(.10118)	(.02500)
lgsy4	.15995**	.22005**	.02847
	(.07916)	(.10215)	(.02524)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lgsy=Legal systems (2=Common law, 3=Code(Civil) law, 4=mixed). Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

With interaction:

	PMR	OSS	ROA
ffbrwr	.00031	.00108	.00005
	(00168)	(.00216)	(.00049)
lgsy2	-.01196	.11068	.00448
	(.13313)	(.17139)	(.04061)
lgsy3	.16970	.26748	.02267
	(.12560)	(.16167)	(.03830)
lgsy4	.15211	.25106	.02354
	(.12747)	(.16408)	(.03887)
ffbrwr#lgsy2	.00215	.00108	.00040
	(.00175)	(.00225)	(.00052)
ffbrwr#lgsy3	.00023	-.00045	.00028
	(.00170)	(.00218)	(.00050)
ffbrwr#lgsy4	.00017	-.00050	.00011
	(.00172)	(.00220)	(.00051)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lgsy=Legal systems (2=Common law, 3=Code(Civil) law, 4=mixed). Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- With the interaction, none of the coefficients are significant.
- However, for PMR, while coefficients for lgsy variables are individually not significant, the coefficients are jointly significant beyond 1%, i.e., the overall interaction is significant above the 1% level for PMR.

TABLE 4

Part A

	PMR	OSS	ROA
GINI	. 00077	. 00054	. 00026
	(.00069)	(.00088)	(.00021)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. GINI=Inequality Index. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

	PMR	OSS	ROA
ffbrwr	.00080***	.00080**	.00031***
	(.00025)	(.00032)	(.00007)
GINI	.00089	.00037	.00027
	(.00070)	(.00091)	(.00021)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; GINI=Inequality Index. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

With interaction:

	PMR	OSS	ROA
ffbrwr	.00168*	.00165	.00075**
	(.00100)	(.00132)	(.00031)
GINI	.00216	.00158	.00091**
	(.00156)	(.00204)	(.00047)
ffbrwr#GINI	-.00002	-.00002	-.00001
	(.00002)	(.00003)	(.00000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; GINI=Inequality Index. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Interaction is not significant

Part B

	PMR	OSS	ROA
GI_CRP	-.00167***	-.00222***	-.00047***
	(.00053)	(.00068)	(.00016)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. GI_CRP=Government Integrity (Freedom from Corruption). Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

	PMR	OSS	ROA
ffbrwr	.00069***	.00069***	.00027***
	(.00019)	(.00024)	(.00006)
GI_CRP	-.00144***	-.00192 ***	-.00043***
	(.00056)	(.00072)	(.00016)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; GI_CRP=Government Integrity (Freedom from Corruption). Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

With interaction:

	PMR	OSS	ROA
ffbrwr	.00096**	.00066	.00022**
	(.00038)	(.00048)	(.00011)
GI_CRP	-.00051	-.00205	-.00058
	(.00126)	(.00162)	(.00037)
ffbrwr#GI_CRP	-.00001	.00000	.00000
	(.00002)	(.00002)	(.00000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; GI_CRP=Government Integrity (Freedom from Corruption). Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Interaction is not significant.

Part C

Secondary schooling:

	PMR	OSS	ROA
lsc	.00012	.00035	-.00004
	(.00039)	(.00048)	(.00012)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. lsc=Percentage of females (ages 15 and above) who completed secondary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

Female borrowers

	PMR	OSS	ROA
ffbrwr	.00095***	.00099***	.00030***
	(.00020)	(.00025)	(.00006)
lsc	.00076*	.00103**	.00013
	(.00041)	(.00051)	(.00012)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lsc=Percentage of females (ages 15 and above) who completed secondary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- With ffbrwr, lsc is significant for PMR and OSS, but changes sign for ROA

With interaction:

	PMR	OSS	ROA
ffbrwr	.00093***	.00073*	.00011
	(.00032)	(.00039)	(.00009)
lsc	. 00072	. 00030	-.00040*
	(.00081)	(.00100)	(.00024)
ffbrwr#lsc	.0000	.00001	.0000***
	(.00001)	(.00002)	(.0000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lsc=Percentage of females (ages 15 and above) who completed secondary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Significance of coefficient estimates for ffbrwr and lsc changes when interaction included
- Interaction of ffbrwr and lsc for ROA is significant above 1% level.

Female loan officers

	PMR	OSS	ROA
fflo	.00035**	.00033*	.00006
	(.00014)	(.00018)	(.00004)
lsc	. 00142***	.00239***	.00031**
	(.00042)	(.00058)	(.00013)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. fflo=Percentage of female loan officers; lsc=Percentage of females (ages 15 and above) who completed secondary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- With fflo, lsc estimates are significant for PMR, OSS and ROA, but changes sign for ROA

With interaction:

	PMR	OSS	ROA
fflo	.00038	.00047	.00016**
	(.00027)	(.00033)	(.00008)
lsc	.00146***	.00258***	.00043***
	(.00052)	(.00069)	(.00016)
fflo#lsc	-.0000	-.0000	-.0000
	(.00001)	(.00001)	(.0000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. fflo=Percentage of female loan officers; lsc=Percentage of females (ages 15 and above) who completed secondary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Significance of coefficient estimates for fflo changes when interaction included, estimates for lsc remain significant as when no interaction included.
- Interaction of fflo and lsc is not significant.

Tertiary schooling:

	PMR	OSS	ROA
lhc	.00386***	.00458***	.00079***
	(.00083)	(.00102)	(.00024)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. lhc=Percentage of females (ages 15 and above) who completed tertiary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

Female borrowers

	PMR	OSS	ROA
ffbrwr	. 00100***	. 00106***	.00031***
	(.00020)	(.00025)	(.00006)
lhc	. 00418***	. 00517***	. 00088***
	(.00092)	(.00115)	(.00027)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lhc=Percentage of females (ages 15 and above) who completed tertiary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Coefficient estimates for both ffbrwr and lhc remain significant

With interaction:

	PMR	OSS	ROA
ffbrwr	.00104***	.00121***	.000255***
	(.00027)	(.00033)	(.00008)
lhc	.00463**	.00699**	.00022
	(.00230)	(.00286)	(.00067)
ffbrwr#lhc	-.0000	-.00003	.00001
	(.00003)	(.00004)	(.00001)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lhc=Percentage of females (ages 15 and above) who completed tertiary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Significance of coefficient estimates for lhc changes when interaction included
- Interaction of ffbrwr and lhc is not significant.

Female loan officers

	PMR	OSS	ROA
fflo	.00039***	.00041**	.00007*
	(.00014)	(.00018)	(.00004)
lhc	.00143	.00214	.00037
	(.00119)	(.00164)	(.00036)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; lhc=Percentage of females (ages 15 and above) who completed tertiary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- With fflo, significance of estimates for lhc changes

With interaction:

	PMR	OSS	ROA
fflo	.00025	.00024	.00008
	(.00021)	(.00026)	(.00006)
lhc	.00064	.00124	.00044
	(.00149)	(.00197)	(.00045)
fflo#lhc	.00002	.00003	-.0000
	(.00002)	(.00003)	(.0000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. fflo=Percentage of female loan officers; lhc=Percentage of females (ages 15 and above) who completed tertiary schooling. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Significance of coefficient estimates for fflo and lhc changes when interaction included
- Interaction of fflo and lhc is not significant.

Part D

Masculinity:

	PMR	OSS	ROA
MAS	-.00042	-.00081	-.00036
	(.00072)	(.00086)	(.00024)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. MAS=Masculinity. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

	PMR	OSS	ROA
ffbrwr	.00056**	.00028	.00021***
	(.00025)	(.00030)	(.00008)
MAS	-.00051	-.00114	-.00029
	(.00074)	(.00088)	(.00024)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; MAS=Masculinity. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

With interaction:

	PMR	OSS	ROA
ffbrwr	-.00135	-.00148	-.00030
	(.00106)	(.00129)	(.00032)
MAS	-.00282*	-.00326*	-.00091**
	(.00145)	(.00176)	(.00045)
ffbrwr#MAS	.00004*	.00003	.00000
	(.00002)	(.00002)	(.00000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; MAS=Masculinity. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Significance and signs of coefficient estimates for ffbrwr change when interaction included
- With ffbrwr and interaction, MAS coefficient estimates become significant.
- Interaction of ffbrwr and MAS is significant above 10% level for PMR.

Individualism:

	PMR	OSS	ROA
IDV	.00039	.00048	.00017
	(.00063)	(.00075)	(.00021)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. IDV=Individualism. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

	PMR	OSS	ROA
ffbrwr	.00054**	.00025	.00021***
	(.00025)	(.00031)	(.00008)
IDV	.00011	.00013	.00000
	(.00065)	(.00078)	(.00021)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; IDV=Individualism. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

With interaction:

	PMR	OSS	ROA
ffbrwr	.00043	.00012	.00016
	(.00053)	(.00064)	(.00016)
IDV	-.00019	-.00023	-.00012
	(.00145)	(.00174)	(.00045)
ffbrwr#IDV	.00000	.00000	.00000
	(.00002)	(.00002)	(.00000)

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. ffbrwr=Percentage of female borrowers; IDV=Individualism. Control variables: llr tear lalbg lglp lequ yglpr glpar der cpb disc Property

- Interaction of ffbrwr and IDV is not significant

Table 5: Results of panel data estimation for MFI's outreach performance

	albg	albg	albg
ffbrwr	-.0087431*** (.0013861)	-.0088011*** (.0013888)	-.0089283*** (.0013849)
fflo	.000359 (.0004623)	.0003983 (.000464)	.0003804 (.0004649)
lgsy2	-1.116611*** (.2898919)	-1.113665*** (.2903061)	-1.104062*** (.2897149)
lgsy3	-.372731 (.2648982)	-.3651525 (.2651588)	-.3591224 (.2644629)
lsc	-.0095261** (.0043157)	-.009913** (.0043165)	-.0096564** (.004332)
lhc	-.005492 (.0052165)	-.0052832 (.0052244)	-.0053576 (.0052256)
GINI	-.0266717*** (.0059349)	-.0265858*** (.0059455)	-.0264992*** (.0059492)
GI_CRP	.0005496 (.0044782)	.0004312 (.0044852)	.0003443 (.0044912)
IDV	-.0092615*** (.003194)	-.0089786*** (.0031956)	-.0090336*** (.0031905)
MAS	-.0039881 (.0032225)	-.0040921 (.0032258)	-.0039858 (.0032239)
PMR	.1555395 (.104298)		
OSS		.0703997 (.0814212)	
ROA			.3824251 (.3601704)
llr	-.1245687 (.4619594)	-.1654295 (.463473)	-.1572788 (.4633288)
tear	-1.490036*** (.3020961)	-1.576617*** (.3004058)	-1.534047*** (.3095952)
lglp	.342092*** (.0329675)	.3469084*** (.0327746)	.3444916*** (.032925)
lequ	-.2265036*** (.0335164)	-.2284143*** (.0335497)	-.2279536*** (.0335489)
yglpr	-.7956266*** (.2353562)	-.7558107*** (.2369108)	-.7792948*** (.2397605)
glpar	-.0027111 (.0154211)	-.0021562 (.0154795)	-.0027393 (.015546)
der	-.0002844 (.0004811)	-.0003645 (.0004772)	-.0003777 (.000475)
cpb	.0003622*** (.0000316)	.0003588*** (.0000316)	.0003587*** (.0000315)
disc	.0452403 (.0555373)	.0466933 (.0555982	.0455418 (.0554876)
Property	.0055516 (.0140727)	.0046126 (.0140942)	.0048258 (.0141149)
Constant	-.5832029 (.5507264)	-.6834259 (.5552401)	-.5887435 (.5506721)
R-sq overall	0.7001	0.7003	0.7005

***, **, * indicate that the coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels respectively. Standard errors are in parentheses. See Appendix for Abbreviations.

APPENDIX

ABBREVIATIONS

Variable Name	Variable
Profit margin ratio	pmr
Operational self-sufficiency	oss
Return on assets	roa
Female Borrowers %	ffbrwr
Female Loan Officers %	fflo
Legal Systems (all combined)	lgsy
Legal System – Common law	lgsy2
Legal System – Code(Civil) law	lgsy3
Legal System – Mixed	lgsy4
Secondary Schooling %	lsc
Tertiary Schooling%	lhc
GINI Inequality Index	GINI
Government Integrity	GI_CRP
Individualism	IDV
Masculinity	MAS
Loan loss reserve ratio	llr
Total expense/assets	tear
Average loan balance (log)	lalbg
Gross loan portfolio (log)	lglp
Equity (log)	lequ
Yield on gross portfolio (real)	yglpr
Gross loan portfolio/total assets	glpar
Debt to equity ratio	der
Cost per borrower	cpb
Disclosure Rating	disc
Property Rights	Property

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DOES ONE SIZE FITS ALL? STAKEHOLDERS' PERCEPTIONS OF IFRS ADOPTION ACROSS EUROPE AND BRAZIL

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ABSTRACT

The main objective of this study is to put in evidence the perceptions of stakeholders about IFRS adoption across Europe and Brazil. By means of a survey, (816 completed questionnaires, 10% of population), we investigate whether producers (chief financial officers), users (financial analysts), and controllers (auditors) of accounting data share the same views on the usefulness and goals of the international financial reporting process. We use descriptive statistics and univariate tests to analyze the responses to our multiple-choice questions. Results suggest that respondents' activity has less influence on their answers than the country where they are located.

1   INTRODUCTION

We conduct a comprehensive survey that asks auditors, CFOs and financial analysts to describe their choices related to the motives, benefits and consequences of IFRS adoption, the impacts of fair value accounting and the problems associated with the first adoption of IFRS. Our objective is to address the following questions: Is data complying with the IFRS more informative than that complying with local GAAPs? Is fair value accounting relevant? What problems are associated with initial application of IFRS? And, the second motivation for this work is to determine whether the "one size fits all" principle applies to IFRS adoption. To this end, we compare the perceptions of chief financial officers, financial analysts and auditors from distinct market environments, using Europe as a proxy for a highly developed capital market environment and Brazil or ex-communist countries as a proxy for a less developed capital market environment. We also triangulate our answers to these questions with those from theoretical and empirical research to enhance our understanding of these issues.

Our research follows a recent wave of accounting[1] field studies that aim to narrow the gap between academics and practitioners. By means of a survey, we want to identify whether producers of accounting data (chief financial officers), users of that data (financial analysts who are shareholders' main advisers), and controllers of accounting information (auditors) share the same views on the goals of the financial accounting process and usefulness of IFRS. Recent studies look at the perceptions of one category of preparers of financial reports and their concerns about the cost of IFRS implementation (Morris et al., 2014) or at the cost of IFRS implementation for national stakeholders within European countries (Fox et al., 2013). Our research both look at the opinions of all stakeholders (users, preparers and controllers) of

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[1] Most studies are focused on the United States and Europe (see Barker and Imam, 2008; Graham *et* al. 2005; Saghroun, 2003; Barker, 1998; Arnold and Moizer, 1984; Moizer and Arnold, 1984)

financial information and extends the survey across two geographical environments (Europe and Brazil).

Over the last decades financial market development has created a need for a set of universal accounting rules (see Ernst & Young and FIPECAFI, 2009; Hoarau, 1995) and several countries have moved in this direction by implementing IFRS. The European Union (EU) adopted IFRS in 2005, and other countries, Brazil for example, did this later, only in 2010 (see CVM, 2007). Our research, therefore, aims to determine whether CFOs, analysts and auditors share an identical view on inputs of IFRS. It also aims to determine whether the opinion of CFOs and auditors on IFRS is affected by the country in with they operate, country being used as a proxy for the level of development of the capital market where the firm is listed and for the accounting "process" prevailing before IFRS adoption.

Extending the study to several countries is a potential means for determining whether and how the economic environment affects the respondents' views of accounting information. Emerging markets may serve as convenient laboratories for shedding new light on accounting and finance realities known to be problematic in developed markets. Volatile economic conditions, less liquid capital markets, highly concentrated firm ownership, a non-negligible share of state-owned firms, inefficient and weak institutions, poor monitoring practices, financing restrictions, and large amounts of information asymmetry are among the many distinct features of emerging markets. Such imperfections exacerbate issues thought to be important for financial decision-making, and highlight difficulties that may lie in a financial executive's path.

The questions on IFRS are motivated by the switch from national GAAP to IAS/IFRS in more than 100 countries in a short period of time. This switch is a unique and exceptional opportunity to analyze the relevance of strongly investor-oriented accounting rules. Raffournier (2007) and Hoogendoom (2006) state that the implementation of IFRS represents

a transformation of the philosophy underlying accounting rules. This switch also provides an opportunity to study the technical problems related to major changes in accounting systems. Thus, profiting from this transitional period, our research will focus on the disclosure of mandatory reports and the problems related with the initial adoption of IFRS. These mandatory reports are important to all stakeholders and provide valuable information on enterprise performance and health (Graham, Harvey and Rajgopal, 2005). These reports are broadly released, notably through companies' websites. Financial analysts use such reports to recommend companies (Baker and Imam, 2008; Saghroun, 2003; Arnold and Moizer, 1984; Moizer and Arnold, 1984) and auditors use them to investigate and to control firms (Nelson *et al.*, 2002).

A final and important observation on prior research in this field: There has not been a combined study of controllers/finance directors, financial analysts and auditors, despite the fact that the behavior of these groups will inevitably influence each other. The evidence resulting from this research, therefore, offers a unique opportunity to develop a grounded theory based on primary market information and on evidence coming from interactions between each of the major constituent market groups.

This research also contributes to the literature in several ways. First, it applies the field study method in accounting, which, to date, remains a relatively rare approach in this discipline. Second, it focuses on distinct level of development of capital markets context, which is even rarer in this field. Finally, by employing identical questionnaires (translated of course) in different markets, this study highlights the similarities and differences between emerging and developed markets and between classes of actors of the IFRS adoption process.

Fig. 1 summarizes the organization of the paper. The two main topics of interest are effects of IFRS adoption and fair value. Section 3 presents evidence that IFRS adoption supports the objectives of IASB. Section 4 focuses on fair value and implications related to this in

accounting figures. Section 5 discusses about the problems related to the first IFRS adoption. The last section offers some concluding remarks about the IFRS process and its reliability for users and adopters.

2   RESEARCH DESIGN

Using qualitative methodology, the surveys offer an opportunity to ask auditors, CFOs and financial analysts a specific series of question in order to gather information about what interviwers do or think about the motivation behind financial reporting choices. Additionally, the survey enables us to adopt an integrated perspective on the trade-offs between the adoption of IFRS and fair value. As said in the introduction, surveys can also propose new explanations that have not been previously considered by academic researchers. Finally, the survey methodology allows us to explore the assumptions underlying theories of IFRS and fair value. We investigate the viability of the assumptions behind a given theory, which can lead to identification of more assumptions for models.

The survey methodology suffers from some limitations. Surveys measure opinions or beliefs from interviewers, which may not coincide with their actions. Sometimes they can answer things that they learned, rather than state their true beliefs. Perhaps some of the survey questions are misunderstood. Maybe our respondents are not representative of the underlying population. Even with these limitations, we hope to make available unique information about IFRS adoption. We hope that our results will be used by researchers to develop new theories or modify existing views, and practitioners and students will use our results to observe how firms work and also where practice diverges from academic recommendations.

2.1   The instrument

The questionnaire has two sections and three versions. The first section aimed at validating key issues of the financial accounting on Inputs of IFRS. In this part we have two different

versions. The first version is devoted to CFO or similar and for auditors. The second questionnaire is dedicated to financial analysts. The second section is addressed to the characterization of the sample according to the respondent. Respondents need approximately 10 minutes to answer the questionnaire.

In order to achieve the required comparability, it is necessary to ensure that the survey questions have the same meaning for all respondents despite differences in language, culture, and institutional setting. In this research, the same questionnaire, written in English, and translated into Portuguese and French was used in each country, thus ensuring that the survey instrument carries the same meaning in Brazil and the European Union. The translation procedures employed are those used by Vallerand (1989) and Balbinotti *et* al. (2007) in his research. Furthermore, the procedures used for translation guarantee that such biases are minimized.

This research relies on the voluntary support of thirty-two financial professionals from either academic or practitioner communities. Ten participants evaluated the Portuguese version of the questionnaire, ten the French version and ten the English version. This research relied also on the voluntary support of two official translators and two bilingual financial academic that also made the translation. Participants were assured of total confidentiality regarding information provided.

2.2 Sampling Selection and Data Collection Procedures

All public corporations from the São Paulo Stock Exchange (Bovespa) directory and all public corporations from Europe stock markets made up the CFO target population. This population consists of almost 8,000 enterprises. Of the 8,000, only 3,306 companies provided correct email addresses for their financial directors or equivalent. In addition to the afore mentioned public, we sent the questionnaire to APIMEC registered financial analysts in Brazil and to all financial analysts following IFRS adopters listed in the Capital IQ database. There

are nearly 7,000 analysts; but only 4,389 financial analysts provided their correct email addresses. And, as the last group are auditors from auditing enterprises in Brazil and in Europe. We found 1,663 correct email addresses from auditors. We found contact information for these two publics in the Capital IQ database and companies websites. At the end, we had 403 completed questionnaires by CFOs or a 12.18% return rate, 277 completed questionnaires by financial analysts or a 6.31% return rate and 136 completed questionnaires by auditors or an 8.17% return rate. Based on the work of Klassen and Jacobs (2001), several ways to answer the questionnaire were offered to the participants: by post, by fax, by email, and by a website built specifically to that end. Table 1 shows the distribution of respondents. Respondents were invited to participate in three successive waves: March 2010, July 2010 and September 2010. The website changed the order of items for each new respondent as a way to prevent the questions in the beginning of the questionnaire to be the ones that are more likely to be answered.

2.3 Summary statistics and data issues

We did not use any of the 1884 questionnaires that were not fully completed. This resulted in 824 exploitable questionnaires. We deleted respondents that were identified as professors, tax lawyers or database analysts. We also eliminated all CFOs or auditors that worked in countries not accepting IFRS rules. Finally, our database includes 795 complete questionnaires. Our respondents are divided into analysts, auditors and CFOs.

Regarding CFOs, Table2 presents summary information about characteristics of their firms. The companies range from small (24.44% of the sample firms have sales of less than € 50 million; Table2, Panel A) to very large (14.71% have sales of at least € 5 billion; Table3, Panel A). Furthermore, 18.45% of the firms do not have any analyst coverage, while 20.70% are covered by at least 16 analysts (Table2, Panel B). Our sample also presented a reliable

indicator for stock markets. More than 50% of CFOs work in firms with less than 20% of insider's investors (Table2, Panel A).

In terms of age, we can perceive that our sample is largely composed of young respondents (the majority has less than 40 year old). Maybe their skills in the computer world increase their participation. Seventy percent of analysts are less than 40 years old and eighty percent of auditors and CFOs are less than 50 years old. Our results suggest that the younger analysts are more representative in a study using financial analysts. Pike *et* al. (1993) found an average age for financial analysts of 34.3 years. Previous research conducted by Graham *et* al. (2005) and Benetti *et* al. (2007) presented evidence that American and Brazilian CFOs vary in age from 50 to 59 years old. Our results presented the 40-49 year range as the most common in our CFOs respondents or less than this. In relation to education, the college degree or less than this level was the most common in their research. In our research, we found that the great majority of our respondents had more than a college degree, suggesting that the development of the stock market demanded an increase in the level of education (or the use of internet, maybe a potential bias).

Afterwards, we analysed how many years our respondents usually stayed in their last job. Pike *et* al. (1993) found that analysts normally have eight years' expertise. Our results presented that analysts are evenly divided. The majority has less than seven years for analysts. Graham and Harvey (2001) and Graham *et* al. (2005) and Benetti *et* al. (2007) found that the great majority of CFOs stay in their job more than nine years. The great majority of our CFOs stay in their job more than seven years. Our analyses showed that 82% of auditors have less than seven years of expertise.

Our results also suggest that analysts follow thirteen firms in two distinct sectors. Pike *et* al. (1993) observed also that analysts follow, on average, three distinct sectors. In terms of

auditors, our results show that our respondents audit, on average, five public and twenty three private firms per year, in four distinct sectors.

2.4   Classification of Countries

In order to determine whether answers to our questionnaire depend on the country where the responded is located, we divided our respondents into six groups. The survey was sent to CFOs and auditors of European (EU) or Brazilian firms. For our surprise, we also received questionnaires from auditors that were not European and Brazilian. European or Brazilian firms may be audited by auditors located in a foreign country. Then, we decided to use in our study respondents placed in a country that applied IFRS. In the case of analysts we considered that their location was not a problem, if they provide forecasts or recommendations on firms complying with IFRS.

To classify the respondents, we used the Nobes (1983; 1998) and Belkaoui (2000) results. It is important to remember that the goal of our study is to compare Brazil and the European Union. Then, we split the European countries into four groups. In the first one, "Europe 1", we included countries that were UK-influenced. This grouping is in accordance with the two works of Nobes (1983, 1998), micro-based or Class A respectively. This group includes UK, Malta, the Netherlands and Ireland. For the next two groups we maintained the Nobes' classification presented in 1983 and 1998 as macro-based and Class B. We split his group into two. In the "Europe 2" group (more tax-based oriented) are Belgium, France, Italy, Luxembourg, Portugal and Spain. In the "Europe 3" group (more law-based oriented) are Austria, Denmark, Finland, Germany, Japan, Norway, Sweden and Switzerland. We added Japan to this group because almost all previous literature shows that the accounting systems in Germany and Japan are very close, and are both bank-oriented. The last European group is the "Eastern Europe" group that puts together all ex-communist countries, corroborating thus the Belkaoui' (2000) classification: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Poland,

Romania, Russia, Slovakia, Slovenia and Ukraine. The final group, the "Others" group, is composed of all other countries (Algeria, Australia, Canada, Cayman Islands, China, Croatia, Greece, Hong Kong, India, Indonesia, Kazakhstan, Korea, Mexico, Nigeria, Pakistan, Peru, Philippines, Qatar, Singapore, South Africa, South Korea, Taiwan, Thailand, Turkey, United Arab Emirates, USA) that completed the questionnaire. Our classification is presented in Fig. 2. An important contribution to the diversity of our results comes from different accounting cultures. Their interpretation will be partly influenced by the accounting history of the countries under study, and by their previous accountancy practices.

3   BENEFITS AND CONSEQUENCES OF IFRS ADOPTION

The goal of the IFRS Foundation and the IASB was to develop a set of high-quality, understandable, enforceable and globally accepted financial reporting standards based on clear principles. These standards were aimed at improving transparency and at disclosing comparable financial information to help stakeholders make economic decisions (Alexander and Servalli, 2010). To this end, IASB worked in cooperation with all stakeholders to develop the IFRS. The IASB suggest the IFRS adoption can improve financial reporting, and consequently, capital market efficiency.

The time of the first adoption of IAS/IFRS was an exceptional period of deep change in accounting practices (Daske et al., 2008, 2013). The IASB issued IFRS 1 to help companies in transition to this new accounting framework. IFRS 1 provides applicable guidance to entities applying IFRS for the first time. The standard explains the steps a firm must follow to adopt IFRS for accounting figures. An entity must prepare an opening IFRS balance sheet at the date of transition to IFRS. This balance sheet is the first step of the transition process. In preparing this statement, the firm needs to adjust the amounts reported for the same date under local GAAP. IFRS 1 requires IFRS to be effective at the reporting date of the entity's

first IFRS accounting statements applied retrospectively, with certain limited mandatory and optional exceptions.

The IASB suggest the IFRS adoption can improve financial reporting, and consequently, capital market efficiency. For PricewaterhouseCoopers (2006), investors and fund managers believed that IFRS could impact all firms' key financial indicators, independently of firm size, and consequently of their investment decisions. The same study shows that the switch to IFRS was significant. It has affected some perceptions of companies' value and investment decisions by fund managers.

For Jermakowicz and Gornik-Tomaszewski (2006) the benefits expected from IFRS adoption result from higher information quality, greater comparability and timeliness of accounting data, less information asymmetry, better access to foreign capital markets and lower cost of capital. The expected costs are tied up resources, high cost of transition and increased volatility of earnings and balance sheet items mainly because of the use of fair value. Figure 3 illustrates the association between the expected benefits. The adoption of IFRS is expected to increase the quality of accounting information, resulting in more comparable and timely accounting data and in lower information asymmetry. Less information asymmetry between firm management and investors on the one hand, and between investors themselves on the other hand, makes access to capital markets easier, notably the access to foreign markets. Easier access to finance reduces firms' cost of capital.

3.1   Effects of IFRS adoption[2] (1)

Earnings Quality: The objectives of IASB (2008) are the most clearly supported by respondents. IFRS adoption was expected to increase earnings quality, notably by providing more value-relevant accounting figures (Daske *et* al., 2008; Ahmed et al., 2013). Rebouças

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[2] This chapter is related to the first question of our questionnaire in annex.

(2009) suggests that the adoption of IAS/IFRS in Brazil will increase the relevance of accounting figures, provide data of higher quality and generate additional information useful to all users of accounting outputs, even though Cameran et al. (2014) put in evidence that IFRS adoption did not improve reporting quality among private companies. Our respondents agree with the higher information content of IFRS data. Results show data 66% of analysts, 87% of auditors and 81% of CFOs consider that IFRS convey more additional information. Moreover, an increase in the value relevance of accounting data under IFRS was observed (Table 3, Panel A, rows A, B and D, and Fig. 4).

Asymmetry: Expected benefits of IFRS adoption are also related to information asymmetry. Analysts, Auditors and CFOs agree with this benefit (Table 3, Panel A, rows E, and Fig. 4). This result can be observed also in conditional averages by country for Brazil and Europe 2 (composed by countries with Latin origins) (Table 3, Panel B and C, rows E, and Fig. 4). Brazilian CFOs have higher expectations with regard to the adoption of IFRS. The fact that countries in the "Europe 1" group view accounting figures complying with IFRS as conveying more additional information is somewhat tricky, since the accounting standards used in these countries prior to IFRS adoption were not significant different from IFRS.

Comparability: Other expected benefit of IFRS adoption is easier comparable accounting figures. These standards should lead firms to release more comparable accounting figures (Daske *et* al., 2008; IASB, 2008). Indeed, all respondents agree with the increase in comparability of accounting figures resulting from IFRS adoption (72.26% for analysts, 76.67% for auditors and 73.57% of CFOs). Regarding conditional answers in Brazil, all auditors agree with this, contrary to other countries that in average 20% of auditors do not agree with this. Hoogendoorn (2006) highlights that IFRS adoption creates new possibilities for comparison between European firms by reducing balance sheet and income statement

format differences. He observes that the implementation of IAS/IFRS is a real challenge in many countries, and it is nearly impossible to expect full or near-full comparability.

Timeliness of Accounting Data: Respondents agree that IFRS adoption results in financial statements that there is more timely loss recognition (Table 3, Panel A, rows C and F, and Fig. 4). However, this was the benefits less important for all respondents. For Brazilians auditors and CFOs this information is more important than for other countries. Jermakowicz and Gornik-Tomazewski (2006) considers that the timeliness of disclosed information is perceived as a notable benefit by firms while Horton et al. (2013) show that forecast accuracy and other measures of the quality of the information

environment increase significantly more for mandatory adopters relative to non- adopters and voluntary adopters..

Difficult to Understand: CFOs that are the producers and auditors that are the controllers of accounting figures agree (in average 50%) that these statements are difficult to understand. Interestingly, analysts tend to disagree with this option. Indeed, analysts found

IFRS statements easier to understand than CFOs and auditors. This result was unexpected and contrary to previous results (Jermakowicz and Gornik-Tomaszewski, 2006; Hoogendoorn, 2006). One possible explanation is that analysts observe companies all around the world, and therefore increase their understanding of IFRS statements compared with CFOs and auditors. Responses from auditors per country confirm the relevance of IASB (2008) objectives. But our results present a different opinion on the ability of accounting users to fully understand IFRS implications (Table 3, Panel B, row F, and Fig. 4). It is interesting to observe the optimistic view and the huge expectations of Brazilian auditors (recent users), when compared with European auditors. Auditors in "Brazil", "Eastern Europe" and "Others" groups do not agree with this users' difficulty in understanding financial statements complying with IFRS. One possible explanation is that in "Brazil", even before IFRS, some Brazilian public firms were used to publish their accounts in local Gaap (BR GAAP) as well as in US GAAP,

notably those that issued ADRs in the US. Therefore, because they apply US GAAP regularly, these firms are not disturbed by the adoption of IFRS inasmuch as they do not strongly differ from US GAAP. Another possible explanation is related to the audit firms. They have higher experience in different accounting standards. They may therefore feel able to apply IFRS with no difficulty as soon as these standards will become mandatory.

The same behaviour is observed for CFOs in these country groups in conditional analyses (Table 3, Panel C, row C, and Fig. 4). Another interesting observation is that for auditors domiciled in "Europe 1, 2 and 3" (basically the European Union), IFRS adoption is likely to result in accounting data that are not easy to understand by most users. The same behaviour is observed for CFOs in these groups of countries (Table 3, Panel B and C, row C, and Fig.

4). **3.2** **Effects of IFRS adoption[3] (2)**

The mandatory or voluntary adoption of IFRS can have less expected consequences, such as more efficient monitoring of the company by shareholders or creditors and therefore better shareholder or creditors protection. Furthermore, the impact of IFRS can be heterogeneous between countries. In general respondents agree that IFRS adoption improves the monitoring of firms by shareholders and creditors, thus decreasing information asymmetry between insiders and outsiders (Table 4, Panel A, row A and B, and Fig.

5). Our results are in accordance with those found by Pae *et* al. (2008) that investors expect mandatory IFRS adoption to reduce both agency costs associated with ownership concentration and information asymmetry in EU firms.

Responses of auditors present evidence that auditors from countries such as "Brazil" and "Eastern Europe" strongly agree with the notion that IFRS improve the monitoring of firms by shareholders and creditors if we compare their responses with those of the other groups

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[3] This chapter is related to the second question of our questionnaire in annex.

(Table 4, Panel B, rows A and B, and Fig. 5). Answers from financial directors of all countries (excepted "Europe 1") show that better monitoring by shareholders and creditors and decreased information asymmetry are expected from IFRS adoption.

Cost of Capital: Another expected benefit of IFRS adoption is a decrease in the firm's cost of capital. Daske *et* al. (2008, 2013) observe that the cost of capital of mandatory adopters of IFRS has decreased by 26% the year before IFRS implementation and that there are some differences between 'legal' and 'serious' adopters. The impact of the implementation of IAS/IFRS was stronger in countries with reasonable enforcement regimes and with strong motivation for firms to be more transparent. Our results not agree with this idea. Respondents also share the view that the adoption of IFRS does not result in a decrease of firms' cost of capital (Table 4, Panel A, row D, and Fig. 5). Only for Brazilian auditors, adoption of IFRS reduces firms' cost of capital. For the other countries, IFRS adoption is likely to improve monitoring by shareholders and decrease information asymmetry.

Easier Access to Capital Markets: For Brazilian and Eastern European CFOs, the adoption of IFRS reduces the cost of capital for firms. For the other country groups, a reduction in firms' cost of capital is not expected from of IFRS adoption (Table 4, Panel B and C, rows C and D, and Fig. 5). Auditors and CFOs in "Europe 1" tend to disagree more than they agree with these possible consequences of IFRS adoption. This effect may be perceived in these countries because accounting figures, resulting from the adoption of IFRS, are more relevant and reliable, increasing the number of investors, the number of sources of financing, and reducing cost of capital. For example, Daske *et* al. (2008) observe an increase in stock market liquidity, after IFRS adoption, in countries where firms have incentives to be transparent and where legal enforcement is strong.

4   Fair Value vs. Value Relevance[4]

The IASB defines fair value as "the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties, in an arm's length transaction". IASB (2009c, p. 22) explains this definition as follows. "When an asset is acquired or a liability is assumed in an exchange transaction for that asset or liability, the transaction price is the price paid to acquire the asset or received to assume the liability". Conversely, "the fair value of the asset or liability represents the price that would be received to sell the asset or paid to transfer the liability". Fair value is usual for assets whose book value is based on mark-to-market valuations. Empirical studies present some evidence showing that the adoption of fair value has a strong impact on accounting figures complying with IFRS, resulting in more value relevant accounting figures and in unjustified increase in the volatility of earnings and equity. Furthermore, the adoption of fair value is costly.

Fair Value and Comprehensive Income: According to Batsch (2005), the comprehensive income is based on a redefinition of the concept of profit, and the notion of performance. The idea is that accounting has to provide a measure of equity capital changes. Therefore, the relevant accounting result, i.e. the comprehensive income, is no longer the difference between revenues and expenses for a given period. It is the difference between stocks of equity capital between the end and the beginning of the accounting period. Thus, comprehensive income measures the difference of value of net assets, excluding the impact of transactions with shareholders.

We asked our respondents' one specific question about the most controversial point of IFRS: fair value. In general, our survey's participants agree with the suggested consequences of the

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[4] This chapter is related to the third question of our questionnaire in annex.

adoption of fair value. Our results showed that respondents by activity or by country agree that one of the implications of fair value is it is useful to present unrealized capital gains in a specific comprehensive income statement. It was not the preferred one by the interviewers, but they are unanimous in this answer (Table 5, Panel A, B and C, row E, and Fig. 6). Finally, Brazilian auditors are more in accordance than European ones that presenting unrealized capital gains in a specific comprehensive income statement is useful.

Relevance: By allowing some deviations from market price, standard setters need to distinguish between situations in which a market price is misleading and/or a manager merely claims that this is so in order to avoid a "write-down" (reducing the book value of an asset because it is overvalued compared to the market value). Without restrictive guidance, the standards could be easily evaded. Thus, standard setters need to decide between relevance and reliability: FVs models may be more relevant in certain situations but quoted market

prices are easier to verify and harder to manipulate. Deviations from market prices under existing FV standards require substantial judgement by the preparers and the auditors. Managers and auditors have personal costs and risks (litigation) related to deviations from market prices that can be used as enforcement mechanisms. Litigation risks and legal enforcement are weaker in Europe than in the USA, but the opposition to fair value is stronger in Europe. However, there is empirical evidence that European companies are usually less liable to impairments because most banks established support of historical cost (Leuz *et* al., 2003). The trade-off between relevance and reliability suggest that fair values introduce volatility in financial statements in ''normal times" and it can produce contamination effects in times of crisis.

The consequence that "fair value has great impact in accounting figures" was the most approved by respondents, which is strongly approved by auditors and CFOs (Table 5, Panel A, row B, and Fig. 6). Regarding the impact of fair value on the value relevance of accounting figures, Brazilian auditors believe much more than European auditors in the positive impact

of fair value accounting on the value relevance of IFRS figures. In the case of CFOs, results show that for Brazilian CFOs "the adoption of fair value results in more value relevant accounting figures" is the best explanation for the use of fair value; however, this is the option the least chosen by European Union ("Europe 1, 2 and 3") countries.

Volatility: The analysis of responses by auditors provides another evidence for the option "The adoption of fair value results in an unjustified increase in the volatility of earnings and equity". Brazilian and European auditors have distinct opinions. While Brazilian auditors disagree (71.43%) with this option, European auditors agree (50% in mean). Around 55% of CFOs of the three European groups believe that fair value adoption increases volatility of earnings. In contrast, Brazilian CFOs disagree with this. Moreover, CFOs in all countries tend to agree with the fact that fair value is costly (Table 5, Panel C, Fig. 6).

But the controversy persists on whether fair value is helpful in providing transparency and whether it leads to undesirable actions on the part of banks and companies (such as manipulations). Opponents of the FV claim that: (a) FV is not relevant but potentially misleading for assets that are held for a long period, in particular those held to maturity; (b) prices could be distorted by market inefficiency, investor irrationality or liquidity problems; (c) fair values based on models are not reliable, and (d) FV contributes to the procyclicity of the financial system.

Fair value is Costly: The consequence that "fair value accounting is costly" is strongly approved by auditors and CFOs (Table 5, Panel A, row A and D, and Fig. 6). In this question, auditors and CFOs tend to agree more than analysts with the consequences of the fair value approach. Another interesting point is that auditors are the respondents those disagree the most with the positive impact of fair value on the volatility of earnings and equity. The other agreement between auditors is that the adoption of IFRS is costly. In "Eastern Europe" countries, none of the auditors disagree with this opinion.

Strong impact: Finally, auditors consider that the adoption of fair value impacts accounting figures. This view is shared by all auditors in "Brazil" and "Europe 1, 2 and 3" country groups (Table 5, Panel B, and Fig. 6).

For Hoogendoorn (2006), the fair value and impairment approaches bring significant differences between firms. Mandatory IFRS adoption has been criticized for both the flexibility of the standards and the encroachment of the fair value paradigm. Jermakowicz and Gornik-Tomaszewski (2006) find that most European companies agree that equity based on IFRS is expected to be higher than in local GAAP. For these authors, the problem in the conversion process is the use of fair value as the primary basis of asset/ liability measurement.

5. Problems related to the first application of IFRS

The first adoption of IFRS may bring several unexpected problems to firms. The objective of IFRS 1 is to provide a guide to help entities adopt IFRS. Upton (2010) observes that countries realize that they have cultural, legal or political difficulties when they start the convergence to IFRS adoption. In the light of this, countries normally decide to adapt their local GAAP insofar as the amounts reported in the financial statements are the same as in IFRS. Upton (2010) claims that the direct full application of IFRS is less costly than a part by part and necessarily long-term convergence process. Furthermore, all countries need a plan before starting the transition process, involving accounting professionals, companies, financial and pension regulators. Afterwards, they need an IFRS team involving every sector that will be affected by the convergence. Countries must have a plan to solve the problems emerging during this process. They must create an infrastructure of knowledge for IFRS practitioners. Finally, the IASB participation is important to help countries in this convergence process.

5.1   Was the first application of IFRS costly? [5]

This question was presented only in auditor's and CFO's questionnaires. Auditors (92.50%) and CFOS (76.06%) are strongly in agreement with the idea that IFRS adoption is costly because it requires in-depth training of the people involved in the adoption process. The lack of clarity in some standards, the IT problems and costs related to the IFRS adoption are also ranked high by these respondents. Such problems selected by auditors and CFOs are in accordance with the problems reported by Hoogendoorn (2006, p. 2) and IASB (2008). (See Table 6, Panel A, row A, C and D, and Fig. 7).

Information Systems: Jermakowicz and Gornik-Tomaszewski (2006) and Upton (2010) discuss this issue. These studies put in evidence that a good IT infrastructure is vital for the success of IFRS adoption. IFRS convergence has great impact on IT infrastructure used to support data of accounts, consolidation and management of multiple GAAPs simultaneously. All of our respondents agree that information systems are an important point in IFRS adoption. Specific analyses show that Brazilian and auditors located in Europe 3 group agree more than others that the first application of IFRS demands information that was previously not available or that needed to be re-processed. (See Table 6, Panel A, row A, C and D, and Fig. 7).

Training: Another important item evidenced by previous research is the lack of IFRS knowledge among employees and auditors. For Zain (2009), the organisational area requires great time investment because it also has an impact on the business. To begin with, companies need to assess their internal IFRS capacity to assess the required training for their teams, both during and subsequent to the first implementation. He also observes that managers must be involved from the beginning to confirm commitment and authority in allocating resources for the planning process IAS/IFRS convergence.

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[5] This chapter discuss question four used to CFOs and Auditors, in annex.

In our research, auditors and CFOs agree that this is the most important item related to the IFRS adoption (See Table 6, Panel A, B and C row D, and Fig. 7). In our conditional analysis by countries groups, five in six groups completly agree with the importance of in-depth training oh the people involved in the adoption process.

Overall costs: For auditors and CFOs, the costs associated with the first application of IFRS are relevant. In almost all country groups, auditors and CFOs agree with this, except in "Eastern European" countries in which none of the CFOs found the adoption process costly. Our results show that auditors are more firmly convinced that this process is costly than CFOs. One example of this observation is demonstrated in item D, when auditors do not disagree with this option. The same behaviour is not observed for CFOs (Table 6, Panel B and C, row F, and Fig. 7).

Moreover, an important percentage of European auditors from "Europe 1" countries disagree with the fact that the first application of IFRS led in an increase of the fees of consultants. In general, CFOs do not consider that the overall costs related to the first adoption of IFRS are not higher than previous one. One exception is CFOs from "Eastern Europe" countries. Nobody in these countries disagree with this option. Brazilian CFOs agree more than European ones those information systems need to be reorganized and that an in-depth training is important in this adoption process.

5.2 Analysis of the first financial statements complying with IFRS [6]

This question and the next one were presented only in analyst's questionnaire. Other possible problems related to the IFRS adoption are associated with the relevance of analysts' forecasts and recommendations. Rebouças (2009) suggest that in Brazil, the implementation of IAS/IFRS improves the relevance of analysts' forecasts and recommendations. Using forecast

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[6] This chapter discuss question four used in analyst's questionnaire, in annex.

accuracy, disagreement between analysts and information precision of individual forecasts as factors of transparency.

In this question we ask for analysts if the time spent to process accounting information and financial statements complying with IFRS had increased or decreased. We observe that the percentage of analysts that believe in an increase or a decrease in the time for processing accounting information is not so relevant. In general, almost 40% of respondents think that the adoption of IFRS does not impact the time spent to understand accounting data or financial statements. The second part of this question asked about the relevance of their forecasts and recommendations under IFRS. At this time, analysts are convinced that financial statements under IFRS do not diminish the relevance of their forecasts (Table 7, Figure 8). The results suggest that almost 50% of respondents have not perceived a change in forecasts' accuracy.

5.3   Switching to IFRS.[7]

In this question we can perceive that the lack of special training in understanding IFRS statements is a problem for analysts (49.27%). However, this is still a bigger problem for auditors and CFOs (see questions 1 and 4, and **Erreur! Source du renvoi introuvable.**7, Figure 9).

In question 1, analysts strongly agree that accounting figures under IFRS are more easily comparable. However, this increase in comparability was not detected if the previous financial statements were not in IFRS. Indeed, the different accounting methods and hypotheses complicate the analysts' job. Almost 50% of them believe that this adoption requires specific training. Finally, about 60% of analysts think that accounting data under IFRS differ from the ones in the previous statements, making more difficult the comparability

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[7] This chapter discuss question five used in analyst's questionnaire, in annex.

between accounting figures.

As suggested by the Observatoire de la Communication Financière (2006), the application of IFRS has resulted in changes/problems in the analysts' job. Zain (2009) observes that the analysis of the first financial statements complying with IAS/IFRS requires specific training because these standards differ significantly from those used previously.

In general, we could observe that IFRS adoption is viewed as bringing more comparability and information to accounting figures. European CFOs agree that the greatest benefit from IFRS adoption is the increase in available information and in the quality and relevance of the information. For Brazilian CFOs, higher comparability and improved monitoring by external users are the main contributions of IFRS adoption. Furthermore, the first adoption of IFRS was not seen as a minor task by most respondents. Information systems must be adapted and the people involved in the adoption must be trained. Moreover, the fair value approach was considered as costly and with strong impacts on accounting data. European respondents tend to agree more than Brazilian ones with the positive impact of fair value on earnings volatility.

6   CONCLUSIONS

This research reports the opinion of producers of accounting data (i.e. chief financial officers), users of that data (i.e. financial analysts who are shareholders' main advisers), and controllers of accounting information (i.e. auditors) concerning inputs on IFRS adoption. Indeed, one of our objectives was to present a new 'working tool' for accounting research. Our results, based on a questionnaire (in three languages), present evidences of similarities and differences in the view of respondents in relation to their activities and to the country where they are domiciled. The main result of our research is that, despite national differences, each category of actors share a same point of view about the harmonization process.

The survey evidence provides contribution on different dimensions. Firstly, we established some facts about financial reporting. Secondly, respondents rated the descriptive validity of

academic theories on IFRS adoption. Thirdly, the survey suggests new explanations for several phenomena that have not yet received extensive attention in the academic literature.

Our work particularly highlights, through the perceptions of the main stakeholders of financial information, that the harmonization process of financial reporting is viewed as a kind of common practice and knowledge that can be shared across the practitioners.

Our results should be relevant to international regulators and institutions involved in the accounting harmonization process, either because in some countries listed companies were required to apply IFRS for statutory accounts, or because the results provide evidence on the impact of IFRS in countries with different characteristics. Our respondents consider that the adoption of IFRS results in improved information and in increased comparability of accounting figures. Moreover, auditors consider having greater difficulties in understanding the new accounting standard than analysts.

Managers, analysts and auditors consider that IFRS adoption has increased management monitoring efficiency, resulting thus in better investor protection. Our respondents also expect from the adoption of IFRS a reduction in firms' cost of capital equity. Another interesting issue in the adoption of IFRS is the use of fair value. Our findings provide evidence that the fair value approach is expected by all respondents to have a strong impact on accounting figures and to increase the value-relevance of accounting figures. Furthermore, providing information on unrealized gains in a comprehensive income statement is seen as very useful. On the other hand auditors are in doubt with the impact of fair value on earnings volatility and on earnings quality.

In relation to the problems associated with the first adoption of IFRS, auditors and CFOs think that the adoption of IFRS is costly because IT systems need to be reorganized, because available information needs to be reprocessed, and because it is important to train those who are involved in the adoption process since IFRS are difficult to understand. Analysts consider

that IFRS require specific training and that comparing accounting figures complying with different standards is not easy. Furthermore, they declare that IFRS adoption has improved the accuracy of their forecasts, but they take more time to process available accounting data.

Despite the pro and cons of the harmonization process, the adoption of IFRS and the benefits linked with it are shared as a common basis for the daily work of users, adopters, and controllers of financial information.

ANNEX:

Questions to CFO, Auditors and Analysts

1. The adoption of IFRS results in: (Please follow the scale: 1 to Strongly Disagree until 5 to Strongly Agree)

1 2 3 4 5   1 2 3 4 5

☐ ☐ ☐ ☐ ☐   A. More easily comparable accounting figures   ☐ ☐ ☐ ☐ ☐   D. Figures of higher quality

☐ ☐ ☐ ☐ ☐   B. More value relevant accounting figures   ☐ ☐ ☐ ☐ ☐   E. More additional information (disclosures)

☐ ☐ ☐ ☐ ☐   C More timely loss recognition   ☐ ☐ ☐ ☐ ☐   F. Financial statements that are difficult to understand by most users

2. The adoption of IFRS leads to: (Please follow the scale: 1 to Strongly Disagree until 5 to Strongly Agree)

1 2 3 4 5   1 2 3 4 5

☐ ☐ ☐ ☐ ☐   A. More efficient monitoring of the company by shareholders and therefore better shareholder protection   ☐ ☐ ☐ ☐ ☐   C. A decrease of information asymmetries between insiders (managers and directors) and outsiders (shareholders, creditors, suppliers, customers, …)

☐ ☐ ☐ ☐ ☐   B. More efficient monitoring of the company by creditors and therefore better creditor protection   ☐ ☐ ☐ ☐ ☐   D. A decrease in the firm's cost of capital

3. About Fair Value accounting you can say:

(Please follow the scale: 1 to Strongly Disagree until 5 to Strongly Agree)

1 2 3 4 5   1 2 3 4 5

☐ ☐ ☐ ☐ ☐   A. The adoption of fair value has a strong impact on accounting figures complying with IFRS   ☐ ☐ ☐ ☐ ☐   D. The adoption of fair value accounting is costly

☐ ☐ ☐ ☐ ☐   B. The adoption of fair value results in more value relevant accounting figures

☐ ☐ ☐ ☐ ☐   C. The adoption of fair value results in an unjustified increase in the volatility of earnings and equity.   ☐ ☐ ☐ ☐ ☐   E. It is useful to present unrealized capital gains in a specific comprehensive income statement.

Question to CFO and Auditors

4. The first application of IFRS was costly because:

(Please follow the scale: 1 to Strongly Disagree until 5 to Strongly Agree)

1 2 3 4 5   1 2 3 4 5

☐ ☐ ☐ ☐ ☐   A. Information systems had to be reorganized, the information required by IFRS being not available in its entirety

☐ ☐ ☐ ☐ ☐   D. It required in-depth training of the people involved in the adoption process

☐ ☐ ☐ ☐ ☐   B. The information required by IFRS was available but it had to be re-processed in depth

☐ ☐ ☐ ☐ ☐   E. Fees charged by consultants involved in the adoption process were (are) high

☐ ☐ ☐ ☐ ☐   C. The lack of clarity of several IFRS standards required an in-depth analysis and interpretation of these standards

☐ ☐ ☐ ☐ ☐   F. The overall costs associated with the adoption of IFRS were not significantly high

Questions to Analysts

4. Switching to IFRS: (Please follow the scale: 1 to Strongly Disagree until 5 to Strongly Agree)

1 2 3 4 5   1 2 3 4 5

☐ ☐ ☐ ☐ ☐   A. Has increased the time spent to process accounting information and financial statements

☐ ☐ ☐ ☐ ☐   C. Has improved the relevance of our forecasts and recommendations

☐ ☐ ☐ ☐ ☐   B. Has decreased the time spent to process accounting information and financial statements

☐ ☐ ☐ ☐ ☐   D. Has diminished the relevance of our forecasts and recommendations

5. Analyzing the first financial statements complying with IFRS:

(Please follow the scale: 1 to Strongly Disagree until 5 to Strongly Agree)

1 2 3 4 5

☐ ☐ ☐ ☐ ☐   A. Required a specific training because these standards differ significantly from those used previously

☐ ☐ ☐ ☐ ☐   B. Was complex because of accounting figures that they were not easily comparable with those disclosed in the previous statements

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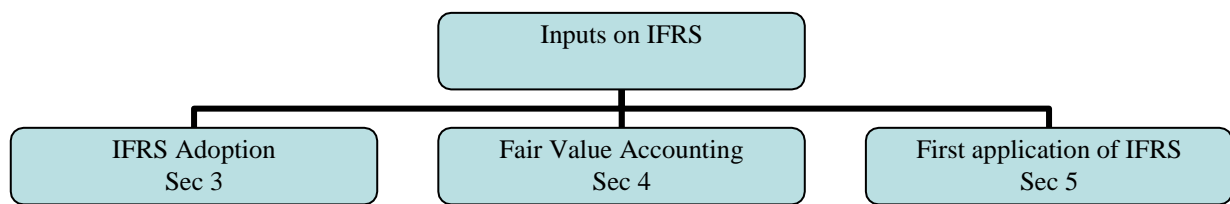
Fig 1: Organization of the paper

Table 1: Number of questionnaires by langue and ways to answer.

	Exploitable		Non Exploitable		Total
	Other	**Website**	**Other**	**Website**	
English	41	563	**8**	**757**	**1369**
French	13	96	**2**	**137**	**248**
Portuguese	4	107	**2**	**154**	**267**
Total	**58**	**766**	**12**	**1048**	**1884**

Table 2: Number of employees, revenues, analysts and insiders of our CFOs sample.

Panel A: Frequency of answers by number of employees and revenues.

Employees	Obs	%	Sales (millions)	Obs	%
< 100	71	17.71	< €50	98	24.44
100-499	59	14.71	€50-€100	40	9.98
500-999	34	8.48	€100-€499	89	22.19
1000-2499	59	14.71	€500-€999	43	10.72
2500-4999	44	10.97	€1,000-€4,900	72	17.96
5000-7499	24	5.99	€5,000 +	59	14.71
7500-9999	20	4.99			
10000	90	22.44			

Panel B: Frequency of answers by number of analysts that follow a firm and shareholders inside the firm.

Analysts	Obs	%	Insiders	Obs	%
1-5	142	35.41	<5%	149	37,16
6-10	63	15.71	5-10%	38	9,48
11-15	39	9.73	11-20%	28	6,98
>16	83	20.70	>20%	186	46,38
None	74	18.45			

Note: Frequencies are based on non-missing observations. Guidance is not explicitly defined on the survey instrument.

Figure 2: Final country classification of accounting systems

Countries
- Micro
  - UK Influence
    - Ireland, Malta, Netherlands, United Kingdom
  - US Influence
    - Australia, Canada, Cayman Islands, Mexico, Philippines, USA
    - Others
      - Algeria, China, Croatia, Greece, Hong Kong, India, Indonesia, Kazakhstan, Korea, Nigeria, Pakistan, Peru ,Qatar, Singapore, South Africa, South Korea, Taiwan, Thailand, Turkey, United Arab Emirates
- Macro - Government
  - Ex-Communists
    - Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine
  - Tax-based
    - Brazil
    - Belgium, France, Italy, Luxembourg, Portugal, Spain
      - Continental Europe
  - Law-based, Bank orientations
    - Austria, Denmark, Finland, Germany, Japan, Norway, Sweden, Switzerland
      - Scandinavian Influence

Figure 3: Expected benefits from IFRS adoption

Table 3: Question 1: The effects of IFRS adoption.

Panel A: Conditional averages by activity.

	Analyst (Obs: 274)			Auditor (Obs: 120)			CFO (Obs: 401)			
	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	K^2
A	72.26	15.69	3.74	76.67	15.83	3.79	73.57	13.47	3.76	NS
B.	51.82	15.33	3.39	64.17	13.33	3.62	57.61	16.71	3.46	NS
C.	35.77	15.33	3.21	43.33	25.00	3.22	41.65	22.44	3.21	***
D	47.08	17.88	3.30	60.83	16.67	3.58	52.62	16.21	3.40	NS
E.	65.69	6.57	3.65	87.50	4.17	4.23	81.55	5.24	4.03	***
F.	35.40	39.42	3.00	51.67	31.67	3.31	48.88	33.42	3.29	***

Panel B: Responses of auditors conditional on countries group.

	Brazil (Obs: 28)%		Eastern Europe (Obs: 19)%		Europe 1 (Obs: 15)%	
	Agree	disagree	agree	disagree	agree	disagree
A.	96.43	0.00	78.95	10.53	66.67	20.00
B.	89.29	0.00	73.68	0.00	33.33	33.33
C.	67.86	3.57	36.84	21.05	33.33	46.67
D.	75.00	3.57	68.42	5.26	40.00	26.67
E.	92.86	3.57	73.68	10.53	86.67	0.00
F.	14.29	53.57	31.58	52.63	66.67	20.00

	Europe 2 (Obs: 22)%		Europe 3 (Obs: 24)%		Others (Obs: 12)%	
	agree	disagree	agree	disagree	agree	disagree
A.	72.73	22.73	66.67	20.83	66.67	33.33
B.	54.55	22.73	54.17	16.67	66.67	16.67
C.	36.36	27.27	29.17	41.67	50.00	16.67
D.	63.64	18.18	45.83	29.17	66.67	25.00
E.	95.45	0.00	87.50	4.17	83.33	8.33
F.	86.36	4.55	79.17	12.50	33.33	50.00

Panel C: Responses of CFOs conditional on countries group.

	Brazil (Obs: 43)%		Eastern Europe (Obs: 15)%		Europe 1 (Obs: 52)%	
	agree	disagree	agree	disagree	agree	disagree
A.	90.70	2.33	93.33	6.67	71.15	13.46
B.	72.09	9.30	60.00	6.67	42.31	25.00
C.	55.81	18.60	20.00	26.67	30.77	23.08
D.	74.42	6.98	60.00	13.33	25.00	26.92
E.	83.72	6.98	53.33	20.00	82.69	3.85
F.	27.91	51.16	6.67	80.00	59.62	13.46

	Europe 2 (Obs: 134)%		Europe 3 (Obs: 117)%		Other (Obs: 40)%		
	agree	disagree	agree	disagree	agree	disagree	K^2
A.	70.15	16.42	70.09	14.53	72.50	15.00	NS
B.	53.73	20.15	55.56	14.53	80.00	12.50	**
C.	43.28	24.63	39.32	19.66	50.00	25.00	NS
D.	54.48	15.67	52.14	17.09	57.50	12.50	***
E.	88.06	3.73	79.49	4.27	72.50	7.50	NA
F.	54.48	32.09	54.70	26.50	37.50	47.50	***

Table 4: Question 2: The effects of the adoption of IFRS

Panel A: Conditional averages by activity.

	Analyst (Obs: 274)			Auditor (Obs: 120)			CFO (Obs: 401)			
	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	K²
A.	53.28	19.34	3.37	60.83	17.50	3.47	54.36	19.20	3.36	NS
B.	49.64	16.06	3.36	47.50	19.17	3.28	47.88	23.69	3.24	NS
C.	42.34	22.99	3.20	50.00	23.33	3.33	51.12	24.69	3.29	*
D.	22.63	30.29	2.88	27.50	35.83	2.86	18.95	33.42	2.81	NS

Panel B: Responses of auditors conditional on countries group.

	Brazil (Obs: 28)%		Eastern Europe (Obs: 19)%		Europe 1 (Obs: 15)%	
	agree	Disagree	agree	disagree	agree	disagree
A.	82.14	0.00	73.68	5.26	26.67	40.00
B.	64.29	7.14	68.42	0.00	20.00	40.00
C.	60.71	17.86	47.37	5.26	26.67	40.00
D.	46.43	21.43	15.79	31.58	20.00	53.33

	Europe 2 (Obs: 22)%		Europe 3 (Obs: 24)%		Others (Obs: 12)%	
	agree	disagree	agree	disagree	agree	disagree
A.	50.00	22.73	58.33	25.00	58.33	25.00
B.	36.36	27.27	29.17	29.17	66.67	16.67
C.	59.09	27.27	58.33	29.17	25.00	25.00
D.	18.18	50.00	29.17	37.50	25.00	25.00

Panel C: Responses of CFOs conditional on countries group.

	Brazil (Obs: 43)%		Eastern Europe (Obs: 15)%		Europe 1 (Obs: 52)%	
	agree	disagree	agree	disagree	agree	disagree
A.	69.77	6.98	93.33	6.67	34.62	34.62
B.	67.44	9.30	73.33	13.33	21.15	38.46
C.	72.09	13.95	73.33	13.33	34.62	34.62
D.	48.84	20.93	26.67	13.33	7.69	44.23

	Europe 2 (Obs: 134)%		Europe 3 (Obs: 117)%		Others (Obs: 40)%		
	agree	disagree	agree	disagree	agree	disagree	K²
A.	50.75	24.63	55.56	11.11	57.50	22.50	***
B.	48.51	24.63	46.15	22.22	55.00	25.00	***
C.	53.73	25.37	48.72	23.08	40.00	30.00	**
D.	13.43	40.30	19.66	25.64	15.00	40.00	***

For table 3, 4, 5, 6: The "agree" column gives the percentage of strongly agree and agree answers for this question. The "disagree" column gives the percentage of strongly disagree and disagree answers for this question. The NA – not applicable; NS – not significant; Khi2 test ***, **, *: 1%, 5%, and 10% of level of significant respectively.

Country groups are "Brazil" (Brazil), "Europe 1" (Ireland, Malta, Netherlands, United Kingdom), "Europe 2" (Belgium, France, Italy, Luxembourg, Portugal, Spain), "Europe 3" (Austria, Denmark, Finland, Germany, Japan, Norway, Sweden, Switzerland), "Eastern Europe"(Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine), "Others" (Algeria, Australia, Canada, Cayman Islands, China, Croatia, Greece, Hong Kong, India, Indonesia, Kazakhstan, Korea, Mexico, Nigeria, Pakistan, Peru, Philippines, Qatar, Singapore, South Africa, South Korea, Taiwan, Thailand, Turkey, United Arab Emirates, USA).

Table 5: Question 3: The implications of Fair Value accounting.

Panel A: Conditional averages by activity.

| | Analyst (Obs: 274) | | | Auditor (Obs: 120) | | | CFO (Obs: 401) | | | K² |
	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	
A.	64.23	4.74	3.71	88.33	1.67	4.04	74.56	5.49	3.85	***
B.	47.08	21.90	3.25	63.33	14.17	3.57	49.13	22.44	3.26	**
C.	48.54	22.99	3.36	42.50	43.33	3.03	52.87	20.95	3.44	***
D.	35.77	17.52	3.23	78.33	10.83	3.82	60.85	13.47	3.62	***
E.	49.64	18.61	3.32	61.67	13.33	3.52	51.62	17.21	3.36	NS

Panel B: Responses of auditors conditional on countries group.

| | Brazil (Obs: 28)% | | Eastern Europe (Obs: 19)% | | Europe 1 (Obs: 15)% | |
	agree	disagree	agree	disagree	agree	disagree
A.	92.86	0.00	78.95	5.26	86.67	0.00
B.	82.14	3.57	47.37	15.79	53.33	6.67
C.	10.71	71.43	57.89	26.32	60.00	20.00
D.	82.14	10.71	89.47	0.00	73.33	13.33
E.	75.00	3.57	47.37	15.79	53.33	20.00

| | Europe 2 (Obs: 22)% | | Europe 3 (Obs: 24)% | | Others (Obs: 12)% | |
	agree	disagree	agree	disagree	agree	disagree
A.	90.91	0.00	87.50	0.00	91.67	8.33
B.	68.18	18.18	45.83	29.17	83.33	8.33
C.	50.00	40.91	54.17	37.50	33.33	50.00
D.	90.91	4.55	66.67	16.67	58.33	25.00
E.	63.64	18.18	58.33	16.67	66.67	8.33

Panel C: Responses of CFOs conditional on countries group.

| | Brazil (Obs: 43)% | | Eastern Europe (Obs: 15)% | | Europe 1 (Obs: 52)% | |
	agree	disagree	agree	disagree	agree	Disagree
A.	67.44	6.98	53.33	6.67	65.38	0.00
B.	76.74	6.98	53.33	6.67	32.69	25.00
C.	27.91	34.88	40.00	33.33	53.85	15.38
D.	62.79	16.28	46.67	13.33	65.38	9.62
E.	51.16	20.93	60.00	13.33	53.85	11.54

| | Europe 2 (Obs: 134)% | | Europe 3 (Obs: 117)% | | Others (Obs: 40)% | | |
	agree	disagree	agree	disagree	agree	disagree	K²
A.	84.33	4.48	73.50	5.98	72.50	12.50	NA
B.	50.75	26.87	40.17	24.79	60.00	20.00	***
C.	62.69	19.40	52.14	17.09	52.50	25.00	**
D.	66.42	14.18	51.28	12.82	67.50	15.00	NS
E.	52.99	19.40	45.30	15.38	60.00	20.00	NS

For table 3, 4, 5, 6: The "agree" column gives the percentage of strongly agree and agree answers for this question. The "disagree" column gives the percentage of strongly disagree and disagree answers for this question. The NA – not applicable; NS – not significant; Khi2 test ***, **, *: 1%, 5%, and 10% of level of significant respectively.

Table 6: Question 20: Why the first application of IFRS was costly

Panel A: Conditional averages by activity. Only Auditors and CFOs.

	Auditor (Obs: 120)			CFO (Obs: 401)			
	Agree%	Disagree%	Mean	Agree%	Disagree%	Mean	K²
A.	84.17	3.33	4.05	69.33	8.48	3.78	***
B.	70.83	18.33	3.56	64.59	11.72	3.62	***
C.	74.17	10.00	3.78	72.57	7.48	3.82	NS
D.	92.50	0.83	4.20	76.06	6.98	3.87	***
E.	63.33	14.17	3.58	58.85	12.22	3.64	NS
F.	20.00	59.17	2.56	26.93	46.63	2.74	**

Panel B: Responses of auditors conditional on countries group.

	Brazil (Obs: 28)%		Eastern Europe (Obs: 19)%		Europe 1 (Obs: 15)%	
	agree	disagree	agree	disagree	Agree	disagree
A.	92.86	0.00	73.68	0.00	66.67	13.33
B.	71.43	21.43	68.42	10.53	53.33	26.67
C.	71.43	17.86	68.42	0.00	73.33	20.00
D.	96.43	0.00	89.47	0.00	73.33	6.67
E.	64.29	17.86	57.89	5.26	53.33	33.33
F.	25.00	67.86	10.53	47.37	26.67	60.00

	Europe 2 (Obs: 22)%		Europe 3 (Obs: 24)%		Others (Obs: 12)%	
	agree	disagree	agree	disagree	agree	disagree
A.	86.36	9.09	95.83	0.00	75.00	0.00
B.	95.45	4.55	58.33	33.33	75.00	8.33
C.	72.73	9.09	79.17	8.33	83.33	0.00
D.	95.45	0.00	95.83	0.00	100.00	0.00
E.	68.18	9.09	70.83	12.50	58.33	8.33
F.	22.73	63.64	20.83	58.33	8.33	50.00

Panel C: Responses of CFOs conditional on countries group.

	Brazil (Obs: 43)%		Eastern Europe (Obs: 15)%		Europe 1 (Obs: 52)%	
	agree	disagree	agree	disagree	agree	disagree
A.	79.07	9.30	73.33	0.00	71.15	5.77
B.	69.77	13.95	66.67	0.00	59.62	17.31
C.	76.74	9.30	53.33	6.67	73.08	5.77
D.	93.02	0.00	60.00	13.33	82.69	5.77
E.	67.44	9.30	33.33	20.00	65.38	7.69
F.	27.91	55.81	46.67	0.00	21.15	59.62

	Europe 2 (Obs: 134)%		Europe 3 (Obs: 117)%		Others (Obs: 40)%		
	agree	disagree	agree	Disagree	agree	disagree	K²
A.	71.64	10.45	60.68	8.55	72.50	7.50	NA
B.	72.39	8.96	59.83	11.11	52.50	17.50	NS
C.	77.61	6.72	65.81	9.40	77.50	5.00	NA
D.	71.64	9.70	72.65	8.55	80.00	0.00	NA
E.	57.46	17.91	54.70	11.11	67.50	2.50	*
F.	35.07	45.52	21.37	44.44	15.00	47.50	***
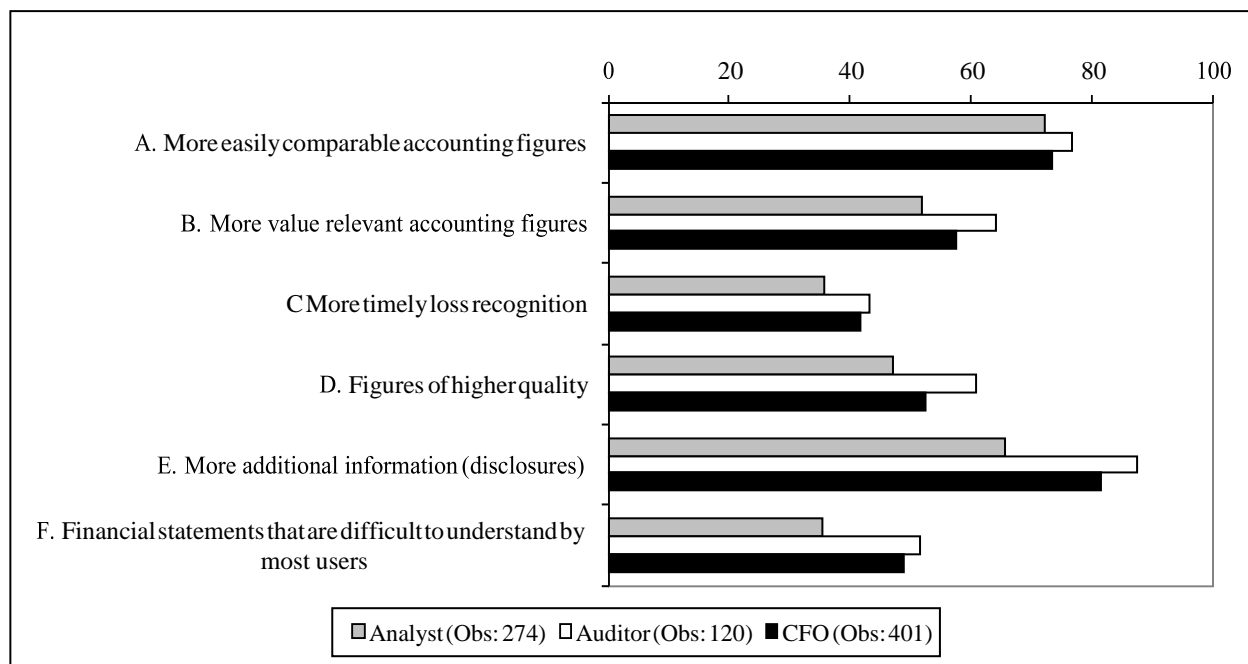
Figure 4: The effects of IFRS adoption
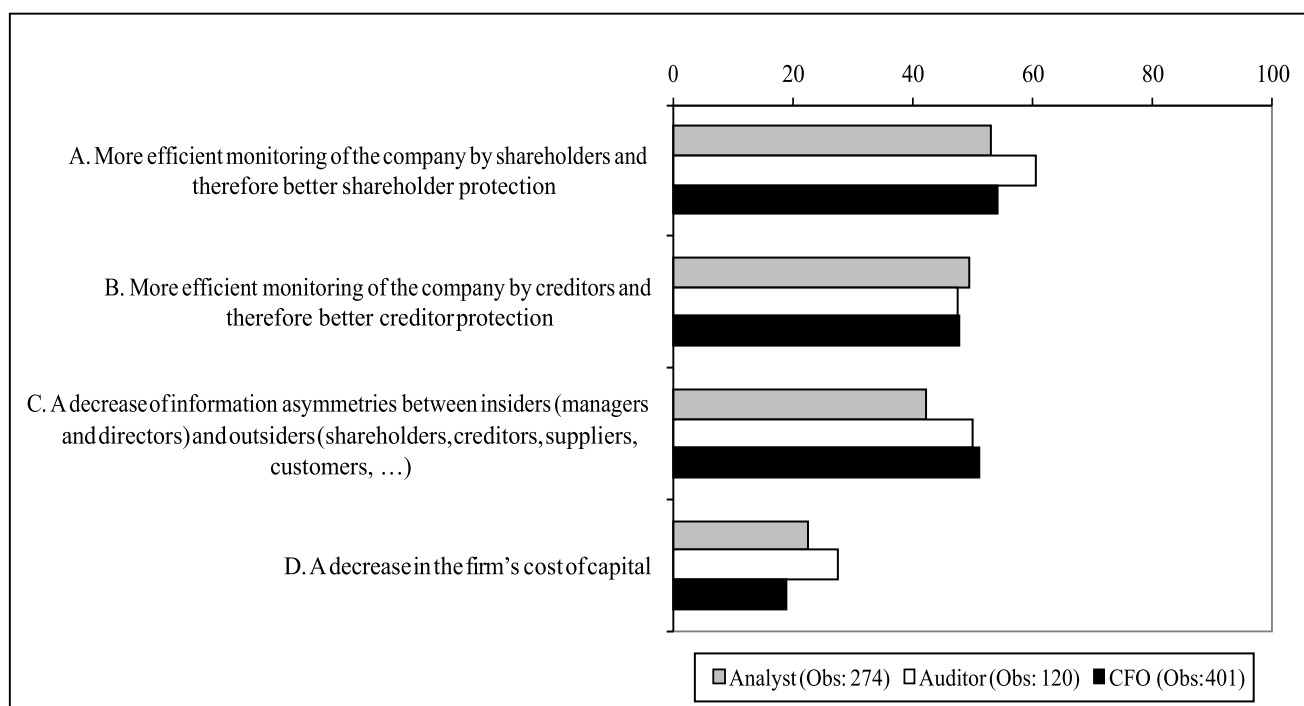
Figure 5: Effects of the adoption of IFRS leads
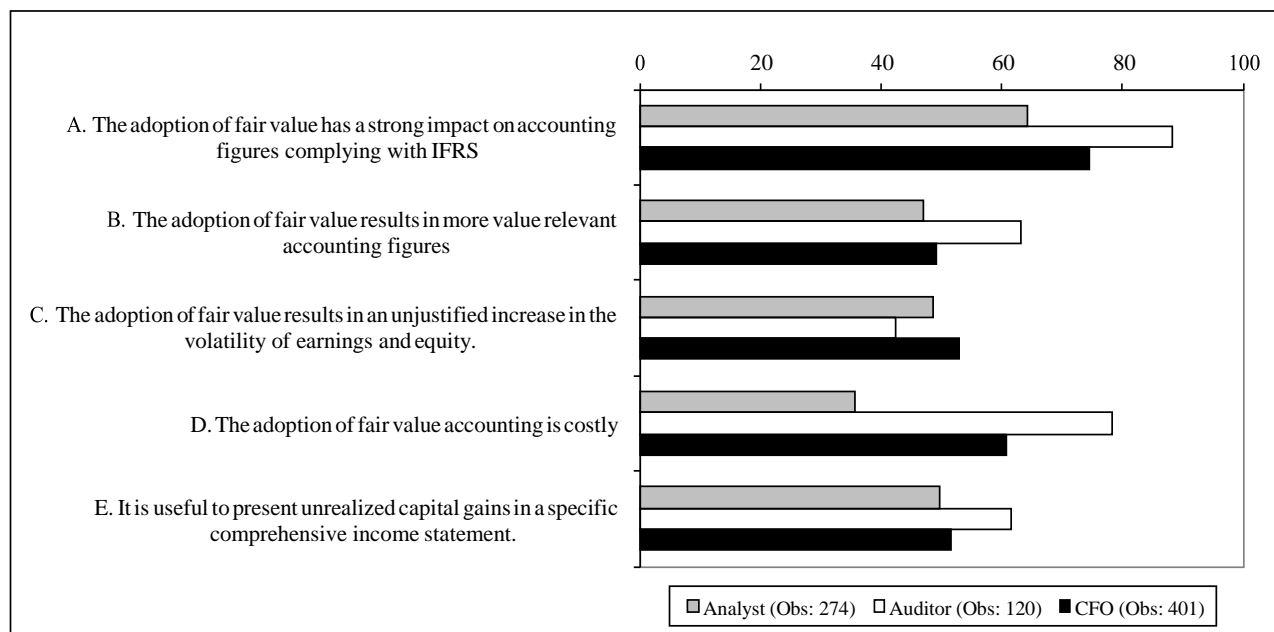
Figure 6: The implications of Fair Value
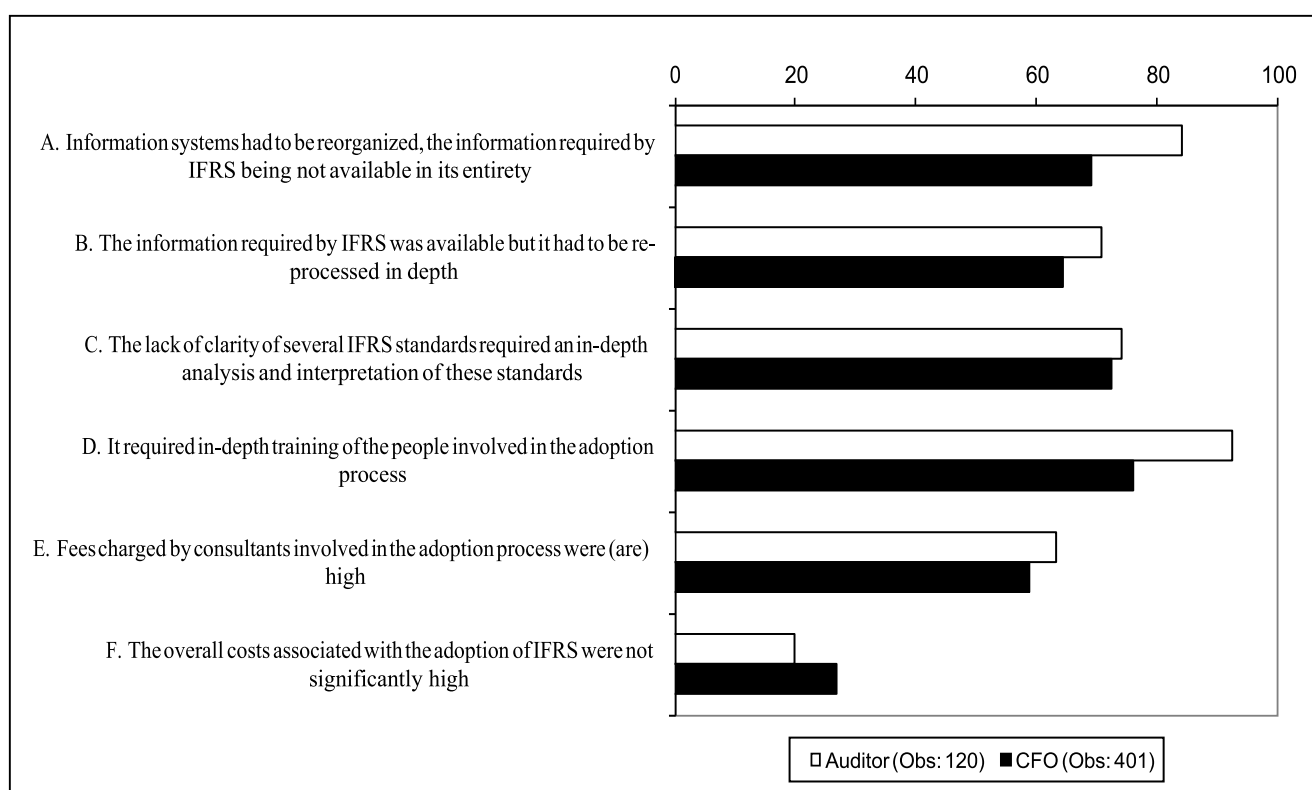
Figure7: First application of IFRS

Table 7: Question 4: Analysis of the first financial statements complying with IFRS

	Analyst% (Obs: 274)		
	agree	disagree	Mean
A. Has increased the time spent to process accounting information and financial statements	38.69	21.17	3.27
B. Has decreased the time spent to process accounting information and financial statements	20.80	38.69	2.73
C. Has improved the relevance of our forecasts and recommendations	37.23	16.42	3.21
D. Has diminished the relevance of our forecasts and recommendations	9.12	52.92	2.51

Table 8: Question 5: Switching to IFRS.
Panel A: Frequencies by activity analysts.

	Analyst% (Obs: 274)		
	agree	disagree	Mean
A. Required a specific training because these standards differ significantly from those used previously	49.27	16.42	3.41
B. Was complex because of accounting figures that they were not easily comparable with those disclosed in the previous statements	56.57	14.96	3.53

For table 7, 8: The "agree" column gives the percentage of strongly agree and agree answers for this question. The "disagree" column gives the percentage of strongly disagree and disagree answers for this question. Khi2 test was calculated however the result was NA – not applicable.
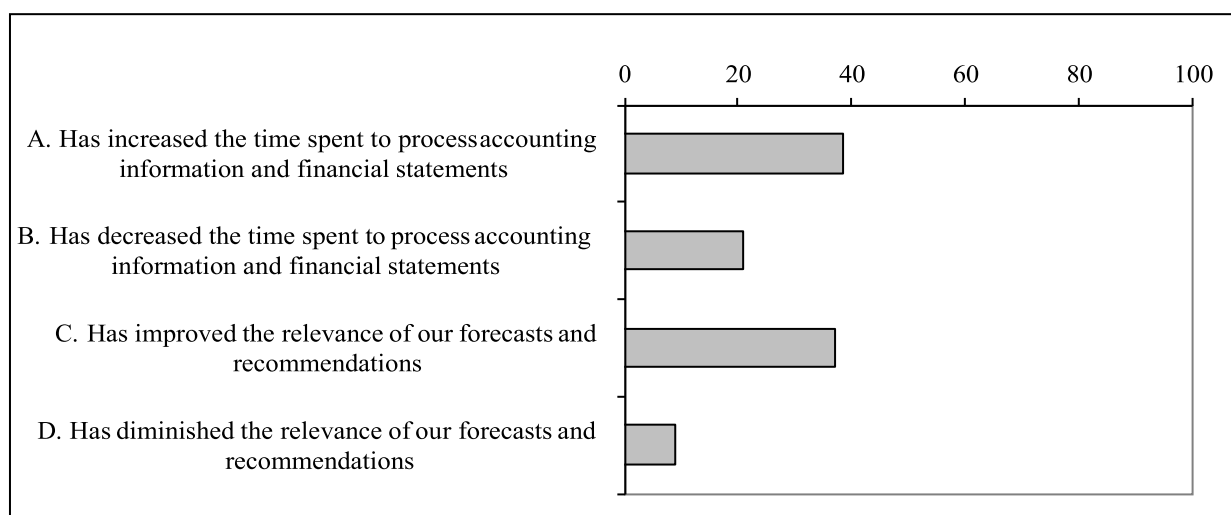
Figure 8: Analysis of the first financial statements complying with IFRS
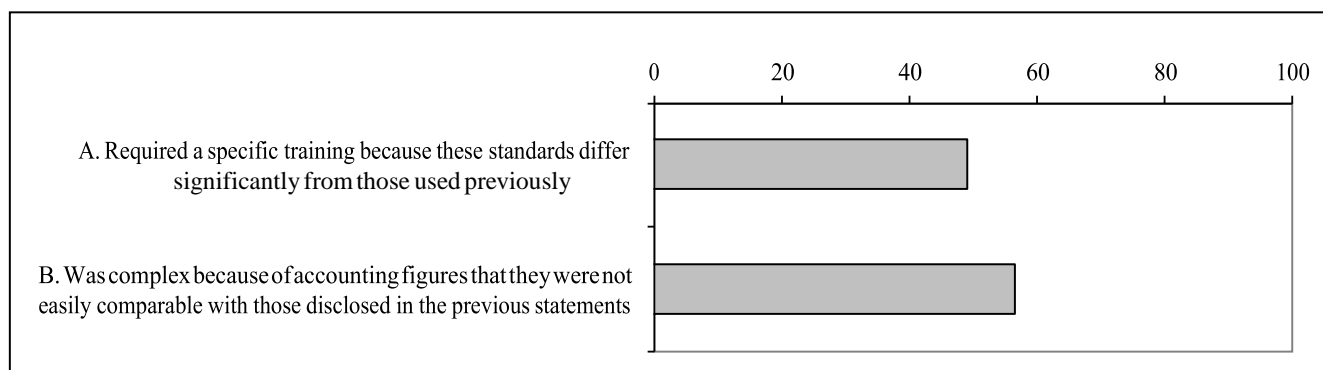
Figure 9: Switching to IFRS

The Evolution of Sustainability in Planning Practice: A Case Study of Tianjin Master Plans, 1986 to 2016

Dr. Yu Wang, University of Glasgow

Abstract

There is an increasing sustainability concern in the process of urban lanning. However, a gap still exists in understand how sustainability was and is being consolidated in planning practice. In this paper, we propose an integrated multi- dimensional method to characterize Chinese planning practice in different periods. By using a case study of Tianjin, we create a dynamic view of the progress of planning in the past four decades. Particularly, we analyze how and why the goals of master plan were developed and the changing circumstances under which the plans were formulated. Early version of master plans highly emphasized on pursuing economic success with great input on infrastructure investment and industrial site expansion. Constrained by land and natural resources, the dimensions of planning had been reshaped with new environmental goals included. Recently, new development blueprint was drawn in the latest master plan that aimed to promote a more integrated and balanced spatial pattern. Results reveal that an endogenous improving process towards sustainability has emerged in Chinese planning practice. However, constrains are found to be from the contextual reality of Chinese cities as well as the progress of institutional reforms. We conclude by summarizing the features of Chinese master planning in the past decades and barriers for achieving sustainable urban growth. We suggest that a dynamic assessment tool is needed to more effectively link the planning input with the outcome of urban development.

Communication Is Stressful: A Survey of Business Communicators

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Abstract

In-depth research has yet to be conducted specifically on the impact stress has on professionals in the expanding field of public relations/strategic communication. Research has been undertaken to determine the impact stress has in journalists. As public relations practitioners have many of the same tasks as journalists, they have an additional burden—that of managing the communication process. Therefore, it is prudent to study how performance and productivity, in addition to the journalistic function of PR, are impacted by stress. This becomes even more essential considering public relations expanding influence and role in competitive businesses. Eight-eight communication professionals responded to a pretest conducted as a precursor to a larger scale survey. After computing a stress score from self-reported stress levels, we found age is a factor regarding stress levels, with those middle aged practitioners reporting higher levels of stress than those older and younger. The findings provide a baseline analysis of how productivity and other factors are impacted by stress.

The economic climate of the 21st century is uncertain, downsizing, layoffs, mergers and bankruptcies, fewer health and retirement benefits, as well as increased competition. These factors affect workers of every type, and at every level are employees are experiencing increased tension and uncertainty. While some workplace stress is normal, excessive stress can interfere with productivity and performance. Stress can also impact physical and emotional health, and affect relationships and home life.

STRESS IN THE WORKPLACE

Numerous studies show that job stress is far and away the major source of stress for American adults and that it has escalated progressively over the past few decades. The American Institute of Stress finds increased levels of job stress to be associated with increased rates of heart attack, hypertension and other disorders. While, the job can be stressful, stress levels are also determined by the person-environment fit. This fit includes the time given to produce results, the amount of multi-tasking, as well as external and internal variables. Regardless or the variable impacting stress, control, or perceived control is a key factor in any stress level. A persons self-efficacy, or their internal beliefs about their ability to have an impact on events that affect their lives, has been demonstrated in a variety of studies to be a significant factor in how people handles stress (Bandura, 2006).

Possessing high levels of self-efficacy acts to decrease people's potential for experiencing negative stress feelings by increasing their sense of being in control of the situations they encounter (Litt, 1988). The perception of being in control (rather than the reality of being in or out of control) is an important buffer of negative stress. When people feel that they are not in control, they start feeling stressed (Litt, 1988).

The severity of job stress depends on the magnitude of the demands that are being made and the individual's sense of control or decision-making latitude he or she has in dealing with them (Frost, Ebstrup, Pisinger, & Jørgensen 2011). "Jobs such as strategic communication executive, newspaper reporter and event coordinator are among the most stressful because of tight deadlines and scrutiny in the public eye" (Wilson 2015, 1). In fact, a *Moneywatch* survey identified public relations in the top nine most stress full jobs in 2018, identified from 11 factors, including travel, growth potential, deadlines and physical demands. According to the survey, "public relations executives count among the higher-paid workers on the most-stressful list, but they're required to juggle quite a bit for the pay. Clients can be demanding, for one. Reaching out to journalists and pitching stories can also be stressful" (Picchi, 2018).[1]

In addition to the high level of multitasking, and pitching stories, the deadline nature of the job has been attributed to stress. Blackman (2014) find that tight deadlines make people less creative, limit people's ability to think and increases stress levels. Additionally, the unique mix of management and technique needed to be successful in public relations can cause stress alone, even without any other external factors. Public relations also require a management mentality to

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[1] Forbes ranked Public Relations as the 8th most stressful job in 2017, and Job search site CareerCast evaluated 200 professions, and found Public Relations ranked 6th.

developing communications objectives that are consistent with an organization's overall objectives, and coordinating the interactions between various key publics, as well as the creativity or "technician" aspect that comes from crafting and executing the mechanics of communication. Thus, working with reporters is not the only aspect that deadlines for strategic communication professionals, in fact, "… the entire work cycle of a PR professional is laden with deadlines. The worst part is that they have to deal with on all sides – client, boss, as well as journalists. Everybody's deadline is a PR professional's deadline" (Reputation Today, 2016).

The strategic communication profession is all about unpredictability and uncertainty, which limits a person's perception of control. Therefore, this general lack of control in the field, is a prominent factor in why strategic communication is a very stressful profession. As public relations is booming at present, and its mechanisms and practices are being adopted by corporations and companies across the globe (Lloyd & Toogood, 2015), it becomes important to investigate what aspects public relation practitioner find stressful in order to determine what corporate strategies and initiatives may be created to help manage employees stress.

Public Relations Vs. Journalism

In many ways, public relations is a child of journalism (White & Hobsbawm, 2007). Practitioners in both fields are constantly communicating with the public. They tell stories and interact with their audiences. In order for professionals in the journalism and PR industries to be successful, it is essential to build credibility and trust with the audience. Journalists build trust by reporting and publishing fair and accurate content so that they are recognized as a credible organization. In addition to credibility, PR professionals build trust to inform and persuade target audiences to support an organization or product. Both fields relay information in an easily understandable way, and both have to write on deadline in a variety of mediums (I.e. online, social media and print). Research has yet to specifically be conducted on stress in strategic communication, despite the similarities that exist between journalism and strategic communication. Because of these similarities, and the scarcity of research investigating stress in public relations, studies that highlight the stress stemming from the field of journalism are referred here as a way to lay a foundation from which to understand stress in strategic communication.

Studies have found (Filak, 2011) that for journalists "even though exhaustions were moderate or even high, personal accomplishment was also high" (252), high anxiety is found in journalism. This anxiety stems from "cultural and political pressures, competition from other news organizations, pressure from supervisors and peers, and pressure from within the journalists themselves" (Newhagen, 2009, 22). In fact. anxiety has become extremely common for journalists both in the United States and China (Newhagen, 2009). Other reasons for this include the fact-paced nature of the business, the demand for accuracy, finding and framing the correct images, getting the exclusive story, choosing which facts provided in a press conference should be corroborated; to writing the story, editing it, and if the piece will even run due to time/space constraints and breaking news (Shevlin, 2003).

Public Relations Specific Stress

The stressors above experienced specifically affecting journalists are in part the same

stressors for strategic communication practitioners. Strategic communication practitioners deal with similar type of situations as journalists, but with three major additions beyond that of journalists: client expectations, the strategic management role of communication oversight, and the ability to explain and define the function and role of public relations. Clients can be difficult, and because of the interactional nature of public relations, the PR practitioner "Can't live with them, can't live without them" Because the nature of the PR business is based on relationships with people, and everyone is so different, understanding how to work with different personalities add additional stress. Furthermore, managing emotions and client expectations adds a layer regarding stress (Pace, 2016).

Public relations must also manage the overall campaign trajectory from the first phase of research through the fourth phase of evaluating the communicating effort.[2] According to Grunig and Hunt (as cited in Jethwaney & Sarkar, 2000), PR must evaluate public attitudes, identifiy the policies and procedures of an individual or an organization with the public interest, and plan and execute a program of action to earn public understanding and acceptance. This in addition to the creation of press materials. Furthermore, "PR is poorly understood, and this leaves a lot of room for confusion and miscommunication. Many people assume that public relations will generate something tangible just like advertising or that the results will be exact. This is not the case, and it creates a lot of stress" (Pace, 2016). In addition, similar to journalists, who don't know for absolute that their story will make it to press, strategic communication professionals are constantly dealing with unpredictability in their job, as you "don't know whether your pitch will be entertained, if at all, then how much space will it get, what kind of words and communication will come out, you have no control over any of it" (Reputation Today, 2016). Lastly, due to the "frequency of PR crises, the technology-driven 24/7 nature of the job and the ever-increasing demands on communicators to prove their worth", strategic communication professionals can be argued to are living with stress even more so than journalists (Van Camp 2012, 24).

The quest for "perfectionism" has also been found to produce high levels of burnout and role stress specifically in the communication fields. Role stress is not the only stress experienced by employees but "is a central form of stress in the workplace" (Childs, 2012, 358). Employees have also been found to feel that others have high standards of their performance and expect perfection in their work. Perfection in communication is a subject item. To this end, professionals have been found to experience very high levels of role stress and burnout, which only increases over time (Childs, 2012). With the 24-news cycle and the expanding role of social media, stress surrounding "getting it right" and "controlling the message" is increasing, adding an addition level of stressors for practitioners.

There are many other aspects of strategic communication that cause stress for professionals in the field, whether that be "a negative article from the press, a damaging tweet from the public or an unforeseen physical disaster are all cause for triage, and that can cause much stress" (Van Camp 2012, 1). Since strategic communication practitioners are implementing new technologies, programs, and social media into their practice, these unfamiliar tasks and processes can cause uncertainty and increases stress levels. Perhaps the most viable function of

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[2] The Ketchum's Strategic Planning Model (Wilcox 2015), has a four stage process. While these stages have varying names depending on which specific process is used, the general phases are: research, planning, implementation, evaluation (RPIE).

public relations, that of crisis communication, is just the tip of the preverbal iceberg regarding the many sources and layers of anxiety and stress for strategic communication practitioners. Strategic communication professionals experience stress from internal pressures, within their own company, as well as external. "The most stressful part [of strategic communication] is coaching a client to achieve balance between the internal need to act thoughtfully and strategically and the external pressures of the media's never-ending news cycle" (PRSA, 2011).

Depending on the type and level of stress, individuals can have emotional and physical changes to their normal lifestyle. Stress is a highly personalized phenomenon and can vary widely even in identical situations for different reasons, however common situations likely to cause stress are those that are unpredictable or uncontrollable, uncertain, ambiguous or unfamiliar, or involving conflict, loss, or performance expectations (McVicar et al., 2013). Stress may be caused by time, limited events (such as the pressures of examinations or work deadlines), or by ongoing situations, such as family demands, job insecurity, or long commuting journeys (Michie 2002). Interestingly, when considering this list, public relations/strategic communicate practitioners job innately meets many of these component: unpredictable events, uncontrollable media, and client conflict.

Public Relations Specific Stressors

Public relations is an industry that is inclusive of women at all levels. Women make up 63 percent of public relations "specialists," according to Bureau of Labor Statistics data, and 59 percent of all PR managers. Studies (i.e. Michie 2002) have shown that women are especially likely to experience stress. This finding has been attributed to the fact that women still carry more of the burden of childcare and domestic responsibilities than men (Michie, 2002). In addition, women are concentrated in lower paid, lower status jobs, may often work shifts in order to accommodate domestic responsibilities, and may suffer discrimination and harassment (Michie 2002).

According to the Institute for Women's Policy Research, if the advertising world is included into public relations demographic data, sixty percent of the content creation, communication and message management workforce is female, compared to 47 percent of the overall workforce. Other estimates say the female percentage is closer to 73, or even 85 percent. Furthermore, jobs for public relations specialists are growing at 12 percent a year.[3] As public relations/strategic communication is a mixture of creativity and management, the job title of a PR practitioner varies. Most positions would be considered middle management or supervisory in nature. These middle range employees "have dual roles that embody aspects of ownership and front-line labor, without the full benefits of being one or the other—they get flak from above and below" making the job that much more stressful (Lam, 2015). A 2015 study found that 18 percent of supervisors and managers reported symptoms of depression/stress, whereas blue-collar workers, and for owners and executives, reported 12 percent and 11 percent respectively (Prins et al, 2015),

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[3] A study by workplace research group Catalyst took a look at 353 Fortune 500 companies and found that those with the highest representation of women in management teams had a higher return on equity and returns to shareholders by more than a third.

Thus, in summation, public relation professionals must compete against similar business segments for coverage in the media, have pressure from management to meet high demand and high worth ethics, deal with co-workers, and clients, and put internal pressure on themselves. Therefore, while it can be defended that strategic communication practitioners experience the same type of stressors as journalists, it can also be argued that public relations is a more stressful job, as evidenced by the various polls that place public relations on the tops stressful jobs list. Couple that with the gender dominance of the field and the middle management nature of the work, the high levels of stress associated with the strategic communication profession would suggest practitioners are being significantly impaired physically and psychologically, which in turn lowers their performance levels (Childs, 2012). However, while the specific sources of anxiety are known for journalists, key stress points have not been determined for strategic communication professionals.

Stress Effects

The human body is designed to experience stress and react to it.. However, when an individual faces continuous challenges without relief or relaxation between challenges, her /she becomes overworked and stress-related tension builds (Kossek, et al., 2012). This negative stress directly negatively affects "employees' physical health, psychological wellbeing and performance" (Childs, 2012, 347).

Stress has direct effects on mood and early initial symptoms of lowered mood can include irritability, sleep disruption and cognitive changes such as impaired concentration. Stress, anxiety and depression have been recognized as important outcome measures in various work environments (Bennett et al, 2004). Furthermore, research has suggested that working conditions may be an important precursor of stress and may, therefore, contribute to the development of depression or anxiety (Plaisier et al, 2006). Rusli, Edimansyah, & Naing, (2008), definitively found that stress is often described as being associated with anxiety and depression at workplaces. Workers with little opportunity for decision-making and greater job demands show higher rates of depressive symptoms (Prins, Bates, Keyes, & Muntaner, 2015). However, it's the indirect effects of stress that often causes depression to take hold. When people experience stress, they often stop doing some of the healthy coping strategies that usually help keep their mood on track.

Additionally, the demands on the individual in the workplace are increasingly reaching out into the homes and social lives of employees. This is likely to undermine a good and relaxing quality of life outside work, which is an important buffer against the stress caused by work (Michie 2002). In addition, domestic pressures can affect a person's focus at work. Thus, a vicious cycle is set up in which the stress caused in either area of one's life, work or home, spills over and makes coping with the other more difficult (Michie 2002).

However, "… job stress is not uniformly negative. Some degree of stress is necessary to motivate job performance and to provide enough environmental stimulation to prevent boredom" (Endres 1988, 1). As public relations/strategic communication is a mixture of creativity and management the effect stress has on creativity as well as productivity is a concern. Luckily, the relationship between stress and creativity is not a toxic one. In fact, small doses of stress -- like juggling multiple projects or working under tight deadline -- are likely to produce the best ideas because they motivate individuals to work toward specific goals (Becker, 2018). But the nature of

stressors does matter in predicting employees' idea generation. Specifically, stressors that employees tend to appraise as challenges relate positively to idea generation, whereas stressors that employees tend to appraise as hindrances are not (Ren & Zhang, 2015). The difference between how people classify stress or "stressors" depends on the meaning of the task. Challenge stressors hold meaning to an employee, and therefore the person channels the stress to build creativity, whereas regarding creativity, hindrance stressors encumber employees' ability to generate novel and useful ideas (Lu, Akinola, & Mason, 2017).

Challenge stressors include factors in the work place such as reasonable time constraints (in order to generate and execute ideas), sizable workload (so that people are sufficiently challenged), and a clear job description with varied responsibilities tied to job performance (Ren, Feifei & Junghuan Zhang (2015). Amabile and Kramer (2011) found workers who worked under low to moderate deadlines, showed the most creativity, followed by those under tight deadlines. The stress of a due date notwithstanding, a time-sensitive environment has been linked to creativity (Amabile & Kramer, 2011). However, multi-tasking and short time to complete projects, negatively impact the final product (Lu, Akinola, & Mason, 2017). This negative impact leads people to consider these variables as hindrances to the work product. Hindrance stressors have been found to include: office politics, red tape that thwarts the ability to get anything done, job confusion and job insecurity (Lu, Akinola, & Mason, 2017).

RESEARCH QUESTIONS

Historically, the typical response from employers to stress at work has been to blame the victim of stress, rather than its cause. Increasingly, it is being recognized that employers have a duty, in many cases in law, to ensure that employees do not become ill. It is also in their long term economic interests to prevent stress, as stress is likely to lead to high staff turnover, an increase in sickness absence and early retirement, increased stress in those staff still at work, reduced work performance and increased rate of accidents, and reduced client satisfaction. (Michie, 2002).

Through the findings found from this research, management will be able to identify which areas of the strategic communication profession impact employee stress levels the most. This information can guide them in developing programs that are focused on effective stress management strategies tailored to public relations/ strategic communication. The questions guiding this reach are as follows:

RQ1: What areas and responsibilities of public relations/ strategic communication profession are the most stressful?

RQ2: What internal and external factors in the workplace impact the stress levels of public relations/strategic communication professionals?

RQ4: What role does stress have on key business components such as production engagement, motivation?

RQ5: Do various demographics (age, job level, position type) affect stress levels?

SAMPLING

A survey of eight-eight strategic communication professionals in the workplace and in their personal life, and recognized individuals ability to self-report stress (stress scores) allowing researchers to determine how stress impacts different generations of strategic communication professionals regarding different factors and responsibilities in the profession.

A homogenous convenience sampling method was determined prudent for this study for several reasons, namely: convenience sampling is very easy to carry out with few rules governing how the sample should be collected; the relative cost and time required to carry out a convenience sample are small in comparison to probability sampling techniques and; the convenience allowed us to gather useful data and information that would not have been possible using probability sampling techniques, which require more formal access to lists of populations. This sampling strategy is by far the most common non-probability sampling strategy used. In contrast to conventional convenience sampling, the sampling frame for homogeneous convenience sampling is intentionally constrained with respect to sociodemographic background (Jager, Putnick, & Bornstein, 2017).

According to Jager, Putnick, & Bornstein (2017), homogeneous convenience sampling allows researchers to study a population that is homogeneous with respect to one or more sociodemographic factors, thus, the target population is a specific sociodemographic subgroup. The key advantage of homogeneous convenience samples, relative to conventional convenience samples, is their clearer generalizability. Because the sampling frame of homogeneous convenience samples is more homogeneous than the sampling frame for conventional convenience samples, researchers can be more confident with respect to generalizability (Jager, Putnick, & Bornstein, 2017). If you were to make a hypothetical continuum of generalizability, probably samples would be at one end and conventional convenience samples at the other. Our homogeneous convenience samples fall somewhere in between. However, the more homogeneous they are (i.e., the more sociodemographic factors that are homogeneous), the closer they fall in terms of generalizability to probability samples (Jager, Putnick, & Bornstein, 2017).

This this study, we disseminated the survey through professional network opportunities in the form of professional organizations, LinkedIn groups, Twitter Groups and Facebook groups. When considering a sample size, it is assumed that a bigger sample size is better. However, considering our homogenous sample, the size of the sample can be smaller. This is because we know the true population parameters for our sample, and therefore are able to judge the validity of our sample's estimates (Jager, Putnick, & Bornstein, 2017). Furthermore, this study was intended as a pre-test. Due to the demanding nature of the public relations industry, this survey was determined to be a pre-test to assist us in determining how many invites we would need in the future, the best pitch to use to, and specifically enabled us to review the time stamps to see how long it took the respondent to take the survey. This review allows us to maximize the time respondents spend on the survey to both provide us the information we needs, and to determine how much of their time we could and should use.

Demographic Representation

Supporting the data from the labor department regarding gender disbursement in the public relations field, our study skewed female, 78% of respondents identifying themselves as

female. As shown in figure 1 to the left, 52% of respondents work in strategic communication, 18% in communications, and 17% in marketing; while, 60% work in an agency setting and 26% work in corporate/in-house. Fifty percent of respondents were between the ages of 20 – 25; thirty percent between 26 – 35, thirteen percent were 46 or older, with eight percent 36 – 45 years of age. In terms of years of experience in the field, as shown in figure 2 below, 13% have worked in the industry for less than a year, 51% for 1 - 5 years, 12% 6 – 10 years, and 24% for over ten years. In terms of the highest degrees earned, 83% received a Bachelor's Degree and 6% received their Master's Degree.

Cronbach's alpha was computed to assess the reliability, or internal consistency, of our stress scales. We correlated the score for each scale item with the total score for individual survey respondents and then comparing that to the variance for all individual item scores. We recoded the variables into a stress score and the Crombach's Alpha coefficient was .932, revealing a good internal consistency (Pavot, Diener, Colvin, & Sandvik, 1991).   This stress score was then used to test individuals self- described stress levels to their responses to a variety of survey questions around their personal life and work life.

Stressful Activities

As a jumping off point for analyzing the impact stress has on strategic communication professionals, the data shows that 80% of all respondents find strategic communication jobs to be stressful. Of the 80% that find strategic communication jobs to be stressful, 85% of them indicated that they find the public relations profession specifically to be somewhat to very stressful. Eighty-two percent of survey respondents indicated that they would continue to work in strategic communication even knowing that it is one of the top 10 most stressful careers; and that 58% of them plan on working in the field for 10+ years.

Specific Tasks

The data suggests that strategic communication professionals experience higher levels of stress when it comes to event planning, crisis management, coordinating strategy between teams and departments, writing and distributing press materials to the media, and analytics, over other areas and responsibilities associated with the strategic communication profession. Creating and implementing campaigns for clients was determined to cause respondents the most stress, with 61% percent of respondents reporting the activity to be moderately stressful to highly stressful. Event planning was also moderately stressful, with 40% of respondents reporting.

Forty six percent of survey respondents found crisis management to be extremely stressful. However, despite the extreme stress rating, the other 54% of respondents reported crisis management to be not at all stressful to seldom stressful. Regarding coordinating strategy between teams and departments, 75% of respondents indicated it was seldom to moderately stressful, and 81% of respondents finding writing and distributing press materials to the media to be seldom to moderately stressful. Seventy six percent of respondents said that they find the analytics to be seldom to moderately stressful. Lastly, when survey respondents' were asked whether they feel

that stress deters them from reaching campaign goals for clients, 58% of respondents identified that stress does not deter them from reaching their campaign goals for clients

Communication Roles

As managing client expectations has been noted as a stressful component in public relations, we asked respondents their attitudes regarding this. The majority of respondents ranked meeting client expectations as the most stressful in comparison to impressing their boss & meeting his/her expectations, internal office stressors (management, stakeholders, etc.), and external office stressors (the media, etc.).

In regard to whether or not respondents feel that their relationships with upper level management influences their stress levels, the findings from this survey determined that 67% of respondents felt that their stress level are influenced by their relationship with upper level management. Additionally, respondents indicated that they find their relationships with fellow employees to be somewhat stressful to not stressful.

Age was found to be a factor that impacts the self-reported stress levels of strategic communication professionals in the workplace. After running an Anova, we found that a statistical significant difference exists between respondents between the ages of 26 – 30 and 46 years and older (sig=.010, f=4.168, df=3). Those that are younger experience stress more often than those who are 46 years old and older. When looking at respondents' reported tendency to fall behind in comparison to their self-reported stress score, a statistically significant difference was found between those whose feel that stress makes them fall behind and those who do not feel stress makes them fall behind in regards to how often they feel stressed.(p=.016, t=-2.602). It was found that those who feel stress makes them fall behind, self- reported feeling stressed more often than those who felt that stress does not make them fall behind, who self-reported feeling stressed less often. Therefore, this suggests that those with a higher self-identified stress level are more likely to feel that stress makes them fall behind.

An interesting finding was in terms of whether or not stress makes strategic communication professionals more or less productive, engaged, and motivated. The data found that strategic communication professionals' self-reported stress score has no significant effect on productivity, engagement, or motivation. Therefore, stress does not make strategic communication professionals more or less productive, engaged, or motivated. However, when asked in the survey if stress makes them more productive, engaged, and motivated; 40% of respondents agreed that stress makes them more productive, 29% agreed it makes them more engaged, and 35% agreed that stress makes them more motivated.

Stress Reduction Programs

Data analyses revealed that 71% of respondents feel as if stress management programs aimed at stressful areas would be useful and beneficial. Of those respondents who said that stress impacts their productivity and ability to reach deadlines, they were then asked if they thought that management should implement special programs to aid in stress management in the areas of the strategic communication job line that cause the most stress to employees. Of the respondents who

answered the question regarding if management should implement special programs to aid in stress management in these specific areas, 73% think that management should implement stress management programs in areas that cause the most stress to strategic communication professionals.

DISCUSSION

The differences found between age ranges and levels of stress is an interesting finding, but not unexplainable. It could be argued that those that are younger experience stress more often than those who are 46 years old and older because the older practitioners have learned to manage their workplace expectation better. Research has found that older generations do cope differently than their younger counterparts. Gutmann (1974) suggested that mastery styles shift from active to passive from youth to midlife, then to "magical" mastery in late life. In contrast, Vaillant (1993) believed that a positive change occurred in the use of defense mechanisms. However, investigating specifically what coping techniques are used by public relations and strategic communication practitioners, specifically, would be helpful in creating and executing employee stress reduction programs. Additional research could also aid in expanding current mentoring programs.

It was found that those who feel stress makes them fall behind, self- reported feeling stressed more often than those who self-reported feeling stressed less often. Thus, those that experience stress more often, we assume, would consider the stress they feel as hindrance stressors. As research has shown that hindrance are work-related demands or circumstances that tend to constrain or interfere with an individual's achievements at work (Boswell et al., 2004). These stressors will create anxieties and psychological strain, and dampen enthusiasm and motivation, as 'the effort expended to cope with them is unlikely to be successful' (Clarke, 2012: 388).

An interesting finding was in terms of whether or not stress makes strategic communication professionals more or less productive, engaged, and motivated. The data found that strategic communication professionals' self-reported stress score has no significant effect on productivity, engagement, or motivation. Therefore, stress does not make strategic communication professionals more or less productive, engaged, or motivated. However, when asked in the survey if stress makes them more productive, engaged, and motivated; 40% of respondents agreed that stress makes them more productive, 29% agreed it makes them more engaged, and 35% agreed that stress makes them more motivated. This finding is also in line with studies investigating positive or challenge stressors., where the stress is perceived as opportunities for learning, growth, and achievement. The beneficial effects of challenge stressors are reflected in worker outcomes such as continuance commitment and organizational citizenship behavior (Boswell, Olson-Buchanan, & LePine, (2004). We suggest that this type of stress, in fact, is one reason why respondents plan to stay on in their "stressful" positions, as the positive effects of this type of stress lead to high motivation because they provide the opportunity for growth, and there is a positive association between effort and rewards (Clarke, 2012).

No significant difference was found between the self-identified stress score of working professionals and whether they worked in corporate, agency, non- profit, or entertainment, etc. The setting of which these professions work in does not influence their self-identified stress levels. We take from this that there the setting of the public relations/strategic communication work does not influence the stress levels of working professionals. There was also no significant difference

found between respondents self-reported stress scores and where they associate their job in the expanding field of strategic communication. This goes to suggest that the stress levels of professionals are not impacted by where they work in the expanding field of strategic communication, from marketing to advertising, to communications and publicity, etc.

CONLCUSION

This survey research study provided a first look at how stress affects strategic communication professionals in the workplace. As strategic communication is one of the top ten most stressful careers in America, this study provided necessary quantitative information to begin a discussion on how stress affects professionals in the field of public relations/strategic communication, as well as if stress has negative effects on their work and well-being. The findings produced from this study will be used to craft working solutions to educate people on how professionals in the workplace of strategic communication can be mentored or trained to overcome negative stress. The information gained from this research study will allow management to become aware of the impact stress has on their employees and determine how they want to attack the potential issues strategic communication practitioners may be having in the workplace due to stress. This will help companies and firms ensure that their strategic communication employees have a stable wellbeing, and that their mental state of stress is being taken care of, by management offering special programs to aid in stress management in the areas of strategic communication that cause the most stress to professionals in the expanding field of strategic communication.

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SUPPLIERS' LEARNING: AGGREGATE AND INDIVIDUAL LEVELS

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ABSTRACT

This research uses the results of laboratory experiments in which subjects playing the role of suppliers compete for the business of a buyer outsourcing the production of a commodity product. This study uses the quantal response equilibrium model to consider whether bounded rationality and learning effects can offer some explanation for the deviation of the experimental results from theoretical predictions. Moreover, we conduct individual level analysis and employ K-means clustering method to explore the main prevalent learning patterns within the subjects. Our findings show that the learning behavior varies in different competition types. Findings of individual-level analysis show that subjects, based on their learning behaviors, can be categorized in (a) Randomizer Learners, who do not learn as the model predicts; (b) Strong Learners, who learn in a way that model explains and learn faster than randomizer learners, (c) Non-Learners, who do not learn. We discuss these learning behaviors in three different competition setups. *Keywords: Behavioral Operations Management, Learning, Heterogeneity, Bounded Rationality.*

INTRODUCTION

Behavioral studies have demonstrated the deviation of actual behaviors from theoretical predictions. Learning is one of the well-studied phenomena explaining this deviation. However, experimental study of learning in simultaneous competitions in the behavioral operations management (BOM) is sparse. This study contributes to the BOM literature by investigating learning behavior of the subjects in a simultaneous competition, in which two suppliers compete for the demand of a single buyer. We investigate whether learning effect varies under different scenarios of competition. This study, to the best of our knowledge, is the first study looking at trends in subjects' decisions over time to investigate suppliers' learning behavior in a supply

chain competition. Moreover, this study explores the subjects' behavior at the individual level. In literature, most of the behavioral studies have reported the results based on the aggregated behavior of all subjects. However, findings of some studies demonstrate that looking only at aggregate level analyses could be quite misleading (Lau et al. 2014). Thus, besides the aggregated level study of learning behavior, we analyze the data at the individual level to explore the heterogeneity of learning behavior and find the most prevalent behaviors. Doing so helps researchers to categorize the subjects based on their behaviors first, and then conduct the aggregated level analysis for each category to have more accurate results. Besides, this study helps practitioners with a better understanding of the decision-making process in a supply chain competition.

METHODOLOGY

In this study, we are using experimental results from the supply chain setup presented in Elahi (2013), which consists of a single buyer who outsources the production of a product among N potential make-to-stock suppliers. Demand from the buyer is generated according to a Poisson process and is allocated to suppliers proportional to a competition criterion. The allocation can be based on the suppliers' fill-rates (termed here as service competition), suppliers' base-stock level (termed here as inventory competition), or a combined performance measure (termed here as optimal competition), which intensifies the competition to its highest level. Each experiment consists of 30 independent rounds in which subjects make a decision.

We apply the QRE framework to our data and model the randomness in subjects' decisions by considering two models: (1) static, includes a constant bounded rationality parameter, and (2) learning, considers bounded rationality parameter as a function of decision round. Additionally, to capture the effect of other factors not included in the utility function, we employ a unified error term showing the probability of choosing the base-stock level in a completely random fashion.

RESULTS AND CONCLUDING REMARKS

The aggregate level results indicate that the bounded rationality models fit our experimental data better than the model of perfect rationality. Moreover, comparing the static and learning models shows that the level of rationality and learning behavior of the subjects differ in three competition types. There is no evidence of learning in inventory competition, a weak learning effect in service competition, and a strong learning effect in optimal competition. The individual-level analysis shows that all subjects do not behave similarly. We can identify three subject groups based on their learning behaviors: (1) "Randomizer learners", who learn, but their decisions are strongly affected by factors not considered in our model; (2) "Strong learners", who learn fast, and our model is a good predictor of their decisions; and (3) "Non-learners", who do not learn or make less rational decisions as the competition proceeds. In addition, the individual level results support our findings at aggregate level analysis. Percentage of randomizers in the optimal competition is higher than other two competitions indicating more complexity of optimal competition. However, the percentage of strong learners in optimal competition is significantly higher than other two competitions, which supports the stronger learning effect in optimal competition.

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Exploring the Interdependence between Dynamic Capabilities and Organizational Knowledge

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Detailed Abstract
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The dynamic capabilities view (DCV) has been deemed as a dominant interest in strategic management since it appeared in Teece, Pisano and Shuen's (1997) seminal work. The DCV captures the core of dynamics in regard to how firms evolve and adapt to environmental dynamism and uncertainty. It has significantly also been viewed as a perspective that constitutes a breakthrough for ameliorating the RBV's theoretical weakness in terms of the equilibrium propositions in organization studies (Priem and Butler, 2001). Dynamic capabilities are identified as a firm's "capacity to purposefully create, extend, or modify its resource base" (Helfat, et al., 2007:4), thereby reflecting how well a firm manipulate its resource base. Instrumental literature on the DCV suggests that dynamic capabilities should be referred to as an important source for generating the competitive advantages of firms (Eisenhardt and Martin, 2000; Teece, Pisano and Shuen, 1997, Zollo and Winter, 2003). Despite its significant contribution, the instrumental studies on the DCV seem to less highlight the strategic role of organizational knowledge and the relevance to the relations around dynamic capabilities, resources and knowledge, but rather only as an element of firm resources.

On the basis of the DCV, this study aims to explore the interdependence between dynamic capabilities and knowledge management in firm operations that are critical for performance creation, and hence competitive advantage. Considering knowledge as an important intangible resource element for firms to pursue competitive advantage (Cepeda and Vera, 2007; Nonaka and Toyama, 2005; Zack, 1999), this study emphasizes that knowledge generation and the relevant managerial activities have a dynamic nature with a capability foundation enabling firms to renew, deploy and leverage their existing knowledge. Simultaneously, with our investigation, we suggest that knowledge generation should be a "pre- consequence" of performance achievement which is posited to be boosted by dynamic capabilities (Teece et al., 1997).

Focusing on knowledge, most companies view knowledge as their most valuable and strategic resource. Knowledge management has become a key managerial effort to retain firms' competitive advantage (Gold, Malhotra and Segars, 2001). Although knowledge management is generally initiated with a focus on managing organizational knowledge per se, it must be immediately embedded in organizational processes, in which the organizational knowledge is employed, generated, adapted and stored in order to support firm operations and business success. In other words, a firm's managerial activities showcase a series of manipulation and leverage tasks based on its resources, and new knowledge must be generated as the parallel outcome in these activities. As a consequence, managerial efforts in such processes demonstrate firms' special dynamic capability for manipulating and managing organizational knowledge.

The methodologies of the research were developed following the logic of grounded theory. We drew on a case-centered narrative approach to analyze the cases we collected from five companies: 4 multinational firms and 1 domestic firm in various industries, including telecommunications manufacturing, contract research organizations (CRO) in the data collection was conducted with a focus on the potentially significant changes in their firms, such as their operations, target markets, product offerings and business models, and the environmental challenges and trends in their industries. Based on these changes, we investigated how they leveraged the existing knowledge base, their learning processes, and any potential relevant to knowledge accumulation and transformation with their best applications and operational success. In addition, this study used semi-structured interviews in order to ensure that each interview had a consistent focus for the survey.

Our findings, derived from the participant companies' narratives, present remarkable similarity. These narratives reveal five basic themes that reflect the dynamic relations among the resource base, knowledge base and dynamic capabilities. We suggest that these themes can be referred to as a theoretical extension of the DCV, in which organizational knowledge is involved; the relevance to the interdependence between knowledge and dynamic capabilities and its role in enhancing the resource transformation and reconfiguration (for developing distinct resources) become visible. The five themes identified are as follows:

Interdependence between dynamic capabilities and existing knowledge

Interdependence between dynamic capabilities and existing knowledge of a firm demonstrates the symbiotic relation and symmetricity between them for the managerial manipulation of specific resources. It should be noted that such interdependence is increased with the increasing necessary specialization and knowledge related to specific strategic purposes. Therefore, one key that dominates the performance of dynamic capabilities is the existence and symmetric level of the necessary knowledge, and vice versa.

Generation and accumulation of VRIN resources

The generation and accumulation of VRIN resources is generally consistent with the RBV (Barney, 1991; 1996; 2005; Acedo et al., 2006); the view that competitive advantages are conferred depending on how well managers manage and build their organizations on the basis of their relatively distinct or key-feature resources, as VRIN (valuable, rare, costly to imitate, and non-substitutable) is suggested. Firms that make better processual efforts on their resource applications, such as learning mechanisms and well-defined organizational procedures and practices, can achieve better performance in transforming or reconfiguring resources into VRIN. A firm's timely and continuous renovating and accumulating process for the resource base especially presents its persistent advantages from its rivals in terms of VRIN.

The co-moderating role of dynamic capabilities and existing knowledge

The co-moderating role of dynamic capabilities and existing knowledge demonstrates the collective moderating effects formed by the dynamic capabilities and existing knowledge pair on the generation of VRIN resources. As discussed above, firms' performance in generating VRIN resources lies in their effective resource transforming and reconfiguring mechanisms. However, such best mechanisms may exhibit commonalities across firms. Especially in the fast-changing environment, such commonalities are generally forced to arise due to the increasing extent of the use of market common resources, such as technologies, labor forces and equipment, and even the settings of organization processes. Therefore, firms may be limited in seeking to outperform their rivals in the generation of VRIN resources.

Our findings reveal that when firms have the capability to leverage either their existing knowledge or resources (and much better if they can manipulate these leverages simultaneously and collectively), they are effective and creative at resource development in terms of the VRIO features. Also as discussed above, a firm's dynamic capabilities and existing knowledge is interdependent and potentially symmetrically symbiotic. Therefore, our investigation tacitly implies a co-moderating effect of dynamic capabilities and existing knowledge on the generation of VRIO resources.

New knowledge generation and accumulation

New knowledge generation and accumulation reflects a firm's autonomous mechanism whereby new knowledge is generated and accumulated. An organization is generally knowledge path dependent. While Salvio, et al. (2000) stress that an organization's knowledge can be produced only via its existing knowledge, more precisely, as our investigation reveals, new knowledge is generated and accumulated through its successful experience in developing the unique features of firm resources, a key factor in its competitive advantage and operational success. In the context of dynamic capabilities, even though knowledge generation and accumulation appear as a consequence in such process, they showcase a knowledge leverage process in which firms are required to apply or stretch their existing knowledge to integrate various resources (including assets and competencies), which are across the organizational units and even across organizations. Teece (2007) views these knowledge management efforts as a part of microfoundation of the dynamic capability relevant to transformation and configuration of firm resources. When new knowledge is generated and accumulated, thereby changing the knowledge base into a new state, it thus calibrates (recalibrates) the firm's knowledge base and dynamic capabilities to become symmetrical.

New knowledge introduction

New knowledge introduction showcases the interactions between a firm and its external environment in terms of knowledge asset renewal. Changes in the external environment may spur a firm's changes of existing resources and knowledge. Such changes require a firm's ability to sense the environmental trend, identify what resources should be newly introduced, and learn how to implement these resources (e.g. techniques or skills, technological know-how and managerial know-how). Liao and Pham (2018) have identified that awareness leverage that is used by top-managing team to help firms develop the capability to sense market opportunities is a crucial ability in this process. In addition, as new knowledge is introduced, the firm's dynamic capabilities related to specific resources are also improved.

Integration of Sustainability Metrics into a Bottom-up Approach for Sustainable Development

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Abstract

To enhance economic, environmental, and social well-being, both private and public agencies are emphasizing the need for adopting more "sustainable" practices and products in design, construction, and maintenance of infrastructure, including but not limited to sustainable pavements, sprayed fire-resistive material (SFRM), and ultra-thin polymer concrete overlays for bridge decks. The trend toward sustainable pavements has led the pavement industry to place more emphasis on the application of new materials such as warm-mix asphalt (WMA), half-warm-mix asphalt (HWMA), and cold-mix asphalt (CMA), in order to reduce fuel consumption, $CO2$ emissions, and the carbon footprint of pavement. Depletion of aggregate resources and a stricter regulatory environment have led to greater recycling, emphasizing increased percentages of reclaimed asphalt pavement (RAP), recycled asphalt shingles (RAS), and recycled aggregate concrete (RAC) mixes. However, most of these practices provide only marginal improvement in pavement performance. Thus, there is a need for a more fundamental and theory-driven approach to materials design and construction. This requires an evolutionary paradigm in the design and engineering of materials to better realize material efficiency and implications of the "material by design" concept. With support from the National Science Foundation, Fini's group has been working on developing and deploying new sustainable construction practices, while integrating sustainability metrics into a bottom-up approach for the design and engineering of bio-materials for construction. Multiple innovative technologies for use in construction have come from our ongoing studies (NSF #1737620, #1546921, #1308728, #1150695) using bio-mass (including woody bio-mass, algae, and animal manure) and several industrial wastes to produce new bio-based nano-composites, adhesives, sealants, and soil stabilizers. Studies are ongoing to characterize the interaction mechanisms between newly developed bio-materials and conventional materials. Density functional analysis and molecular dynamics simulations are being conducted in conjunction with laboratory experiments to study how the two materials interact and affect molecular packing, aggregation, and structuring. For instance, a major component of bio-materials derived from swine manure is hexadecanamide, a saturated hydrocarbon terminated with a primary amide. Computational modeling suggests that this molecule can alter the aggregation behavior of poly aromatic hydrocarbons such as those found in petroleum and asphalt, improving their rheological and mechanical properties. Both H-bonding and dispersion interactions are important in the self-assembly of hexadecanamide, but their relative impacts may vary in different contexts. Indeed, recent results showed that the introduction of hexadecanamide enhanced asphalt's moisture resistance, which is important because water-induced stripping of asphalt from stone aggregate is a significant and costly source of failure in asphalt pavement and roofing shingles. A multi-scale development and deployment of bio-materials in the construction industry could introduce an integration of biological science, chemistry, and mechanics while revolutionizing bio-mass waste management for better environmental protection. The talk further elaborate on process of synthesis and characterization of a bio-adhesive through the support from an NSF CAREER award followed by customer discovery and market analysis via NSF I-Corps and NSF STTR projects discussing several identified markets for bio-adhesive including asphalt and pavement application. Accordingly, the presentation discusses the opportunities and challenges associated with product development and technology commercialization of bio-resin and bio-based construction materials to address technological innovation and product development for bio-based materials.

"Net Zero" Carbon Emission Economy

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Abstract

One of the major goals of the European Union is achieving a "net zero" carbon emission economy by the year 2050. In order to achieve such goal, sustainable energy polices at local, regional, and national levels are imperative. This research studies the goals of the European Union, 2020, 2030, and 2050, along reduction of CO2 and gas emissions and implementation of strategies that are essential in reaching the "net zero" carbon emission economy. The study concentrates on auto and energy industries. It examines the EU approaches to manufacturing clean and energy efficient autos and reduction of pollutants. In addition, it explores the EU strategies for implementation of renewable energy sources. The research further examines the accomplishments of the EU 2020 goals and objectives in working toward the "net zero" carbon emission economy and the goals set for the years 2030 and 2050.

GREEN CITIES AND WASTE MANAGEMENT

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ABSTRACT

This research concentrates on the sustainability practices along the "3 Rs", recycle, reuse, and resell, of wastes and by-products of operations of restaurants. Two cites, Providence, Rhode Island, and Springfield, Massachusetts, were selected for collecting data for this study. Providence is a declared "Green City" and Springfield is the second largest city in the states of New England after Boston, but not a declared green city. Major goals of conducting this research was not only to study the sustainability practices in the restaurant industry, but also to examine the beliefs of the restaurants' managers/owners as to the impacts of sustainable practices on financial, attraction of customers, and reputation of the restaurant. In addition, to determine if declaring a city "Green" would make a difference in enhancing sustainable practices across different businesses in that city.

The results of the survey indicated that a large percentage of wastes and by-products of the operations of restaurants with the potentials of recycling, reselling, reusing, and donation were thrown away, even though the majority of owners/managers believed that sustainability practices had a positive impact on financial situation, reputation, and attraction of customers. An interesting finding was that the results did not show any significant differences in handling the wastes and by-products of the operations of restaurants in Providence, a declared green city, versus Springfield.

SMART BUILDINGS: LEARNING FROM AN HISTORICAL EXAMPLE, JEAN PROUVÉ'S 1956 SCHOOL IN VILLEJUIF, FRANCE.

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Abstract

The authors share the commonly-held view that "Smart Buildings" tend to be framed excessively narrowly in terms of technology, electronics, sensors, data and computing power. The paper argues in favor of reframing the notion of "Smart Buildings" more holistically in order to counterweight to a degree the ever greater pervasiveness of computational power in the built environment. Studying the case of the 1956 Jean Prouvé- designed and -constructed temporary school in Villejuif yields three concepts that, the authors contend, ought to be part of a broader and more inclusive conceptualization of "Smart Buildings".

The three concepts or dimensions inspired by Prouvé's school's clever design, ease of assembly, lightness, material and structural intelligence, as well as thermal and operational efficiency, among other inspiring positive qualities, are: systems integration, sustainability and up-cyclability, as well as nimbleness and flexibility. The paper discusses briefly a few of the implications that including these three dimensions to the list of characteristics that contribute to define a building as a "Smart Building" could have on designing smart building and their related technologies.

Beyond the specifics of the case study presented here, the general and conceptual points raised in the paper can be of interest to designers, marketers, policy makers, and the public at large.

1- Introduction

The paper stems from the authors' dissatisfaction with the prevailing perception of what "Smart Buildings" are which can be paraphrased as buildings with lots of add-on electronic devices, sensors and other computational capabilities that sometimes give the appearance that they encroach on our sense of privacy.

To the non-specialist, the ''1980's smart house'' seemed confronted with the issue of adding another wiring network to the home. It was already a time of intense competition among proprietary systems among different manufacturers for whom the outcome of the race between Betamax and VHS for the dominance of the video recording standard was still a fresh and arguably traumatic memory. The 1990's saw the realization that existing power wires ("the brute force") in the house could also accommodate "light" signals ("the intelligence"). Then came the world wide web, soon followed by wireless networks. Today, the profusion of touch screens, apps, sensors, Internet of Things, Artificial Intelligence- and Machine Learning-based technologies, including all sorts of automated visual recognition capabilities feels like an onslaught of technology, triggering a certain unease. This unease in turn, inspires dystopian narratives such as the Netflix series ''Black Mirror''.

The concept and scope of "smart building" have evolved to integrate public concerns of the time. Early whiteware interoperability aspects of the "smart home" or "home automation", as it was then termed, have shifted to also include personal security and health concerns as well demanding technical or natural predicament." [de Botton, 2006] public awareness of big global issues such as climate change that demand, as Alain de Botton writes: "(…) resolution of today's sustainable development imperative is real. However, as is the case with any emerging technology, there are many documented cases of smart buildings failing to deliver on their green claims. "Latest generation" or "2.0" might be clever marketing labels but if they only excite a kind of hyper-consumerism by affluent status-seeking homeowners in search of yet

another trophy possession or latest talk-of-the-town gadget, then the result is only programmed rapid obsolescence and ever taller heaps of refuse at the landfill. Society is entitled to ask whether the qualifier "smart" is appropriate when it comes to buildings that result in deleterious environmental (and human) impacts.

With computing here to stay and firmly on a trajectory to permeate ever more deeply and ubiquitously all aspects of the built environment, we feel that seeking a richer and more holistic concept of ''Smart Buildings'' is a relevant undertaking. We feel that beyond the specifics of the case study presented here, the points raised in the paper, although general and conceptual in nature, can be of interest to designers, marketers, policy makers, and contribute to the public debate on "smart buildings".

2- Smart buildings: a sketch of literature review.

In the public's view, "Smart building" typically projects ideas of connectivity, micro-controlling and possibly data- or sensor-driven piece of equipment, a kind of microprocessor-based added-on layer of "intelligence". The narrow focus of this definition of "Smart Buildings" is in full display in the one put forth by the Information Society & Media Directorate-General of the European Commission that defines "Smart Buildings" as ''buildings empowered by ICT (Information and Communication Technologies) in the context of the merging Ubiquitous Computing and the Internet of Things: the generalization in instrumenting buildings with sensors, actuators, micro-chips, micro and nano – embedded systems will allow to collect, filter and produce more and more information locally, to be further consolidated and managed globally according to business functions and services.'' [European Commission, 2009]. Such a definition summons visions of living inside machines or inside a computer. The disconnect between such visions and traditional notions of feeling at home, is one of several social factors contributing to the tepid uptake in smart home technologies accurately analyzed by [Balta-Ozkan et al., 2013].

Although a real issue worthy of being remedied, as [Buckman et al., 2014] strive to do, the lack of a commonly shared definition of what "smart buildings" are, is not the only problem. The problem, we would argue along with [Fisco & Adeli, 2011] and many others before us, is that the prevailing view on smart building is too narrowly focused on technology and that the concept of ''Smart Buildings'' should be approached in a more multidisciplinary and holistic fashion. Ironically, IBM, a technology company, stear clear off the narrow focus discussed above by focusing on the services performed by Smart Buildings that "(…) help their owners, operators and facility managers improve asset reliability and performance that in turn reduces energy use, optimizes how space is used and minimizes the environmental impact of buildings.'' [IBM, 2010].

The perimeter of the notion of "Smart Building" has recently expended to integrate notions of "smart energy grids" as well as that of Home Energy Management Systems (HEMS) aimed at optimizing the demand-side management of smart grids in response to decentralized energy production practices [Zhou et.al. 2016]. Here too, examples of technology- and ICT-centric focus are abundant. [Akkaya et al., 2015] see "(…) extensive opportunities for improving the energy consumption of buildings via smart HVAC control" via the exploitation of "(…) the spatial-temporal data obtained from one or more of various IoT devices such as temperature sensors, surveillance cameras, and RFID tags that may be already in use in the buildings." Others such as [Chen, Ou, Chen, 2010], promote the use of "(…) extremely accurate localization technique" of users inside buildings by a multitude of sensors to achieve indoor spaces that "(…) have sensing ability, flexibility, and interactivity…A space is considered as a huge robot, and every space cube is constituted by hundreds of small modulized robots."

And beyond, while the prevailing view of "Smart City" is not simply a scaled-up version of the notion of "smart building", both appear to share in common at their core "(…) the

importance of Information and Communication Technologies (ICTs) (…) for enhancing the competitive profile of a city.'' [Caraglui, 2011]. [Mohanty, Choppali, 2016] similarly state that (ICTs) "(…) are enabling keys for transforming traditional cities into smart cities. Two closely related emerging technology frameworks, the Internet of Things (IoT) and big data (BD), make smart cities efficient and responsive."

3- Another kind of "smart": a case study of Jean Prouvé's 1956 temporary School in Villejuif

Jean Prouvé (1901-1984) was an admired innovator and celebrated designer born in a family of artists and master craftsmen in Nancy, France, who himself was trained as a blacksmith. The late famed Irish structural engineer Peter Rice [Rice, 1996], lauded Prouvé as the perfect embodiment of the "natural engineer", whose great ingenuity, in-depth understanding of materials and fabrication methods as well as whose acute sense of the physical forces acting on a building structure or a building envelope made him a true "Constructeur" (note: in French in Rice's English text). Many books, among which [Huber & Steinegger, 1971], publications and exhibits at prestigious museums on Prouvé's work have raised the public's awareness of his innovative and insightful curtain walls, furniture, prefabricated structures, and the multitude of other design and realized projects lead or contributed to by Jean Prouvé.

By the mid-1950's, Jean Prouvé had set up a new structure, "Les Constructions Jean Prouvé" in Paris. There, with the engineer Serge Kétoff, the architect Jean Masson and the collaborator R. Guidici, he worked on a modular design for a temporary school for Villejuif, a southern suburb of Paris, France.

Designed and fabricated as three similar long bar buildings, the temporary school for Villejuif was one of many Prouvé's experiments in prefabricated architecture. The typical classroom building dimensions were 76-meter-long by 8.75-meter-wide, based on a 1.75-meter-square grid module as shown in figure one. Across the building width, the single-loaded internal corridor occupies one module while and the seven-meter width of the classroom occupies four modules. Classrooms are each five modules deep along the longitudinal axis of the building. The building was designed with ease of assembly and disassembly in mind as well as accounted for the on-site use of a very limited toolset (i.e. no need for a crane) and a small crew. Clearly, as was the case with London's 1851 expo's immensely influential "Crystal Palace" building, the design approached the building erection as an assembly process, more so than as a construction.
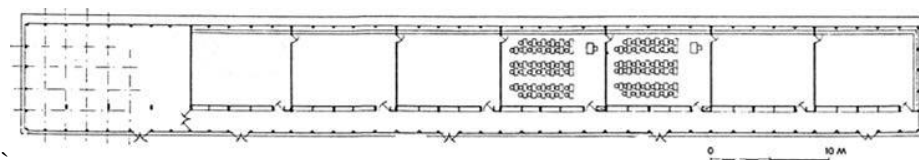
Figure 1: Plan view of one of the classroom building composed of a row of seven classrooms along the adjacent corridor. An indoor recreation area in case of inclement weather is at the left-hand side (the 1.75-meter building square grid is visible).

Figure 2: Partial model of a classroom building (internal partitions are omitted) with "peeled away" to reveal the roof's different layers. (Model at Museum of Modern Art, New York).

The typical cross section visible in figure 3 shows the unique building's profile, that elegantly soars up to approximately 3.40 meter above the classroom floor. The arching roof terminates classroom-side with an overhang that shades the 8-degree inward-tilted glass façade, and, corridor-side, gently curves downward to a height of 2.5m. This section also prominently features an iconic asymmetrically tee-shaped with tapering extremities and a slanted top cross element structural member that Prouvé named "béquille" which translates into English as "crutch". The béquilles, made of custom brake-pressed steel plates as well as concealed hot rolled channels, shaped a massive rigid connection where the column and the lapping twin top cross members met. The béquilles were connected through a pin connection to the floor substructure and stabilized from tipping over by a flanged vee-shaped member (the "poteau aérateur", which translate as "ventilating post" as Prouvé called them) in the plane of the corridor façade. A similar support member, with a eight-degree inclination inboard stands freely in the plane of the other, classroom-side, facade. A discussion of the unusual and very clever integration of the building's natural ventilation within the structural elements, the "poteaux aérateurs", can be found in [Charles, 2017].
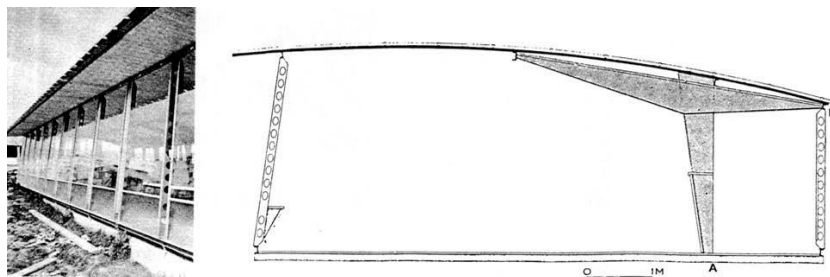
Figure 3: left: the classroom-side façade with the cantilevering roof overhead providing sun-shading to the glass facade. Right: the typical section showing the "béquille" support and the "poteaux aérateurs" at the facades tying the roof down to the ground as well as providing natural ventilation.

The roof is made of pre-manufactured 40-mm thick wooden "contrecollé" roof planks with metal panels on top. Each roof plank was manufactured flat with a width of 90 cm and span the entire 8.2 meters width of the building. The roof is supported by longitudinally-arranged channels resting on the off-center T-column ("béquille") and achieves its gracious curvature by being tied down to the ground by the "Poteaux aérateurs" on each side. Not only is this structural solution highly visually appealing, but it also innovates in the manners in which the wood planks bridge over a portion of the classroom space as well as connects the two steel

support systems (the Tee + column on the corridor side on one hand and the free-standing column on the classroom façade side on the other hand).

Figure 4:Top: An image of the structural analysis model (Software: MASTAN2); Bottom: the same model showing how the roof plank acts as a spring by bending under different load cases. Here, a case of upward bending the roof subjected to wind loads. [note: more on that subject in part 4 c]

Figure 4: a picture from a portion of the school building, after disassembly, transportation and re-assembly, re-used as an architect's office.

Upon dismantling of the school as was planned by the education ministry (a decision maintained quite inexplicably despite the high quality and durability of construction of the school buildings), portion of the school building were salvaged and re-purposed to house an architect's office as shown in figure 5. Fast-forward in time to the new millennium, the salvaged portion of the school has been restored, the re-assembly of which is featured in a quite appealingly staged time-lapse video produced by the art gallery that was selling it [Seguin, 2015].

4- Lessons learned from Prouvé's school design: Three concepts to enrich the notion of "Smart Building"

Prouvé's school design serves its purpose as a classroom with a very generous and well-lit and well-ventilated space that is also visually attractive and unique. This masterful design articulates the following three concepts or pairs of concepts:

a) **Systems integration**. Several elements in the building are multi-functional; a prime example is the "poteau aérateur" which is both structural elements as well as the means to provide natural ventilation, which in turns helps keep the large glass façade elements fixed (i.e. non-operable) and thus, as simple and economical as can be. Furthermore, the slenderness of the "poteaux aérateurs" and the glass-fastening hardware maximizes the daylighting potential which in turns lowers operating electrical energy costs. The building works as a carefully integrated ensemble and it would be hard to remove anything from it without compromising the whole.

b) **Sustainability and up-cyclability**. The design is infused by the deepest understanding of materials, their fabrication methods and assembly processes. The building is also designed for disassembly, thus increasing the project's potential adaptive re-use and up-cyclability –as a kind of value-added, virtuous recyclability which is otherwise too often a mere "melting down" of metal for subsequent re-manufacturing. While the design solution is not standard, the recyclability and potential adaptive re-use of the buildings are integral parts of the design process and implemented in the project delivery.

While the project is the product of an era when the ratio of cost of labor and cost of material was lower than it is today in developed economies, the project scores high in terms of efficiency on the use of the space provided and distribution. The project is remarkable in terms of cost effectiveness and the use of material to their structural limit, within, of course, acceptable coefficients of safety. These authors' reverse engineering of the structure shows how efficient and "lean" it is.

Another important point that touches on both the systems integration and the sustainability aspects is that the elegant simplicity of the implemented solutions increases this type of building asset reliability: operations and maintenance costs are reduced, thus optimizing the asset's functionality and profitability.

c) **Nimbleness and flexibility**. A highly refreshing instance of true "thinking out of the box" is illustrated in the way the school's roof's contrecollé wood planks switches conceptually from being a secondary structure element over the béquille to become part of the primary structure of the building where they span over the classroom. This approach shows flexibility both conceptually and literally (insofar the roof element actually acts as a spring connecting the béquille to the towards the classroom-side free-standing "poteau aérateur") to a point that, we would argue, demonstrates Prouvé's and his team's mastery beyond the conventional codified realm of engineering knowledge. Prouvé innovative thinking is also evident in how the structural reliability of the school's frame is achieved. A reversed-structural analysis of each element was done by the author to be published in an upcoming paper. This analysis has shown that under normal load conditions (live loads, wind loads, and snow loads as well as the self-weight of each element) the building structure performed very well. It showed that the wood roof panels that were uniquely allowed to flex upward or downward depending on the wind and/or snow load cases, did so in both flexion and compression within a proper safety factor.

5- Discussion

This section contributes a handful of suggestions on what the concepts identified in the previous section could entail in terms of possibly contributing to help us think of and develop better smart building technologies.

a) Systems integration: Kinds of smart.

When it comes to buildings it is quite obvious that there is a difference between "Smart" as a marketing language element and "smart" in the sense of inventively conceived and realized piece of architecture. The previous section has highlighted Prouvé's—and his team's—mastery at finding highly integrated design responses: an ability to deliver a truly clever, well-thought, in other words, "smart" building.

There is an undoubtedly tension between the marketing and manufacturers' side that are trying to sell products and technologies they label as "smart" and architects and engineers trying to deliver plain old "good design" that integrates various systems well. Nevertheless, for the benefit of potential consumers, i.e. buyer of smart buildings, and the planet, it seems logical to try to combine both kinds of "smart" to evolve a better kind of ''Smart Building''. What is at stake for the designer of smart building technologies in the area of systems integration is to think of technologies that are not just add-ons, but that are intrinsically part of the building fabric as well as part of how the building performs in the most general and integrated way.

b) Sustainability and up-cyclability: ''smart up''

The theme of energy efficiency, as one many dimensions of sustainable development, is already quite central in current "Smart Building" technologies. Under the umbrella of the "Sustainability and up-cyclability" concept pair, we feel that it would be interesting if designers of smart building technologies took the concept of up-cyclability to heart and came up with solutions not destined to the landfill. Buildings components and components of smart building systems can be designed to be disassembled and re-used towards a potential other use. Knowing the difficulty there is to recycle electronic and computer waste, one could attempt to revisit the cradle-to-grave implication of, for example, the circuit board that if designed in a too integrated fashion, works only for one application/usage and lacks the re- and up-cyclability of its more modularly-based design counterparts. There are obvious costs implication to assembling more pieces together to achieve the same result than with a single all-integrated component, these costs, however, have to be compared to the environmental costs of creating more waste and resources leakage, i.e. non-recovered and thus lost to the productive/consumptive loop. Arguably, the ethos of the "kit-of-parts" that energized the field of architecture and elsewhere for a while during the second half of the twentieth century appears to still have some utility.

c) Nimbleness and flexibility: Smarter me?

The notion of system flexibility and/or adaptability comes immediately to mind when reflecting on what the "nimbleness and flexibility" umbrella could entail in terms of possibly contributing to developing better smart building technologies. However, we elect here to address less the "shape" or technical capabilities of the systems than the effect these systems could have on us. The question then becomes: should the building be the one that is smart or should the building makes us, occupants, smart(er)? One step beyond mere "measuring is knowing", could, for example, the smart building help me better understand the physical phenomena that drives my own personal thermal comfort (notwithstanding that there are other elements than physical ones that contribute to thermal comfort)? This goal will come in contrast with the usual goal assigned to a building –"Smart" or not—consisting of delivering the normative "perfect" environmental conditions (note: this notion is highly contested) which. A building that does precisely that, we would argue, is actually making us more oblivious to the conditions of our own personal

thermal comfort, in other word, making us "dumber" and less fit for inhabiting the world without constant crutches. Can a smart building help me, for example, learn (or deeply interiorize, or "know" in the sense of knowing how to ride a bicycle, a task notoriously hard to describe verbally how to execute) in an engaging or possibly "stealthy" way such physical principles the role and impact of radiation or moisture on thermal comfort, or how a fan works does not cool the air but increases the convective and evaporative processes occurring at the occupant's skin level which in turns makes me feel cooler?

Along these lines, so-called "Passivhaus" standard buildings, for example achieve laudable high energy efficiency through, among other things, the implementation of highly insulated building envelope, low level of air leakage (infiltration/exfiltration), and a mechanical ventilation typically associated with a heat recovery apparatus. Some buildings built with this standard do achieve the claimed energy consumption targets. However, one is arguably justified to be puzzled by the fact the occupant is looked somewhat as a trouble maker, an obstacle to the perfect mechanical performance of the machine. It is arguably perhaps a missed opportunity that the high performance is achieved by sealing the building off from its external environment, by closing the windows and running a mechanical ventilation system; in other words, the performance is achieved despite the human occupant.

6- Conclusive remarks

This paper is to a large extend a symptom of a certain degree of failure by providers of smart building solutions to market a truly appealing offering beyond the fleeting "high" of consumptive satisfaction. The paper has attempted to highlight some of the limitations that comes with focusing the "definition" of "Smart Buildings" too exclusively on high-tech ICT and other "bits". It looked at the case of Jean Prouvé's temporary school in Villejuif, outside Paris, France, as a source of inspiration to identify other features than ICT-based ones that makes a building deserving of the qualifier "smart".

While the paper did not actually offer a better and more encompassing definition of "Smart Buildings", it has outlines three concepts (actually pairs of them) or dimensions that in the mind of the authors are worthy of consideration by both designers and consumers of Smart Building systems, as well as those with power to influence the direction taken by various sectors of the Smart Building industry. The three concepts offered to discussion are: systems integration, sustainability and up-cyclability and nimbleness and flexibility.

The impetus to call for broadening the standard definition of "Smart Building" is driven by the desire of bridging between different worlds, the world of Architecture, Engineering and Construction (AEC) industries on one hand, and the world(s) of industrialists, smart building systems developers, on the other hand in order to move toward more integrated solutions.

In an age of A.I., machine learning, data mining in which much effort and resources are invested to convince customers that they should adopt products, services or technologies promoted as disruptive and innovative, this paper argues that lessons from the past ought to be remembered and that a broader, richer, and more inclusive "definition" of "Smart Buildings" could help actors in the area produces more appealing offerings.

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A Structured Literature Review of Textile and Clothing Industry Supply Chains: Environmental Damage and Solutions

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Keywords: *textile supply chains, literature review, environmental impact, supply chain management, case studies.*

Objectives

The purpose of this paper is threefold. First, we use each step of the supply chain as a basis for a systematic review of the literature which relates the negative environmental impacts to each stage of the textile and clothing supply chain. Second, proposed solutions are presented using the same matrix. The aim here is to provide an integrated perspective of the current research. Finally, the results of this review help answer the following questions: What are the urgent priorities to reduce the industry`s negative impact? Where are the gaps in our current knowledge of both environmental damage and solutions? Addressing these points allows us to provide a summary of the shortfalls in the field and offer useful advice for this global industry.

Gray (2010, p.48) points out that "Sustainability is a system based concept and, environmentally at least, only begins to make sense at the level of eco-systems and is probably difficult to really conceptualise at anything below planetary and species levels". Systems ecologists recognise that the function of any ecosystem can be influenced by human economics in fundamental ways. Systems ecology looks for a holistic view of the interactions and transactions within and between biological and ecological systems. This means that issues such as climate change or the acidification of the world`s oceans should not be treated as individual problems but seen as part of a complex set of interrelated processes. High-energy consumption, the production of fibres with the use of toxic chemicals both during growing and manufacturing stages, CO_2 emissions and water pollution are the main environmental challenges related to fashion production and its distribution processes. Thus, this research focuses on the following aspects:

- rising concentrations of carbon dioxide in the atmosphere through energy consumption;

- freshwater use and pollution of ground water including synthetic organic pollutants and especially endocrine disrupting chemicals;

- intensification of agriculture and mono cropping (cotton growing); many vegetation types have primarily been converted to agricultural land reducing biodiversity.

Broadly speaking the operations and supply chain management community has approached the subject of the environmental sustainability from two perspectives. The first is whether an organisation can compete more successfully by protecting the environment, that is "does it pay to be green?" Most of this research is concentrated on proving that that higher environmental performance means higher financial performance. The second perspective is concerned with the ability of organisations to create a competition where protecting the environment leads to success. In other words, the firms themselves become self-regulatory. Corporations, trade associations, international bodies and stakeholders all have been major motivators behind the creation of various eco-initiatives and certifications. This area of research focuses essentially on who participates in self-regulatory institutions and how participation influences performance. Thus, we have proof that many organisations are making significant progress in greening their activities and integrating environmental sustainability issues into their overall business strategy. (Darnall et al., 2010; Hart and Dowell, 2011). Although these bodies of research must be not be underestimated in their value or contribution to current knowledge, in most cases sustainability measures do not go beyond single issues such as CO_2 emissions or energy efficiencies. These aspects represent only a negligible part of the degradation of the earth`s biophysical factors. Corporate sustainability activities simply do not contain "mechanisms to ensure that human impacts on the environment, in aggregate, are reduced to some acceptable and sustainable level" (Levy, 1997 p.134).

Clothing and textile industry supply chains

The industry is increasingly under the world spotlight as a significant contributor to global environmental and social issue and is one of the most challenging sectors regarding sustainability (Caniato et al. 2012). This is partly due to very short product life cycles, global and fragmented supply chains. Fast fashion is characterized by trendy design articles that can be bought by the masses (Sull and Turconi, 2008), and aims to attract customers and increase their frequency of purchase (Barnes and Lea-Greenwood, 2006). It is also described as a marketplace rhythmed by chronic downward price pressure, international sourcing, high product variety, high volatility and low predictability. (Masson et al., 2007).

The textile industry, specifically the dyeing, printing and finishing industry, is responsible for a disproportionately large amount of environmental damage (Patterson, 2012). Making clothes typically requires using vast quantities of water, pesticides and fertilisers and emits significant amounts of greenhouse gases. Clothing and textiles is a multi-billion dollar business sustained by the most global of supply chains and based on comparatively low-tech production systems. Labour intensive activities can be divided into five stages; first the production of raw material such as wool, silk and cotton or man-made fibres like nylon or polyester. Textile mills process raw material into lengths of cloth in various colours and patterns. These intermediate products are then turned into apparel by garment manufacturers who cut, sew, iron and finish the products. The finished garments reach the final customer via direct distribution through a brand name company or retail stores who procure the merchandise from wholesalers or trade companies. Despite its impacts, widely accepted international environmental performance standards do not exist in the apparel industry (Panayiotou et al., 2009).

Material and methods

The literature has been drawn from a combination of sources, including textbooks, scientific journals (e.g. *Journal of Supply Chain Management*, *Journal of Cleaner Production* and *Clothing and Textiles Research Journal*) and industry reports. The use of databases such as EBSCOhost, ABI Inform, Elsevier Science Direct, allowed access to reliable sources of both business and applied sciences literature. The key search

words were environmental damage, environmental solutions, environmental sustainability, green, textile and clothing industry, textile and clothing supply chains and as well as any iterative combination of these.

Findings

Since research concentrates on environmental problems rather than providing solutions this is the first issue to be addressed. There is a tendency to focus on the production phase of the textile supply chain, mainly on energy and water consumption. Major gaps lie in integration of data for transport, retailing, recycling and return logistics activities. Further review of the literature should provide a more complete set of cross references, which will advance the research and provide a holistic understanding of textile supply chains effects and solutions.

Conclusion and contribution

While science advances in uncovering the causes of ecological degradation, action in the textile industry remains weak and inconsistent. By applying the cradle to grave approach, the paper highlights the gap between textiles production and environmental science caused by a lack of industry initiative. It is also possible to uncover the inhibitors and drivers for the possible solutions, which could reduce environmental impact. Both practitioners and academics might find the review useful, as it highlights the industry`s most urgent priorities and provides future research opportunities.

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Brand France

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Abstract

This research examines the idea of "National Branding" in relationship to enhancing intercultural awareness. Among the varied manifestations of cultures studied by cross-cultural specialists, nation-branding messaging has so far received scarce attention as it is a relatively recent trend. However, carefully devised nation-branding packages are strongly indicative of cultural self-representations. The study of how those messages are encoded can help observers to further decode other elements of culture. The case of the recent "Brand France" initiative provides interesting insights not only into France's innovative talent and comparative advantages but also on various aspects of French culture, including its strongly centralized form of governance and policy-making.

MULTI-PERIOD STOCHASTIC PROGRAMMING PORTFOLIO OPTIMIZATION

FOR DIVERSIFIED FUNDS

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ABSTRACT

We investigate a multi-period, stochastic portfolio optimization model for diversified funds choices associated with traditional 401K or 403B plans. This optimization model minimizes the L_1-Norm for negative return rate risk (the downside MAD), while examining parameters that maintain model feasibility. Important components of the model are the incorporation of appropriate time series components and evaluation of scenarios based on investor outlook. A case study experimentation of the model on five potential investment funds using historical data from 2003 through 2013 was conducted, and parameter constraints for diversification and minimum acceptable return rates were manipulated to produce contour plots. The maximum geometric rate of return investment strategy provided by the optimization would have resulted in a 9.7% geometric return rate in 2014 as compared to a 5.0% for a uniform distribution of investment funds across choices.

Keywords: portfolio optimization, stochastic programming, financial engineering, diversification, time series

1. INTRODUCTION

Markowitz (1952) proposed a bi-criteria optimization (mean-variance, MV) model for portfolio selection by considering expected return and variance of return. If returns and risk aversion are normally distributed, then the MV is optimal in the expected utility framework (Tobin, 1958; Hanoch & Levy, 1969). Criticisms of this approach and its related descendants are that they require investors to have exact knowledge of means, variances, and covariances, which are difficult to estimate accurately. Markowitz's portfolio optimization is particularly sensitive to the sample means (Best & Grauer, 1991). It also allows for often unsupportable investment strategies in the canonical model (e.g., shorting positions when shorting is not allowed) (Frost & Savarino, 1998), a problem that is readily handled with proper formulation.

Because of the sensitivity to means, variances, and covariances, some researchers have suggested that they be ignored in favor of a sample minimum variance portfolio (Green & Hollifeld, 1992) or in favor of naïve diversification (De Miguel et al, 2009; Duchin & Levy, 2009). Other methods have focused on "shrinkage" of the sample parameters (Ledoit & Wolfe, 2003; Jagannathan & Ma, 2003) or reduction of sample errors using Monte Carlo resampling (Michaud, 1998) and Bayesian methods (Markowitz & Usmen, 2003). More recent methods (Variance-Based Constrained Optimization, VBC, and Global Variance- Based Constrained Optimization, GVBC) have attempted to take into account the variation of individual stocks, resulting in better portfolio performance (Levy & Levy, 2014).

In this study, we investigate multi-period, stochastic portfolio optimization for diversified funds choices associated with traditional 401K, 403B, and 457 plans. The optimization model itself is unique in that it minimizes the downside return variation while allowing upside variability using an L_1-norm formulation, retaining linearity. Current models routinely focus on total variability rather than directional variability. Sample estimation error is smoothed at the onset because the model relies on monthly aggregation for means, variances, and covariances. An important component of the model is the use of time series components prior to model building (e.g., evaluation of stationarity, seasonality, cross and auto-correlation.) Distributional assumptions and transformations are investigated in light of the time series results and before

generating monthly multivariate and univariate distributions. Three scenarios based on the trimmed distributions are generated: a positive outlook (left truncated sampling), a neutral outlook, and a negative outlook (right truncated sampling). Once the scenarios are generated, we solve a linear optimization model that minimizes the L_1-Norm for negative return rate risk (minimizing the downside Mean Absolute Deviation, MAD) for various values of minimum return rate parameters and diversification constraints. The optimization model provides a monthly reinvestment asset allocation plan for a single year. Diversifying investments monthly (or extended to yearly) over already diversified funds reflects decisions appropriate for many retirement accounts, and the models here are designed precisely for these cases.

2. LITERATURE REVIEW

2.1. Markowitz Mean-Variance (MV) Model.

A formulation for Markowitz's MV (1952) model is shown in Equations (1) through (3).

$$\min_{w} z = w^{T} \Sigma w \tag{1}$$

$$\text{subject to (st):} \quad w^{T} \mu \geq \mu^{*} \tag{2}$$

$$w^{T} \mathbf{1} = 1 \tag{3}$$

In this formulation, *w* is a column vector representing investment allocation percentages, Σ is the covariance matrix of a vector of returns from risky investments, μ is a vector of expected returns from the risk investments, and μ^{*} is the minimum acceptable return rate. The objective function minimizes the variance of the investments subject to constraints that force a minimum return rate (2) with investment percentages summing to one (3). The MV model suffers largely from a requirement for perfect knowledge regarding means, variances, and covariances and is susceptible to outliers. Further, it is inconsistent with second degree stochastic dominance (SSD), as its efficient set might include a portfolio with exceedingly low returns as well as variance (Ogryczak & Ruszczyn´ski, 1999). The problem is quadratic; however, real-life financial decisions may require linear program (LP) solvability because the constructed portfolios have to meet many side constraints such as transaction costs and minimum transaction lots (Mansini & Speranza,

1999, Konno & Wijayanayake, 2001). Finally, minimizing the variance affects both upside and downside variation.

2.2 Gini's Mean (Absolute) Difference Model

Yitzhaki (1982) introduced the Gini's mean difference as a risk measure for optimization, overcoming the concerns of SSD, and applying an approach developed by Hazel (1971) linearizes this model as shown in Equations (4) through (8).

$$\text{MIN } z = \frac{1}{N^2} \sum_{j=1}^{N} \sum_{j>j}^{N} (\alpha^+ - \alpha^-) \tag{4}$$

$$s.s.: \sum_{i=1}^{l} (X_{ij} - X_{ij}) = \alpha^+_{jjjj} + \alpha^-_{jjjj} \tag{5}$$

$$\sum_{i=1}^{l} \alpha_{ii}\mu_{ii} = \mu \tag{6}$$

$$\sum_{i=1}^{l} \alpha_{ii} = 1 \tag{7}$$

$$\alpha_{ii}, \alpha^+_{jjjj}, \alpha^-_{jjjj} \geq 0, \forall\, ii, \mathcal{M}, kk \tag{8}$$

In this adaptation, X_{ij} are the returns of asset i during period j, μ_i is the mean return of asset i, μ is the portfolio mean return, and α_i represents the proportion invested in each asset. The objective (4) uses the standard technique of substituting two variables $(\alpha^+_{jjjj}, \alpha^-_{jjjj})$ for an absolute value function, the original function being to minimize the absolute (L$_1$-Norm) deviation of asset returns between all pairwise comparisons of assets. Equation (5) forces the substituted variables in the objective function to be equivalent to the L$_1$ formulation. Equation (6) requires the proportion invested in each asset times the respective asset return rate to equal the mean return of the portfolio (definition of expectation). Equation

(7) requires that the sum of the proportion invested be equal to one. Konno & Yamazaki (1991) also proposed the use of L$_1$ risk instead of using variance as a measure of risk. Although L$_1$ risk is an

approximation to variance, they concluded that the LP model for portfolio optimization is computationally efficient and the results are comparable to the MV model. While this formulation avoids parametric assumptions regarding return rates, it relies on the accuracy of parameter estimates and is sensitive to outliers (Best & Grauer, 1991). Further, both positive and negative deviations are minimized, which does not reflect appropriate investment strategy for portfolios where shorting is not possible (e.g., 401Ks). Still, we incorporate the concept of the absolute deviation in our formulation, restricting the use of it to the negative return state space.

2.3. VaR & CVaR.

The drawback of using variance as a measure of risk is that it penalizes both the upward risk (gain) and the downward risk (loss) to the same degree. Therefore, Value at Risk (VaR) and Conditional Value at Risk (CVaR) are considered as alternative measures in recent years (Artzner et al., 1999; Rockafellar & Uryasev, 2000). If the loss function associated with a vector of portfolio investment weights (*x*) and vector of portfolio return weights (*y*) is expressed as *f(x,y)* and the probability density of *y* is expressed as *p(y)*, then the probability of *f(x,y)* not exceeding some threshold α is given by Equation (9).

$$\Psi(x, \alpha) = \int_{f(x,y) \leq \alpha} p(y)\,dy \tag{9}$$

Defining a certainly level, β, results in the definition of VaR (10).

$$VaR_{\beta}(x) = \min\{\alpha \in \mathbb{R} \mid \Psi(x, \alpha) \geq \beta\} \tag{10}$$

Equation (10) shows that VaR minimizes the threshold for the loss function given some certainty level. CVaR is a weighted expectation of the loss function where losses exceed the VaR as shown in Equation (11), and for any investment weight *x*, minimizing Equation (12) results in β-CVaR.

$$CVaR_{\beta}(x) = (1 - \beta)^{-1} \int_{f(x,y) \geq VaR_{\beta}(x)} f(x, y)p(y)\,dy \tag{11}$$

$$F_{\beta}(M, \alpha) = \alpha + (1 - \beta)^{-1} \diamond \sum_{f(x,y) \geq VVVVVV_{\beta}(x)} [f(M, y) - \alpha]_{+} p(y) Ay \tag{12}$$

Rockafellar & Uryasev (2000) provide a linear formulation for a CVaR model that extends the traditional VaR approach and focuses on downside risk. From Equation (12), the linear program results from generating q samples for y, using the negative expectation as the loss function ($f(M, y) = -M^{T}y$), and substituting q auxiliary variables for $[f(M, y) - \alpha]_{+}$.

Equations (13) through (17) illustrate the LP formulation.

$$\text{MIN } z = \alpha + \frac{1}{q(1 - \beta)} \sum_{j=1}^{q} u_{j} \tag{13}$$

$$s.s. \quad M^{T}y + \alpha + u_{j} \geq 0 \qquad \forall k = 1, \ldots, r \tag{14}$$

$$1^{T}M = 1 \tag{15}$$

$$\mu^{T}M \geq R \tag{16}$$

$$M, u_{j} \geq 0 \quad \forall k = 1, \ldots, r \tag{17}$$

In this formulation, α is the conditional variation based on the certainty level β. The decision vector x is the vector of weights invested in assets y. R is the minimum return rate for the portfolio. The concept of focusing on negative variation is one that is we incorporate in our study.

Recent work in portfolio optimization has used the concepts of Var and CVaR extensively. Krokmahl et al. (2001) provide a method for calculating VaR and optimizing CVaR simultaneously. The authors justified the use of CVaR as constraints and return as the objective function. In addition, they showed that the use of different periods and different confidence levels allows for shaping distribution according to the decision maker's preferences. Mansini et al. (2007) investigate a LP extension of the CVaR model. Their work mainly focused on simple combinations of CVaR measures (weighted CVaR) and two different types of weight settings namely Wide CVaR and Tail CVaR. They concluded that the Tail CVaR generated diversified portfolios while Wide CVaR required additional techniques to avoid less diversified portfolios.

This work provides some relevance to our own in that we incorporate and investigate diversification parameters.

2.4 Portfolio Selection.

There has recently been considerable focus on different facets of the portfolio selection problem (Levy & Levy, 2014; Adcock, 2014; Aouni et al, 2014; Fliege et al., 2014). According to Steins Lemma (Stein, 1981), a rational decision-maker will always choose a point on the non-dominated frontier in the mean-variance model proposed by Markowitz if the distribution is elliptically symmetric. In reality, this is not necessarily true. Therefore, Adcock (2014) investigated the portfolio selection approach for multivariate skew student distributions and extended Steins lemma for skew student distribution. It was found that the DM will select a portfolio which lies on the mean-variance-skewness non-dominated hyper surface. Levy & Levy (2014) proposed two methods namely Variance-Based Constraints (VBC) and Global Variance-Based Constraints (GVBC) based on the extension of constrained optimization approach to estimate the error for each stock. On comparison of the two methods with ten other optimization methods, they concluded that VBC and GVBC are superior as measured by Sharpe ratio. Fliege et al. (2014) propose a robust formulation to treat convex multi-objective optimization problems with uncertain parameters and compare their results to the standard mean-variance model. Based on the robust efficient frontier and its comparison to the nominal efficient frontier, they conclude that the DM will be able to choose a point based on the efficiency lost and make trade-off between optimality and robustness. The idea of efficiency in investment strategies is incorporated in our study, and we look at the absolute deviation of each stock, similar to Levy & Levy (2014), though we incorporate deviation concerns in the objective function.

2.5. Bi-Criteria Mean-Risk Models.

Risk aversion is an important consideration in portfolio optimization, and modeling it is generally done in one of two ways: bounding analysis and trade-off analysis. In the first method, either risk is bounded from above or return rate is bounded from below. In the second method, a risk aversion coefficient is used (Mansini et al., 2014). Equation (18) demonstrates one method, the bounded risk method.

$$\max \ \mu(x): Q(x) \le Q_0 \qquad\qquad\qquad (18)$$

Here, *Q(x)* is the risk measure. The formulation then maximizes the expected return subject to a constraint that the risk measure is below a specified value Q_0. The approach we take is to bound the return rate from below, while minimizing only the downside risk.

2.6. Problems with Common Portfolio Models.

What is common across portfolio models is that the optimal solution often depends strongly on the expected returns and covariance structure (Barry, 1974; Jorion, 1992; Best & Grauer, 1999). Michaud (1989, 1998) suggests averaging 500 portfolio weights derived by Monte Carlo sampling from a multivariate normal distribution based on the estimated means, variances, and covariances.). "Shrinkage" of the sample parameters (Ledoit & Wolfe, 2003; Jagannathan & Ma, 2003) has been suggested as well as Bayesian methods (Markowitz & Usmen, 2003). In our study, a diversified portfolio and monthly accumulation rates attenuate variation, and we use sampling methods as well.

3. METHOD

The analysis in this paper proceeds as follows. First, a linear portfolio optimization model is presented that minimizes the L_1-Norm for negative return rate variation (the downside MAD) over a set of stochastically generated scenarios. By using the L_1-Norm for negative return rates, we are able to retain linearity in our formulation while simultaneously restricting downside variability. Second, we describe the case study using real-world retirement fund data (2003-2013), providing descriptive analysis of the funds under investigation so that the reader has some familiarity with accumulation rates, variance measures, expectations, and correlations. Third, time series analyses of the funds are conducted to investigate seasonality components, since seasonality is a component of the optimization. Fourth, multivariate normality transformations for risk-based funds are conducted. Fifth, three specific scenarios are generated by bootstrapping percentiles from the monthly accumulation rate distributions. These percentiles reflect a possible outlook of the investor (negative, neutral, positive). Sixth, the optimization is run for various

diversification and minimum return rate parameters. Finally, the recommended investment strategy is applied to return rate data for the year 2014.

3.1. Multi-Period, Stochastic Portfolio Optimization Model.

The multi-period, stochastic portfolio optimization model is formulated as a linear programming model with deviation and loss restrictions incorporated as part of the objective function. Definitions of sets, problem parameters, constraints, and the objective function follow.

3.1.1. Sets

For the optimization, four index sets are required. These sets include indices for the year, month, index fund, and scenario. These indices and their elements follow.

Year , $yy \in YY$ with elements $\{1, 2,\ldots,30\}$.
Month , $mm \in MM$ with elements $\{$Jan, Feb,$\ldots$,Dec$\}$
Index Fund , $ii \in II$
Scenario, $ss \in MM$

3.1.2. Problem Data and Parameters.

The problem data for the optimization include simulated monthly accumulation rates for each fund. We define the accumulation rate, r_{ymis}, as 1 plus the return rate for year y, month m, index fund i, and scenario s. This parameter represents data from the simulation. A transaction cost percent parameter is not included in this formulation, as we assume there are none. A diversification percentage, d, restricts the maximum proportion invested in any given fund. Again, this diversification percentage might be indexed based on the fund type and the month as necessary. The parameter, z_s, represents the weights for the stochastic scenarios. These weights sum to one. Parameter $\theta\theta$ is used to restrict the minimum acceptable accumulation rate, while $\kappa\kappa$ restricts the maximum MAD of the negative return rates. Finally, the data vv_{mmiinn}, are derived from a subset of the accumulation rates. This parameter is the monthly average accumulation

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rates by fund and scenario given that they are strictly less than one (negative returns). This parameter is important, as we use it to restrict the variation of the negative returns.

$r_{yymmiim}$, accumulation rate (rate of return +1) for year y, month m, index fund i, and scenario s
$ll_{yymmiim}$, maximum acceptable expected loss
d, minimum diversification proportion with $AA \leq 1$
zz_m, weights for the stochastic scenarios
$\theta\theta$, minimum acceptable accumulation rate
vv_{mmiim}, monthly accumulation rates for each scenario s given that the return rate is < 1

3.1.3. Decision Variables.

The decision variable, pp_{mmii}, is the proportion of funds invested into fund i for month m-the investment strategy, and $\kappa\kappa_{mm}$ is the value of the MAD for portfolio decisions associated with accumulation rates < 1 by scenario.

3.7.4. Constraints

The optimization model requires the following constraints shown in equations (19) through (24).

$$\sum_{ii=1}^{ll} r_{yymmiimm} \times pp_{mmii} \geq \theta\theta, \qquad \forall\ yy,\ mm,\ ss \tag{19}$$

$$\bar{vv}_{mmiim} - pp_{mmii} vv_{mmiim} \leq \kappa\kappa_{mm}, \qquad \forall mm,\ ii,\ ss \tag{20}$$

$$-\bar{vv}_{mmiim} + pp_{mmii} vv_{mmiim} \leq \kappa\kappa_{mm}, \qquad \forall mm,\ ii,\ ss \tag{21}$$

$$\sum_{ii=1}^{ll} pp_{mmii} = 1, \qquad \forall mm \tag{22}$$

$$pp_{mmii} \leq AA, \qquad \forall mm,\ ii \tag{23}$$

$$pp_{mmii},\ \kappa\kappa_{mmmm} \geq 0, \qquad \forall mm,\ ii,\ ss \tag{24}$$

Equation (19) restricts the total accumulation rate achieved for each year, month, and scenario to be greater than a parameter, θ. This equation requires that the investment strategy work for every year within the sample. Equations (20) and (21) force the MAD of the accumulation rates less than one to be strictly less than κ_m. Equation (22) requires that all funds be expended. Since there may be "no-risk" funds, an inequality formulation to account for unwillingness to invest based on a monthly risk criteria is not necessary. Equation (23) is a diversity constraint reflecting the maximum that may be invested in any given fund. Equation (24) requires non-negativity of the decision variables.

3.1.5. Objective Function.

The objective function in equation (25) minimizes the scenario weighted sum of the downside MAD.

$$\text{Minimize} \quad Z = \sum_{m=1}^{S} p_m \kappa_m \tag{25}$$

The formulation of the optimization is linear. Outcomes from the model, however, are used to calculate the expected geometric return, $\prod_{m} M(r_{ymin} \times p_{mi})$. Manipulation values of θ and d allows for investigation of efficient frontiers, and the linear formulation allows for rapid evaluation of solutions.

3.2 Description of Retirement Plan Case Study

The data used in this case study is that of the Thrift Savings Plan (TSP). The TSP is a retirement contribution plan for federal civilians and uniformed military personnel of the United States, similar to a traditional 401K plan. Participants are offered five different funds including the Government Security Fund (or G Fund), the Fixed Income Index Investment Fund (or F Fund), the Common Stock Index Fund (or C Fund), the Small Capitalization Stock Index Fund (or S Fund), and the International Stock Index Investment Fund (or I Fund). The G Fund is invested in short-term government securities issued by the Treasury and

investment risk is near zero. The F Fund objective is to match the Barclay's Capital U.S. Aggregate Index, which provides a broad representation of the U.S. bond market. The C Fund objective is to track the Standard and Poor's 500 (S&P 500), which provides representation for medium and large capitalization stocks. The S Fund objective is to match the Dow Jones U.S. Completion Total Stock Market Index. Finally, the I Fund attempts to match the performance of the Morgan Stanley Capital International EAFE (Europe, Australasia, Far East) Index (Thrift Savings Plan, 2014). Each of the five primary TSP funds included in the study have complete monthly rates of return since their inception. The dataset used for this analysis included the return rates (converted to accumulation rates) from January 2003 through December 2013.

3.3 Descriptive Analysis

The data set for each of the five funds (G, F, C, S, and I) had no missing data and contained 12 end-of-month rates of return for each fund over 11 years (132 observations). Descriptive statistics for each of the funds' monthly accumulation rates are shown in Table 1. The G Fund would be considered a "no-risk" fund, with an observed minimum return of 1.001. This is due to the fact that it is a special issue treasury provided to investors. The I Fund and S Fund show the highest variability with their coefficients of variation (CV) equal to 5.21 and 5.11 respectively. The G and the F funds exhibit the lowest variability with CVs of .010 and 1.00 respectively. The median monthly return rates (accumulation rate minus 1) for the respective funds are all above 0.

Table 1. Descriptive statistics for the monthly accumulation rate for each fund

Accumulation Rates	*G Fund*	*F Fund*	*C Fund*	*S Fund*	*I Fund*
Minimum	1.0010	0.9746	0.8317	0.7901	0.7941
5th Percentile	1.0012	0.9883	0.9290	0.9215	0.9043
Quartile 1	1.0020	0.9983	0.9851	0.9863	0.9777
Mean	1.0028	1.0038	1.0082	1.0116	1.0091
Median	1.0029	1.0037	1.0136	1.0204	1.0138
Geometric Mean	1.0028	1.0038	1.0074	1.0103	1.0076
Quartile 3	1.0037	1.0104	1.0332	1.0426	1.0396
95th Percentile	1.0044	1.0167	1.0683	1.0795	1.0873
Maximum	1.0050	1.0373	1.1093	1.1500	1.1341
Standard Deviation	0.0010	0.0101	0.0416	0.0517	0.0526

Skewness	-0.0887	-0.1327	-0.8461	-0.7435	-0.7922
Kurtosis	-1.0314	1.3490	2.3187	2.2493	1.9255
Coefficient of Variation	0.1019	1.0016	4.1244	5.1148	5.2138

Figure 1 is a plot of the kernel densities for each of the fund distributions. These plots are scaled identically on the X-axes and illustrate that the G-Fund has positive definite monthly returns above zero, while all other funds have significantly more variance. The funds appear to have bell-shaped accumulation rates, although some negative skewness is visible in the S and I funds. Shapiro-Wilk's tests of all funds suggest non-normality (p-values below .001 for all funds except the F Fund, which has an associated p-value of .014).
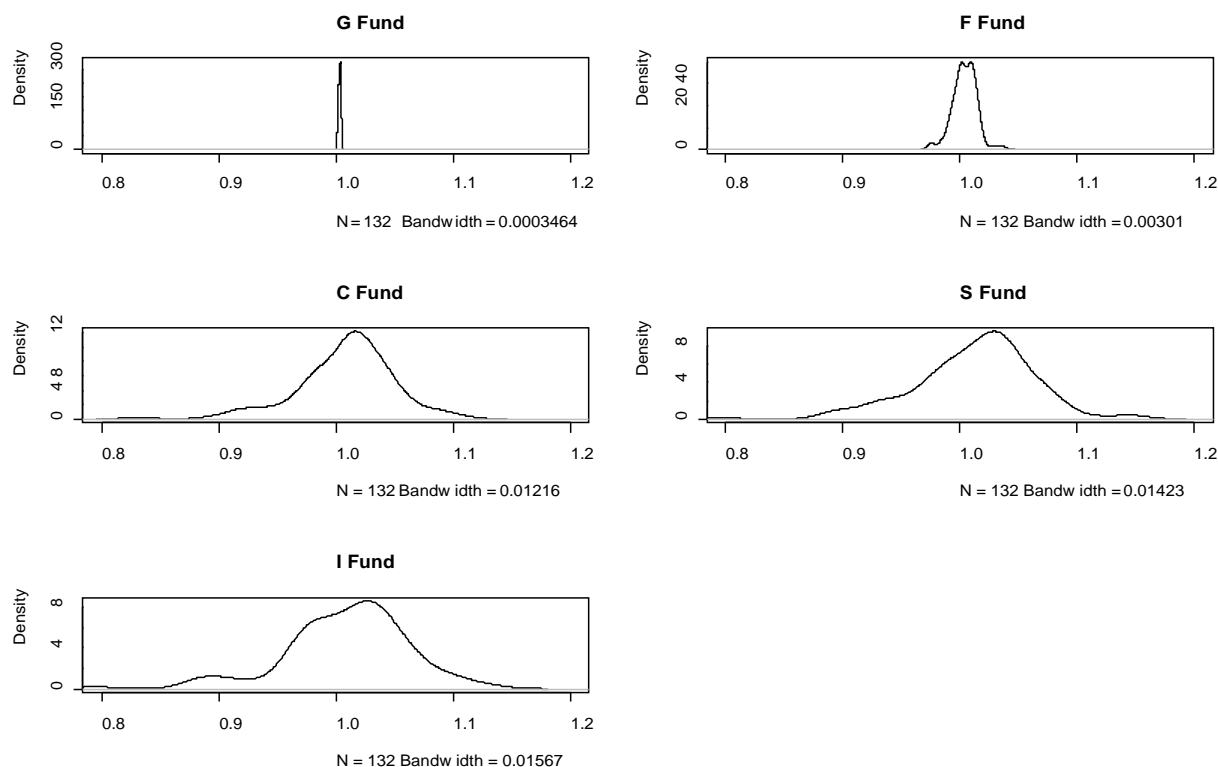
Figure 1. Kernel densities of the funds

Figure 2 shows a small multiple plot set of the accumulation rates for the TSP by month over time (Tufte, 2001). The axes are identical for across fund comparison, and the centerline represents the 1.00 accumulation rate (no gain or loss). As expected, the S and I fund display the most volatility. Further, the

monthly accumulation rates over time appear to have no noticeable trend. In fact, tests of trend for all funds were not significant.
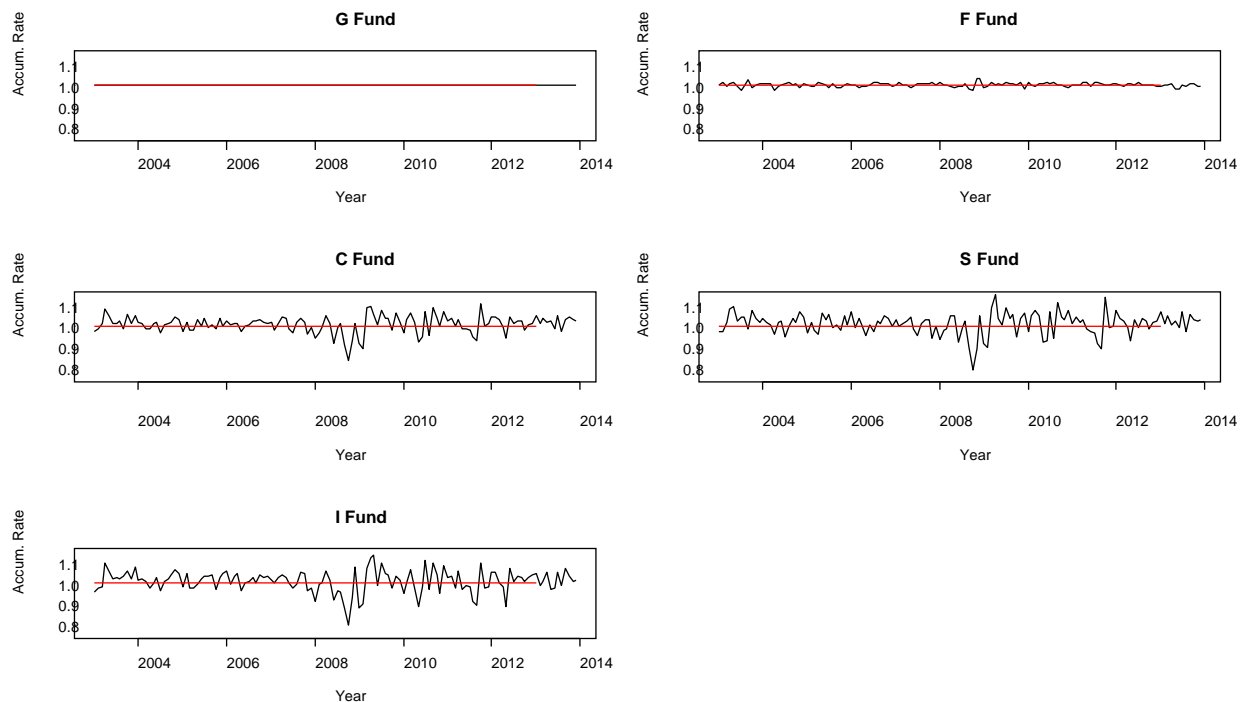
Figure 2. Time series plots of accumulation rates by fund.

Median accumulation rates shown in Table 2 and Figure 3 reveal that two funds, the S and I funds, have median monthly losses for July and May respectively over the 11-year period, with both funds experiencing six years of losses and five years of gain during these months. For the median accumulation rate, no single investment solution dominates.

Table 2. Median accumulation rates by fund

Month	G Fund	F Fund	C Fund	S Fund	I Fund
Jan	1.003	1.001	1.015	1.012	1.013
Feb	1.002	1.003	1.014	1.010	1.001
Mar	1.003	1.000	1.011	1.021	1.006
Apr	1.003	1.008	1.019	1.025	1.048
May	1.003	1.008	1.014	1.027	0.996
Jun	1.003	1.001	1.001	1.005	1.000
Jul	1.003	1.010	1.014	0.994	1.010

Aug	1.003	1.012	1.015	1.014	1.010
Sep	1.003	1.007	1.026	1.025	1.031
Oct	1.003	1.004	1.016	1.028	1.036
Nov	1.003	1.003	1.009	1.030	1.022
Dec	1.003	1.003	1.014	1.027	1.040
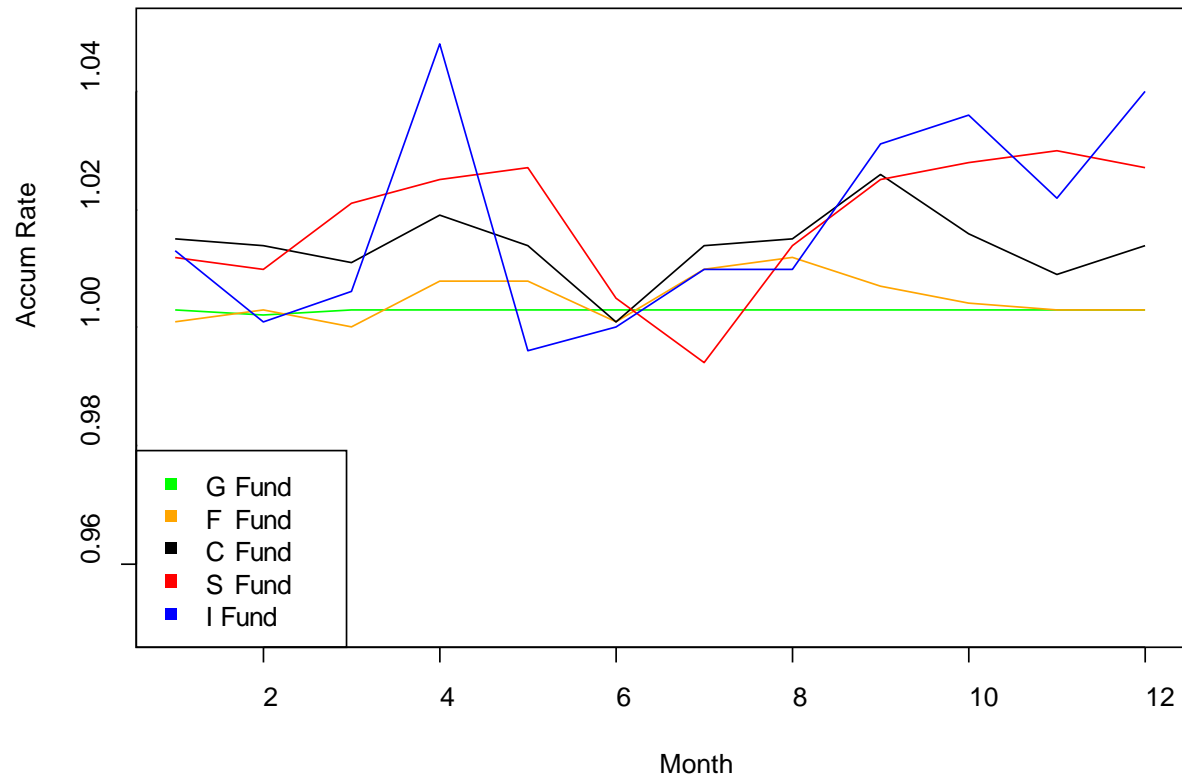
Figure 3. Median accumulation rates by fund

We evaluated various monthly percentile distributions for each fund's accumulation rate. Below the 20th percentile, the G Fund becomes the dominating solution, as monthly accumulation rates for all of the other funds drop below 1.002, the 20th percentile for the G Fund.

A correlation matrix among the funds revealed strong, positive relationships among the C, S, and I funds as would be expected. These funds had statistically significant correlations (p-values associated with Spearman's rho, avoiding normality assumptions, less than .001 in all cases). Table 3 provides those relationships.

Table 3. Correlations among the five fund accumulation rates are depicted. Italicized numbers indicate the statistically significant relationships (p<.05).

	G Fund	F Fund	C Fund	S Fund	I Fund
G Fund	1.000	0.125	-0.094	-0.104	-0.002
F Fund		1.000	0.036	-0.017	0.127
C Fund			1.000	0.948	0.899
S Fund				1.000	0.861
I Fund					1.000

3.4 Time Series Analysis.

Trend. In Figure 1, the accumulation rates for the funds appear to be centered around 1.0. A simple regression analyses for trend only revealed that only Fund G had a statistically significant trend (p<.001), but that trend was of trivial magnitude (-.00002). Trend was therefore not included in the simulation, as one condition of stationarity was present.

Autocorrelation Analysis. We next evaluated separately the autocorrelation and partial autocorrelation for each fund followed by the cross correlation for at-risk funds: F, C, S, and I. One lag significant autocorrelation was evident in all funds except for the F fund as shown in Figure 4 (dashed lines represent the 95% confidence interval). The S fund had statistically significant autocorrelation at time period as well. Durbin Watson tests confirmed statistically significant observations for the C, S, and I funds depicted on the charts (p=.010, p=.007, p=.028, respectively). For simulation modeling purposes, we restricted analysis of autocorrelation to a single lagged time period.
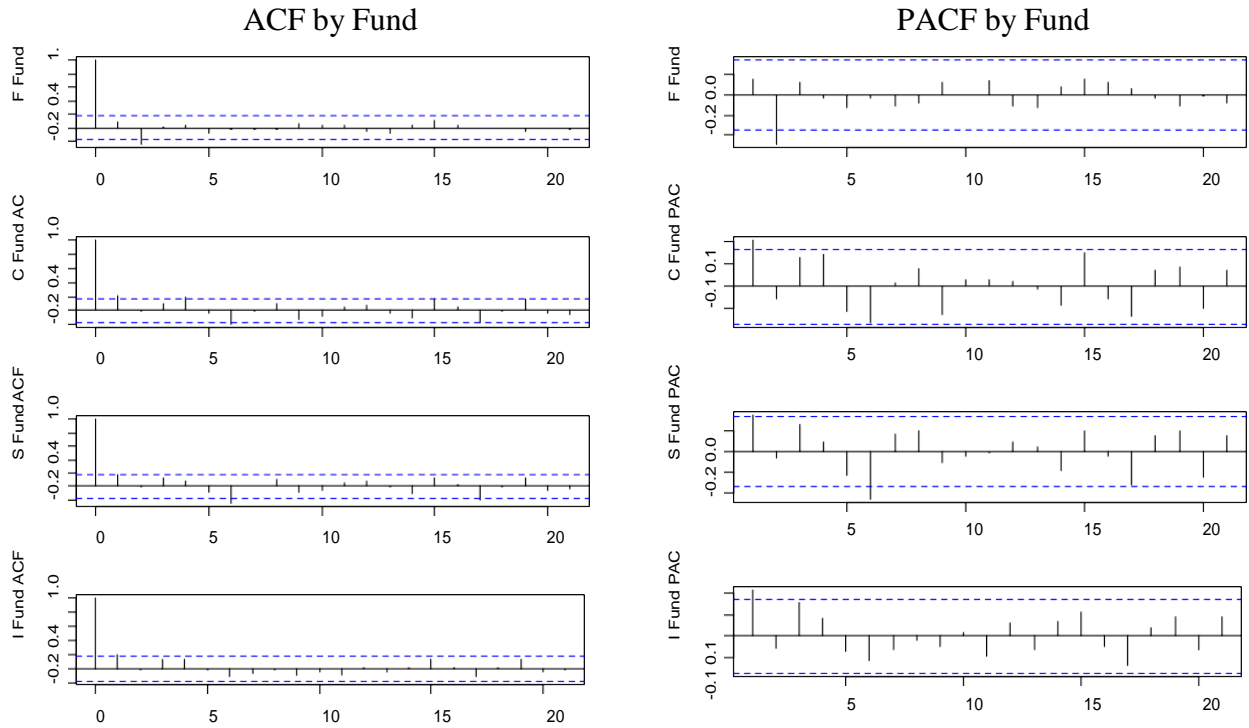
Figure 4. Autocorrelation and partial autocorrelation by lag period and fund.

Cross Correlation Analysis. The analysis of cross correlation allows for the development of fund models linked to lagged observations in other funds. Cross correlation analysis for C vs. S revealed cross-linked effects for -1, +/- 6, +15, and -17 lags. For C vs. I, significant lags were identified at time periods +/-1, +3, -6 and -17. For S vs. I, the statistically significant lags were +1, -6, and -15. Figure 5 shows the cross-correlation analysis. The impact for the simulation is that a covariance matrix is necessary for these three funds.
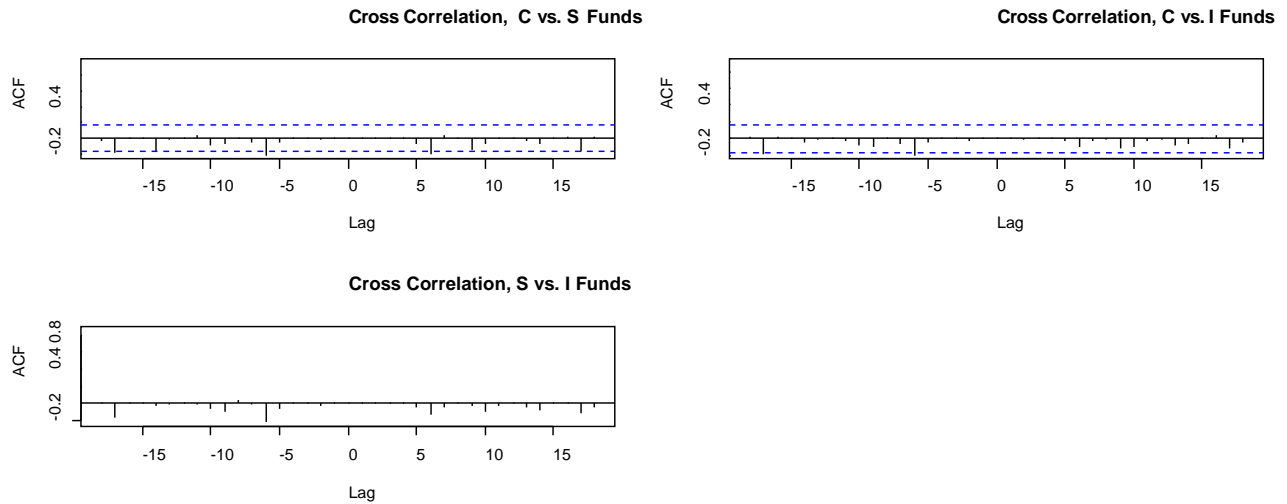
Figure 5. Cross-correlations for selected funds

To investigate the assumptions associated with the follow-on simulation and optimization, we ran additive linear regression with binary seasonal variables and trend, multiplicative and additive decomposition, Exponential Trend & Smoothing (ETS) Models, as well as Auto-Regressive Integrated Moving Average (ARIMA) models for each of the five funds using R Statistical Software (R Development Core Team, 2008) for years 2003 through 2011 and evaluated their performance for 2012 and 2013, a lengthy forecasting period. While ETS and ARIMA can produce identical models, they need not do so, so both algorithms were employed. We then compared the training and test models based on two measures of bias (mean error (ME) and mean percent error (MPE)) as well as on four measures of variance (root mean squared error (RMSE), mean absolute error (MAE) mean absolute percent error (MAPE) and mean absolute scaled error (MASE)). Models were selected from each class by using the corrected Akaike Information Criterion (AICc).

Appendix 1 provides the bias and variance statistics for all training and test models. Models were judged to be superior when their bias statistics were closer to zero and their variance statistics were smallest in the comparison group. For the G Fund, an auto-fitted ARIMA(0,1,1) proved to be best for the testing data set,, with near zero bias (ME and MPE) and the smallest variance measures. The ARIMA(0,1,1) model is expressed in Equation (26).

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$$\hat{Y}_{t+1} = \mu + Y_t + \theta e_t \tag{26}$$

where Y_t is the forecast, μ is a non-zero mean (if required), Y_{t-1} is the previous month's accumulation rate, θ is the moving average parameter estimated from the data, and e_{t-1} is the error of the estimate for the previous month's forecast versus actual result. The forecast function for the G fund is Equation (27).

$$\hat{Y}_{t+1} = Y_t - .6720 e_t \tag{27}$$

Because the errors associated with the G Fund are so small, the estimate of accumulation rates for 12 months forward is nothing more than a constant (1.001162), which is congruent with what one would expect from Figure 1. The implication for the simulation of the G Fund was that univariate sampling from the distribution of accumulation rates would suffice, particularly since the trend was negligible and the correlation among other funds near zero. The "no-risk" option is a separate decision set.

The F Fund training set had no clear dominating model, as additive decomposition, ETS(A,N,N), and ARIMA(0,0,0) or "white noise" appeared to have similar bias and variance characteristics, but when these models were applied to the test set, the ETS(A,N,N) performed slightly better on one bias characteristic than a pure white noise model. The ETS(A,N,N) model is Equation (28).

$$\hat{Y}_{t+1} = \alpha Y_t + (1 - \alpha)\hat{Y}_t \tag{28}$$

In this case, α is just the smoothing constant. The ETS(A,N,N) model is actually equivalent to an ARIMA(0,1,1) model, where $\theta = \alpha - 1$. The estimate for the F Fund, independent of the other funds, is Equation (29).

$$\hat{Y}_{t+1} = .0001 Y_t + .9999 \hat{Y}_t | Y_1 = 1.0043 \tag{29}$$

Given the small value for the smoothing constant, a 12-month forecast is nothing more than a constant for the initial forecast for Y, 1.0043. Again, the implication for simulation modeling for the F Fund given the absence of trend and cross-correlation with the other funds and the minimal effect of autocorrelation is that a simple univariate sampling scheme would be appropriate.

For the C Fund, the optimal ARIMA model, an ARIMA(0,0,1) proved superior than ETS, additive, and multiplicative decomposition models. The final model is Equation (30); however, this model did not include the known covariance with the S and I funds.

$$\hat{y}_{t+1} = 1.0066 + .2603\varepsilon_{t} \qquad (30)$$

For the S Fund and the I Fund, the ARIMA(0,0,1) models with non-zero means were again superior to the other models. Equations (31) and (32) provide the equations for the S and I Fund respectively. Again, these equations do not include known covariation with other funds. Also, one should note that none of the traditional forecasting models produced forecasting estimates with reasonably small variance and bias estimates for the F, C, S, and I funds.

$$\hat{y}_{t+1} = 1.010 + .2288\varepsilon_{t} \qquad (31)$$

$$\hat{y}_{t+1} = 1.0082 + .2605\varepsilon_{t} \qquad (32)$$

In two funds (C and I), analysis of the decomposition models with dichotomous variables identified some months with accumulation rates statistically different from what would be expected. In the C Fund, June showed some evidence of lower accumulation rates, $t(120)=2.12$, $p<.04$. In the I Fund, both May $t(120)=1.94$, $p<.10$) and January ($t(120)=1.99$, $p=.05$) showed some evidence of lower accumulation rates. Further, the C Fund, S Fund, and I Fund exhibited significantly higher variation in the month of October, $F(120,10) = .3034$, $p<.002$), $F(120,10)=.2849$, $p<.0009$, $F(120,10)=.3943$, $p<.02$, respectively). The C and S Funds also exhibited lower variation in December, $F(120,10)=3.7791$, $p<.03$ and $F(120,10)=3.9041$, $p<.03$ respectively). Some evidence existed to suggest that the I Fund's variation in the month of March was lower than other months, $F(120,10)=2.7676$, $p<.08$, and higher in May than other months, $F(120,10)=.5089$, $p<.09$. While no other months proved statistically significant for this extended time period, knowledge of the relationship among the funds coupled with seasonality components provides a basis for modeling.

3.5. Modeling Conclusions from the Descriptive and Time Series Analyses.

Several conclusions emerge from the time series analysis. First, the G and the F Funds should logically be modeled separately as univariate distributions with decisions unlinked to the other funds. This is appropriate since the G Fund represents government securities (risk averse option), and the F Fund represents bond mixes. Both of these are dissimilar to the C, S, and I Funds. The C, S, and I Funds, however, require modeling that includes autocorrelation and cross-correlation. Further, we note some statistically significant seasonality of means and variances, and other differences may have practical relevance while not achieving significance. For this study, the proposed stochastic portfolio optimization model generates scenarios based on sampling from the G and F Fund univariate distributions and sampling from a Multivariate Normal (MVN) distribution for the C, S, and I Funds at time *t* conditioned on each month *m*.

3.6. Transformations and Multivariate Normality.

We investigated multivariate normality of the funds C, S, and I for each month, *m*. No statistically significant differences from MVN assumptions were found using Henze-Zirkler, Royston, and Mardia tests. Using ARC Regression (Cook & Weisburg, 2004), we evaluated the likelihood ratio test (LRT) that Box-Cox transformations would result in $\lambda = [1,1,1]$ for vectors C, S, and I conditioned on month. The result was (again) not significant, $\chi^2 = .766$, p=.858. Without conditioning on month, the LRT for $\lambda = [1,1,1]$ was insignificant, $\chi^2 = .719$. No transformations of the accumulation rate data for the C, S, and I funds were necessary.

3.7. Scenario Generation

We use Monte Carlo simulation to assist in generating three separate scenarios for the optimization model. The algorithm follows.

1. Estimate the sample means, variances, and covariances for C, S, and I funds indexed i for each month indexed m. These parameters are used to randomly sample 1000 random vectors from an MVN distribution.

2. Draw 1000 random samples x 12 months for each of the G and F funds from their respective univariate distributions. The total number of observations drawn equals 12,000 x 2 funds = 24,000.

3. Calculate the product of the accumulation rates for each of the 12,000 monthly observations. This product reflects the accumulation that would be achieved from equal investment over all funds in a given month.

4. Use distribution percentiles of the product of the accumulation rates to trim outlier data (e.g., eliminate data below the 5th percentile and above the 95th percentile). Doing so leaves seasonality and covariance effects intact and reduces (shrinks) the variability of the data.

5. Resample remaining data without truncation for the neutral outlook, with left truncation for the positive outlook (e.g., above 10th percentile) and with right truncation for the negative outlook (e.g., below 90th percentile) using a 30-year time horizon.

For step 1, samples from the MVN monthly distributions were drawn using the MVN package (Korkmaz et al., 2014) in R. This sample size, while arbitrary, was sufficient to make the standard error of the most volatile fund, the I Fund, less than .0017.

4. RESULTS

We formulated the multi-period, stochastic portfolio optimization model in the General Algebraic Modeling System (GAMS) and solved for various values of $\theta\theta$ and d using the IBM COIN-OR Glpk Solver (Makhorin, 2012). After comparing the parameter effects on the existing model, we then used the monthly investment recommendations derived from the simulation of 2003 through 2013 data to see how well they performed for 2014 as a comparison.

4.1. Parameter Manipulation and Complexity

We evaluated the effects of θ and *d* on both the objective function values as well as the expected yearly accumulation rate. Specifically, we looked at values of θ (minimum acceptable accumulation rate) from .8 to 1.0 (by step sizes of .1) and values of *d* from .2 (mandatory diversification, no decision) to 1.0 (no diversification) by step size of .1. The implementation of the mathematical program resulted in 1766 rows, 317 columns, and 7217 non-zeros. Because of the linear formulation, the 21 x 9 or 189 runs took less than .25 seconds each on a 64-bit Toshiba Portege laptop with an Intel i3-2310M processor operating at 2.10 GHz and 4GB Ram.

4.2. Graphical Results

The results of the optimization runs for Figure 6 is a plot of the objective function by these values, while Figure 7 is a plot of the expected yearly accumulation rate.
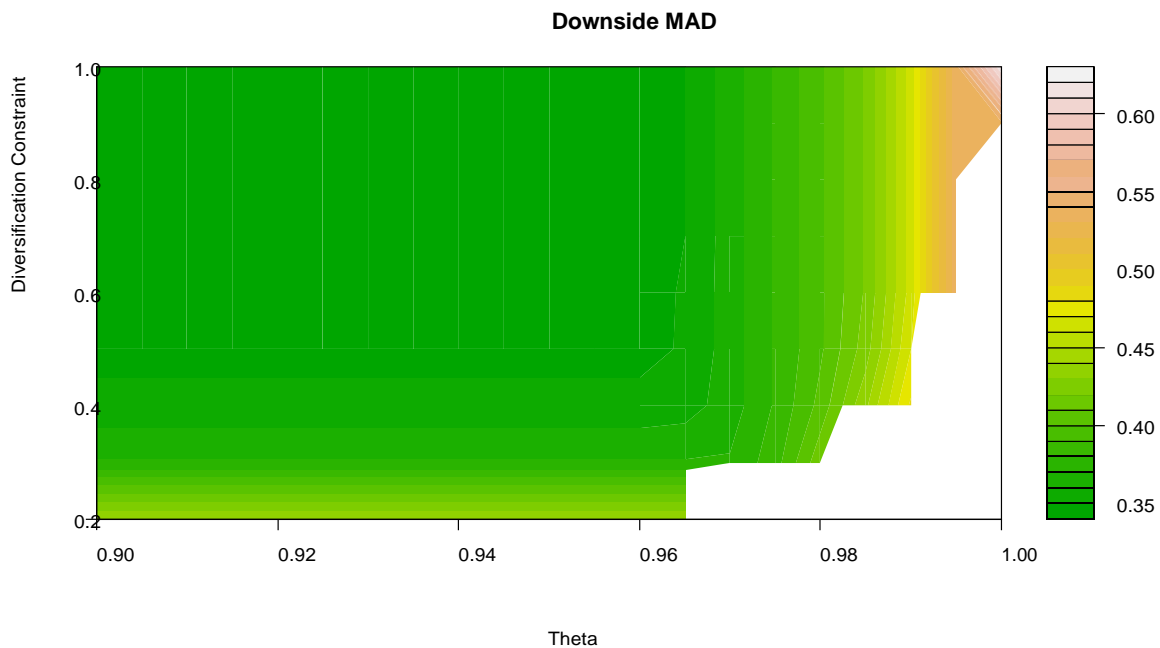
Figure 6. This contour plot shows the downside MAD for various values of θ (x-axis) and the diversification constraint (maximum proportion invested in any given fund, y-axis). The white area reflects the region of infeasibility. Forced diversification and less conservative values of θ allow the solver to choose funds with small downside MAD.

Expected Geometric Accumulation Rate
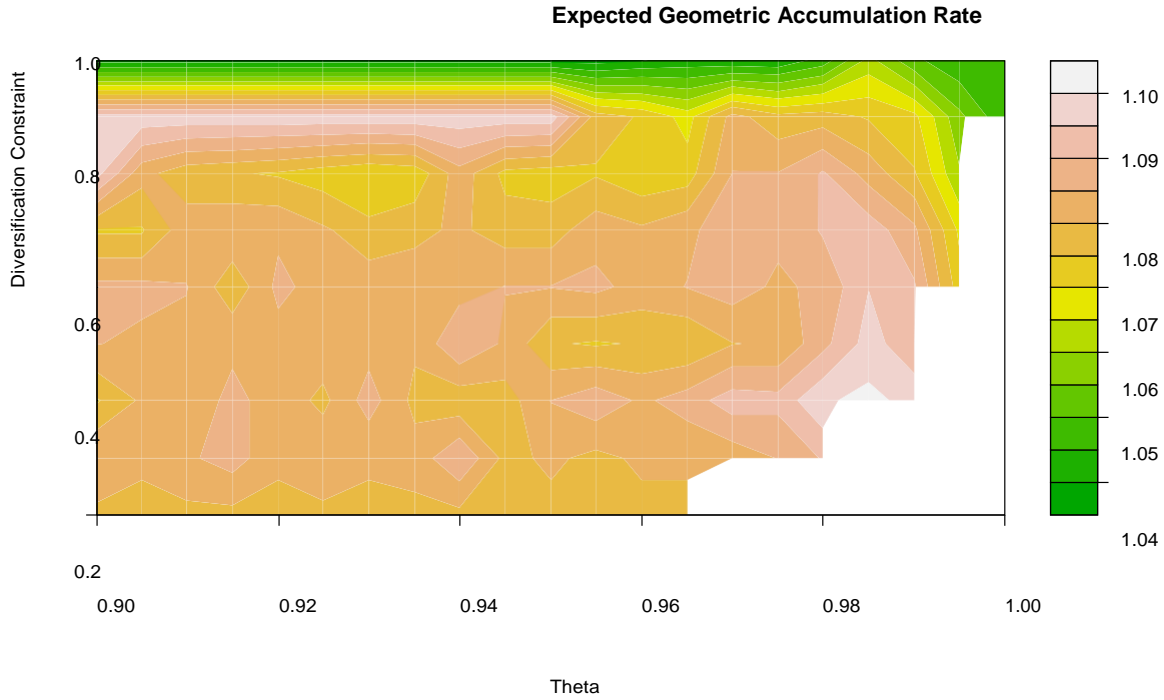
Figure 7. This figure portrays the expected geometric accumulation rate for values of θ (x-axis) and the diversification constraint (y-axis). From this chart, there are two noticeable areas where expected geometric accumulation rate is high. When values of θ are high and diversification constraints are low, geometric accumulation rates are high. When values of theta are low and diversification is high but below one (allowing the Solver some flexibility), the accumulation rates are high. The implication from this chart is that moderate diversification requirements and high values of θ result in improved expected accumulation rates.

The graphs in Figures 6 and 7 reveal the two competing trade-offs: minimizing downside variation and maximizing upside return. In Figure 6, it is easy to see that less restrictions on return rate and diversification result in lower downside MAD. In Figure 7, one notices that either higher θs and lower diversification or lower θs and higher diversification result in better returns. The maximum geometric accumulation rate is associated with $\theta < .91$ and d=.90. The minimum downside MAD is associated with d=1.0 and $.80 < \theta < .92$. The implication here is that over-diversification (d small) of already diversified funds when the downside variation is already minimized may be ill-advised. Using the information from the two graphs, we generated a regression model forecasting the log of the accumulation rate as a function of the downside MAD, theta, and d. The model is specified in Equation (33).

$$\ln\big(M(r)\big) = \ln(\kappa) + \theta + A + \ln(\kappa) \times \theta + \ln(\kappa) \times A + \theta \times A + \ln(\kappa) \times \theta \times A \qquad (33)$$

The results of the regression model were (as expected) statistically significant and accounted for 36% of the variance ($F(7,163)=13.11$, $p<.001$, Adjusted $R^2=.3602$). The model equation is shown in Table 4.

Table 4. Coefficient estimates for the regression model.

	Estimate	*Std. Error*	*t-value*	*p-value*
(Intercept)	-1.2964	0.35342	-3.668	.00033
ln(MAD)	-1.2204	0.36655	-3.329	.00108
θθ	0.0142	0.00386	3.675	.00032
D	4.5524	1.24209	3.665	.00033
ln(MAD) x θθ	0.0124	0.00407	3.037	.00278
ln(MAD) x d	4.1285	1.12706	3.663	.00034
θθ x d	-0.0465	0.01248	-3.726	.00027
log(MAD) x θθ x d	-0.0417	0.01133	-3.677	.00032

From Table 4, the effect of diversification appears to be positive and large. However, the interaction effects for both variables begin to reduce the gain as both $\theta\theta$ and d become large. Figure 8 shows the curvilinear effects of the percent diversification.
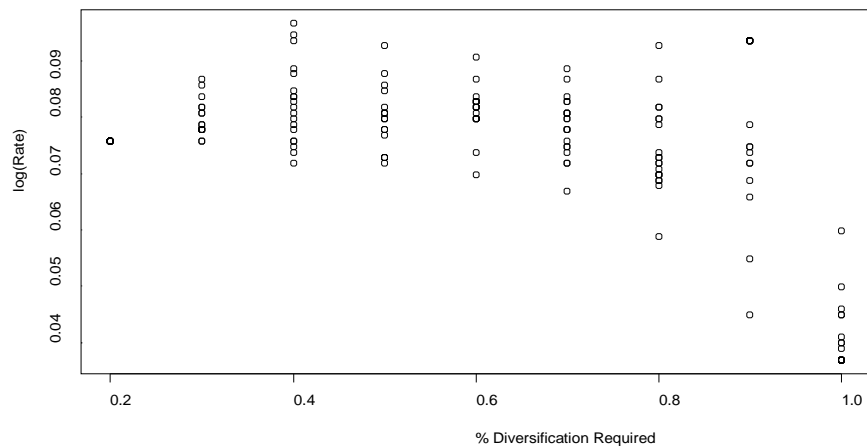
 Figure 8. The curvilinear nature of the ln(Geometric Accumulation Rate) versus the diversification shows that increases in the amount allowed to be invested in any given fund decreases the log of the expected geometric accumulation rate.

4.3 Recommendations with Fixed Scenario Weights for Maximum Return and Minimum Downside MAD

The results of the optimization produce recommended investments by month. Using fixed scenario weights of {.25, .50, .25}, we evaluated a maximum return solution ($\theta\theta$ =.9, d=.9, congruent with our analysis of Figures 5 and 6) and a minimum downside MAD solution ($\theta\theta$ =.92, d=1.0). Table 5 and 6 provide the recommended solution and objective function value for two of the highest expected geometric rate solutions. What is interesting from the separate recommendations is that the investment decisions are not too different. For example, January, February, July, August, September, October, and November investment decisions are identical in terms of fund, although the percent allocations differ.

Table 5. This table shows the allocation decisions for a maximum expected geometric investment return based on $\theta\theta$ and d.

$\theta\,\theta$ =.9, d=.9	G	F		S	I	Total
JAN	14%	86%				100%
FEB			56%		45%	100%
MAR		10%		90%		100%
APR			90%	0%	10%	100%
MAY		47%	53%			100%
JUN	10%	90%				100%
JUL	90%		10%			100%
AUG			49%	51%		100%
SEP			69%	31%		100%
OCT	52%				48%	100%
NOV		63%		37%		100%
DEC			62%		38%	100%

Table 6. This table shows an allocation decision for a minimum expected downside MAD based on $\theta\theta$ and d.

$\theta\,\theta$ =.92, d=1.0	G	F	C	S	I	Total
JAN	12%	88%				100%
FEB			59%		41%	100%
MAR				100%		100%
APR				100%		100%
MAY		44%	53%		3%	100%
JUN		100%				100%
JUL	80%		20%			100%
AUG			51%	49%		100%
SEP			71%	29%		100%
OCT	48%				52%	100%
NOV		66%		34%		100%
DEC				42%	58%	100%

4.4 Return Rates for 2014 Based on Model

We use the parameter investment percentages in Tables 5 and 6 to evaluate what the actual geometric return rates would have been for 2014. Using the TSP data and Table 5, the geometric rate of return for the maximum geometric return investment strategy (Table 5) proposed would have been 9.72%. The return rate for the solution that minimized the downside MAD based (Table 6) was 5.77%. These solutions assume scenario weights of {.25, .5, .25} for the negative, neutral, and positive scenarios. In contrast to these results, a uniformly distributed solution (investing equally in all funds each month) resulted in a geometric return rate of 5.05%.

5. CONCLUSIONS

In this study, we demonstrated the use of a multi-period, stochastic portfolio optimization model based on time series analysis of data that incorporated the Mean Absolute Deviation of the negative return rates, minimizing the downside return variation, while evaluating restrictions on the upside return rate based on investor preference. We built this model on smoothed and already diversified investments, as a method for evaluating investment strategies for retirement plans. Our motivation here was to find reasonable methods for evaluating investments in various retirement funds (e.g., 401-K funds). By basing our work on previously known models and incorporating extensive time series analysis as well as a focus on downside (undesirable) variation, we were able to develop novel models that incorporated the MAD of the downside variation as well as time series assumptions.

The performance of our models based on a stochastic scenario with weights {.25, .5, .25} for negative, neutral, and positive outlook scenarios (a weighting which assumes that "average" performance is most likely) was excellent in that the maximum geometric accumulation rate model produced a return rate of

nearly 10% when applied to 2014 data while at the same time minimizing the negative MAD. Our proposed models are the first to use the downside MAD, time series analysis, and already diversified funds for evaluating investment decisions. While we recognize that all models are wrong, we also suggest that the use of many of the methods demonstrated in this study will be useful for others attempting to structure investment decisions.

5.1 Limitations

The assumptions of the provided model are significant. The user of such a model would have to test seasonality for the investment funds in question. Further, another significant assumption is that historical, seasonal fund performance is likely to represent future fund performance, an assumption that may not hold in many cases. The number of years of data to include in such a model is also a subject for analysis as well. Additionally, using such a model to actually shift funds only meets the model's investment strategy if such shifts can be timed such that the monthly rate of return is achieved. In this case, full exposure requires purchasing on the first trading day and selling on the last trading day of the month. In some grouped investment plans, this is not a possibility. Also, as in the case of the TSP, penalties for shifting funds monthly must not exist. For investment opportunities that have demonstrated seasonality component, however, this type of seasonal optimization can be useful.

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Appendix 1. Bias and Variance statistics of Training and Test Sets

Model	Fund	Group	ME	MPE	RMSE	MAE	MAPE	MASE
Decomp A	G	Train	-0.001	-0.147	0.007	0.001	0.147	13.053
Decomp M	G	Train	-0.001	-0.147	0.007	0.001	0.147	13.053
ETS(M,N,N)	G	Train	0.000	-0.005	0.001	0.000	0.038	0.543
ARIMA(0,1,1)	G	Train	0.000	-0.004	0.001	0.000	0.039	0.555
Decomp A	G	Test	-0.002	-0.184	0.009	0.002	0.184	16.265
Decomp M	G	Test	-0.002	-0.184	0.009	0.002	0.184	16.265
ETS(M,N,N)	G	Test	0.000	-0.024	0.000	0.000	0.035	0.833
ARIMA(0,1,1)	G	Test	0.000	-0.023	0.000	0.000	0.034	0.823
Decomp A	F	Train	-0.003	-0.303	0.043	0.007	0.730	0.900
Decomp M	F	Train	-0.003	-0.303	0.043	0.007	0.730	0.900
ETS(A,N,N)	F	Train	0.000	-0.010	0.010	0.008	0.793	1.000
ARIMA(0,0,0)	F	Train	0.000	-0.011	0.010	0.008	0.793	1.000
Decomp A	F	Test	-0.003	-0.328	0.046	0.008	0.791	0.976
Decomp M	F	Test	-0.003	-0.328	0.046	0.008	0.792	0.976
ETS(A,N,N)	F	Test	-0.003	-0.339	0.008	0.007	0.683	0.646
ARIMA(0,0,0)	F	Test	-0.003	-0.340	0.008	0.007	0.683	0.646
Decomp A	C	Train	0.011	1.042	0.149	0.025	2.439	0.793
Decomp M	C	Train	0.011	1.042	0.149	0.025	2.445	0.795
ETS(A,N,N)	C	Train	0.000	-0.197	0.044	0.032	3.226	1.000
ARIMA(0,0,1)	C	Train	0.000	-0.177	0.042	0.031	3.115	0.969
Decomp A	C	Test	0.013	1.175	0.167	0.027	2.640	0.860
Decomp M	C	Test	0.013	1.174	0.168	0.027	2.649	0.862
ETS(A,N,N)	C	Test	0.012	1.153	0.030	0.026	2.513	0.619
ARIMA(0,0,1)	C	Test	0.012	1.141	0.030	0.025	2.499	0.615
Decomp A	S	Train	0.011	0.992	0.169	0.027	2.655	0.656
Decomp M	S	Train	0.011	0.991	0.170	0.027	2.669	0.660
ETS(A,N,N)	S	Train	0.000	-0.309	0.055	0.041	4.190	1.000
ARIMA(0,0,1)	S	Train	0.000	-0.286	0.053	0.041	4.092	0.980
Decomp A	S	Test	0.012	1.063	0.188	0.029	2.842	0.703
Decomp M	S	Test	0.012	1.063	0.189	0.029	2.859	0.707
ETS(A,N,N)	S	Test	0.012	1.063	0.035	0.028	2.733	0.523
ARIMA(0,0,1)	S	Test	0.012	1.066	0.035	0.028	2.733	0.523
Decomp A	I	Train	0.008	0.656	0.193	0.031	3.076	0.702
Decomp M	I	Train	0.008	0.656	0.194	0.031	3.093	0.706
ETS(A,N,N)	I	Train	0.000	-0.313	0.055	0.041	4.199	1.000
ARIMA(0,0,1)	I	Train	0.000	-0.274	0.053	0.040	3.991	0.954
Decomp A	I	Test	0.008	0.619	0.215	0.035	3.431	0.781
Decomp M	I	Test	0.008	0.618	0.216	0.035	3.453	0.787
ETS(A,N,N)	I	Test	0.009	0.720	0.041	0.031	3.102	0.624
ARIMA(0,0,1)	I	Test	0.009	0.744	0.041	0.031	3.116	0.627

If, when, and how financial decisions affect firm value: A meta-analysis

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Abstract

The aim of this study is to analyze the interaction between capital structure decisions and risk management decisions as well as the channels through which they add value to the firm. Therefore, competing theories are aggregated in a new integrated theoretical model, which we test by means of meta-analytic structural equation modeling based on 6,312 reported results, manually collected from 411 empirical studies. We find that capital structure mediates the relation between risk management and firm value. In this regard, risk management positively affects leverage by providing greater debt capacities. Further, leverage has a negative impact on firm value. Therefore, managers should leave debt capacities unused but should instead use additional internal funds, made available via from risk management, for carrying out profitable projects and research and development activities. Overall, corporate hedging is especially found to add value to the firm by lowering bankruptcy risks and underinvestment risks.

How team characteristics & commitment affect team learning outcome: mediating effect of Team performance

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Abstract

Research on new venture teams (NVT) has largely addressed direct relationship between team functioning and team outcomes. However, few studies are devoted to the intermediary mechanisms that more precisely explain how team inputs lead to team effectiveness (Kolt, Hmieleski, Bradley and Busenity, 2014). This study aims to extend the understanding of NVT research by investigating the interplay between team characteristics and team learning outcome and how this relationship is influenced by team performance. For this purpose, we use an experimental research design trough an entrepreneurship education (EE) program based on experiential learning and simulation at early stage of new economic activities. Building upon existing team work literature, diversity and organizational learning theories, and applying an inputs-mediators-outcomes (IMO) framework, we show that NVT characteristics such as team commitment and diversity significantly affect the learning outcomes of the EE program, and in a way which is mediated by the entrepreneurial team performance. We discuss the implications of our findings for both researchers and high education policy makers.

Keywords:
Team characteristics; Diversity; Gender; Commitment, Performance; Learning; Experiment.

3. Results

Figures 1-3 represent the 7 models in the form of path diagrams tested along with the computed standardized coefficients (β_i) and the corresponding significance levels. Tables 4-6 list standardized and non-standardized coefficients, standard errors, and exact p-values for each direct and indirect path tested, including any interaction terms. Model-level parameters are reported for each model in the lower half of each table.

The key result highlights of interest can be summarized as follows:

Performance-mediated learning effects
- All 7 models indicate a strong statistically significant (greater than 99.9% confidence level) coefficient for the Performance→Learning pathway with standardized coefficients ranging from $\beta_i = 0.48$ to $\beta_i = 0.66$ irrespective of which combination of variables is used to represent team diversity and team commitment. A one standard deviation increase in performance leads to a minimum of 0.48 standard deviation increase in learning. This offers very strong support for the hypothesis that performance mediates learning in a simulator-aided entrepreneurship course setting.

Estonian e-government approach

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Abstract

Estonia is one of the countries, where government services have achieved high degree of digitalization. What is distinctive from the other countries, which embarked on a similar path towards e-governance, is that most of the Estonian citizens have welcomed their participation in the digital economy. This paper discusses key projects on which digital Estonia is based and key factors, which contributed to its success as Estonian digital economy project is running for a few years now. Paper also looks what were the key issues arising from the government's pioneering engagement with the digital world.

This was a remarkable achievement for a small country. Several effects arise from Estonia's experience with the e-government: Increased efficiencies in information exchange, which enables faster document rotation and information access, improved international recognizability and prestige, which resulted in higher startup and IT companies' activity in the country, information sharing and possibility to participate in projects and export government digitalization "know-how" to other countries, thus also increase international prestige and visibility.

These Estonian e-government activities attract increased interest from the tech community and young people, which resulted in the positive spillover effect of government's digital activities - more tech entrepreneurs and students choose to come to Estonia to engage in startup activities or study. Estonian startups have caused great interest from overseas venture capitalists.

Digital identity, government information exchange backbone X-road, and general public openness towards technology and innovation characterizes Estonia today and no doubt made digital transformation possible and an example for other countries. Moreover, Estonian government's success already generated interest in cooperation and consultations about e-governance with such countries as Dubai, Ukraine, Greece and India.

Evaluating Privacy Preserving Algorithms in Association Rule Data Mining

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ABSTRACT

Data mining is an emerging interdisciplinary field drawing upon database management, artificial intelligence, and statistics. Data mining can discover patterns and relationships among the data that are useful for management and planning. Data mining comes with the risk of revealing strategic patterns when data is shared commercially. Privacy preserving data mining (PPDM) research addresses this concern through the development of techniques to hide the sensitive knowledge patterns which are considered strategically relevant to the owner of the data and result in adverse consequences if disclosed outside of the organization. This research focuses on PPDM when using the association rule data mining method. Association rule data mining, considered one of the most commonly used data mining techniques, finds patterns and relationships between items within a database. Association rule data mining algorithms identify association rules that are strong enough to be considered interesting through the examination of item sets that appear frequently. Association rule data mining process begins with an identification of the frequent item sets within the database. Next, association rules are discovered through an examination of frequent item sets. The application of PPDM to association rule data mining is an area of active research. Sensitive frequent item sets are hidden through the use of a number of techniques that reduce the statistical significance of the item sets without seriously affecting the original data and the nonsensitive rules. The data sanitization process should minimally affect the original database, through the preservation of the general patterns and trends, while concealing sensitive frequent item sets. Quality is indicated by considering how the sanitization process meets three goals. The first goal requires that sensitive rules are not discovered in the sanitized database when the database is mined under the same or higher privacy thresholds as the original database. The second goal requires that non-sensitive rules mined from the original database may also be mined in the sanitized database so there are no lost association rules. The third goal requires that no false rules should be produced when mining the sanitized database at the same or high privacy thresholds. The majority of the methodologies for association rule hiding are of a heuristic nature in order to effectively tackle the combinatorial nature of the problem. Heuristic approaches are algorithms that selectively sanitize a set of transactions from the original database to hide the sensitive association rules. The computational and memory efficiency results of the techniques vary with the database structures. Given the enormous size of databases, the underlying NP-hard problem of hiding sensitive data before sharing so that it scales well to very large dataset is well established. There is active research in improving both the scalability and the quality of the techniques. The purpose of this research is evaluate the performance of privacy preserving data algorithms for association rule data mining by processing the algorithms using the same set of test cases. The test cases will reflect a variety of database structures so as to ascertain both the computational performance and the quality of the results.

Energizing Research into Green Cities through Open Data

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Abstract

In the era of big data, we are told that we are awash with data. While some datasets, such as the twitter firehose, are available to the public and have inspired a significant amount of intellectual work, much of 'big data' remains 'closed' (opposed to being 'open'), proprietary and difficult to access. In contrast to 'closed' data, open data are data that "can be freely used, modified, and shared by anyone for any purpose" (Vetrò et al., 2016). An open and accessible data revolution is underway (Weerakkod et al., 2017), and the value of making data open has been well recognized (see, e.g., Ahmadi Zeleti, Ojo and Curry, 2016; Manyika et al., 2013).

While the open data movement has been mainly pioneered by the public sector (see, e.g., Ruijer, Grimmelikhuijsen and Meijer, 2017), open data can also be from private sources (Manyika et al., 2013). Institutions are motivated to make data open, particularly in the public sector, by societal goals such as improving the transparency and accountability of institutions (Manyika et al., 2013). Open data can be also used to launch commercial and non-profit ventures, do research, make data-driven decisions, and solve complex problems (Australian Government, 2015).

A persistent challenge in research is data collection. It is therefore not surprising that a noted weakness reported in many papers is limitations arising from limited sample size. To address this issue, researchers have attempted to research techniques such as the use of synthetic datasets and reporting confidence intervals for statistical analysis, among other approaches. Given the challenges in data collection, just like a new theory, the release of a new dataset into the public domain can launch an energized burst of research activity. In this respect, this paper looks at the release of one well-known dataset into the public domain – NYC Taxi trip data (Donovan & Work, 2014). This dataset was released by the NYC Taxi and Limousine Commission, which is a charter-mandated New York City agency that aims to ensure that "New Yorkers and visitors to the city have access to taxicabs, car services, and commuter van services that are safe, efficient, sufficiently plentiful, and provide a good passenger experience." (NYC TLC Annual Report, 2016). Our review of research referring to this dataset found that, over a short period of time, it has inspired a significant level of intellectual activity across several different fields of study, including transportation, operations research, networks, visualization, and event analysis.

This case study presents an example of the potential value of making open interesting datasets relating to cities and livability, and is a call for releasing more such datasets into the public arena to foster future research in the areas of the environment, city behavior, smart cities, and livability.

Exploring the Value-based MR Model and the Change of the Role of Dominance in the Modern Servicescape

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The Mehrabian-Russell (MR) model (Mehrabian and Russell, 1974) of environmental influence was developed as a psychological model to depict the stimulus-response relations among environmental settings, emotional states, and behavioral responses. This model has been widely applied, especially in servicescape studies (Bakker, et al., 2014; Donovan, et al., 1994, Foxall and Greenley, 1999; Foxall and Yani-de-Soriano, 2005; Massara, Liu and Melara, 2010). However, the recent development of servicescape settings in businesses seems to be extensively apparent with a tendency toward increasing the dominance engagement of customers, especially when organizations deliberately seek the best practice in order to enhance customer experience. In considering such a shift in marketplaces, this study develops a value-based MR model, in which we stress the relation between environmental stimulus and the creation of customer perceived value (CPV). Simultaneously, we highlight a potential theoretical shift in the MR model whereby the moderating role of dominance in enhancing the effects of pleasure on arousal exists in modern servicescapes.

Environmental psychology has always emphasized that the physical environment has a role in stimulating consumers' responses. Scholarly work suggests that spatial decorations have direct stimulating effects on customers' emotions, staff performance, and interactions between customers and staff (Mehrabian, 1974). In the service industry, Boom and Bitner (1982) highlight the role of intangible cues in servicescapes, and suggest that firms may deliberately implement "tangible cues" to enhance physical environment settings (e.g. lights, air conditioning and temperature, site furnishings, and color tones), in order to "visualize" the intangible cues, and thereby advance the communications with customers for product offerings. Furthermore, Bitner (1992) proposes a theoretical framework for incorporating the behavior responses (of both staff and consumers) to environmental stimuli into the cognitive, emotional and physiologic states.

The application of servicescape theory in the aviation industry is a particularly special one. Kotler (1974) emphasizes that when safety is the basic requirement, the airline's publicity focus shifts to the cabin's servicescape settings. For example, inflight services, such as comfortable seats, entertainment equipment and meals, will largely ease passengers' trepidation, and even make them forget that they are in flight. In addition, the cabin crews are generally rigorously selected (i.e. for manners, attitudes and appearance), and even the design of their uniform should be considered as a radical setting of the inflight servicescape (Kotler, 1974). Currently, especially when facing rapid technological changes, airlines have been using technology to reform inflight entertainment (IFE), such as bigger LCD screens, audio and video on demand (AVOD), USB, WiFi, seat chat, and electronic charging equipment. These inflight settings are all reflective of Mehrabian's (1974) definition of the sense modality variables in a physical environment. That is, passengers' (as customers) emotions are influenced by the servicescape settings, which in turn affect their behavioral responses.

In the environmental psychology field, pleasure, arousal and dominance are conceived as three underlying dimensions of the emotional state that indicate peoples' behavioral responses toward a servicescape (Mehrabian and Russell 1974; Russell 1980). The factors of pleasure and arousal have been perceived as the core effects in the circumplex model of

emotional experience; whereas dominance is generally conceptualized as an autonomous episode reflecting the feeling of control or freedom of choice. However, especially in retail service environments, the investigation of the dominance dimension has often obtained insignificant results in many servicescape empirical studies.

While marketing research often uses consumers' behavioral responses to build the MR model, this study builds the model on the basis of CPV for the service industry. We argue that CPV is a deepening perspective of arousal rooted in consumers' minds. In other words, CPV can be viewed as perception, which leads to consumers' judgment concerning their buying behavior; and which is an intangible cue for the service provider to evaluate whether it properly and correctly delivers its value proposition to the consumers in the servicescape (Payne, Frow and Egger, 2017; Skålén, et al, 2015). Therefore, this study views CPV from a market angle, suggesting that CPV is what a consumer feels regarding a firm's offerings based on her/his experience in the servicescape (Dumond, 2000; John Ramsay, 2005). In our modeling, CPV is thus a causal outcome of the PA dimensions.

Furthermore, this study especially addresses the role of the dominance dimension of PAD in modern servicescapes. In our pre-investigation on dominance and its potential shift in the hospitality industry, dominance is conceptualized as a customer's appraisal process in an emotional episode (where both P and A states are involved), instead of an emotional state of customers. In many service situations, such as IKEA's interactive showroom, customer experience themes and the relevant activities have been suggested as a useful approach to increase product (or service) perceptions. Herein, the need for dominance remains a key to the success of such customer experience. Therefore, dominance should be perceived as a fulcrum on which firms leverage routine efficiency and customer experience in the service process. In this study, we thus propose that dominance demonstrates a moderating role in the relation between pleasure and arousal.

The following is a list of these key propositions which are found and posited relevant to the proposed framework:

Proposition 1: A company's servicescape settings in the service processes specifically for its product offerings will have effects on the emotional states of customers which will in turns lead to customers' perceived value for this company.

Proposition 2: Customers' pleasure and arousal represent the essential emotional states of customers. They will be inspired significantly through the stimuli of a company's servicescape settings with any deliberate tangible and intangible cues for presenting its value propositions.

Proposition 3: Both customers' pleasure and arousal given rise from a company's servicescape settings will have effects on their attitudes by which they build or rebuild their perceived value for this company.

Proposition 4: Customers' pleasure and arousal make themselves a causal relationship, in which pleasure contribute an effect on arousal. This phenomenon will be significant in the service industry, in which the servicescape settings are essentially concerning with the way in which the message of value propositions is transmitted.

Proposition 5: The effect of pleasure on arousal will be greater when a company sets the dominance settings or procedure into its servicescapes. The applications of dominance should consider the balance between processual efficiency of a service process and the stimulating effectiveness of customers' emotional state.

Ethical Actions that Best Serve CSR Goals

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Abstract

The Ethisphere® Institute is the global leader in defining and advancing the standards of ethical business practices that fuel corporate character, marketplace trust, and business success (Ethisphere.com). This organization has been recognizing the world's most ethical companies since 2007. The 2017 list of honorees includes 135 companies from 23 countries and 57 industries. This research project will analyze the 2017 list in order to identify the actions most frequently enacted by these companies as well as from which industries they emerge. The analysis will reveal trends among nominees in the areas of sustainability and CSR. In particular, what are the actions most commonly taken that reflect ethical concerns of organizations? Are these actions more likely to be taken in particular industries? Recommendations for companies that would like to earn this recognition will be developed from these findings.

Impact of economic crisis and leadership on knowledge sharing in SMEs:

Evidence from an exploratory case study in a French sport textile company

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Objective and research work originality

If literature underlines that leadership plays a key role in the issue of knowledge sharing, there are still very few empirical studies devoted specifically to SMEs and even less in a context of economic crisis. Moreover, to our knowledge, there is no study that apprehends the potential combined impact of crisis and leadership on knowledge sharing in SMEs. Thus the aim of this article is to study the dual impact of the economic crisis and leadership on a knowledge sharing issues in a French SME.

Research design / methodology

We conduct an exploratory study as it is relevant given the stakes regarding the performance and even the survival of such organisations. Based on a 5-year longitudinal case study, the data collected come from observation phases and semi-directive interviews with the manager and other stakeholders concerned by the knowledge sharing.

Results

While the economic crisis was clearly a constraining factor for the knowledge sharing project studied in the case, particularly with regard to the question of the resources needed, it also facilitated it in other ways, for example by reinforcing stakeholders' sense of urgency of change and by minimizing certain potentially strong resistances. Leadership was also seen as a critical success factor, with transformational style proving much more relevant than transactional style. Perhaps the most striking result of the case is that it was largely the economic crisis that brought the salutary change in the leadership style of the leader.

Limitations of the research

The knowledge sharing project studied is part of a very specific context of an SME in the sport textile sector which is strongly affected by the economic crisis. Consequently, its generalizability is necessarily limited.

Practical implications

For SME managers and executives, the proactive and combined consideration of the two factors, Economic crisis and leadership, seems essential for the success of a knowledge sharing issue within an SME.

Keywords: Knowledge sharing, SME, Economic crisis, Leadership, Case study.

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Decision-making: Water for Sustainability of Urban Areas

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Abstract

Sustainability for urban areas is, in part, attributable to a safe and dependable water supply. Extended drought in South Africa makes this apparent for Cape Town. In southwestern United States, the Phoenix metropolitan area provides an example of efforts for a sustainable water supply. Decisions require consideration of land use planning, water conservation and reuse as well as management of alternative water sources. The framework for decision-making and the economic-political processes are keys to the solution for sustainable water supplies for urban area.

Navigating European Union 2020 Strategic Plan: A Pilot Project in Entrepreneurial Learning-based for Future High Performance Start-up Teams

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ABSTRACT

According to the European Commission, to enhance the economic growth and to add new jobs, European Union (EU) needs more entrepreneurs (http://ec.europa.eu/growth/smes/promotingentrepreneurship/action-plan/, 2017).

The focus on the entrepreneurship has been a reaction to the past fifty years of economic downturn and high unemployment rates in several EU countries. As a result, the EU Commission has developed the "Entrepreneurship 2020 Action Plan" to ease the barriers to opening new businesses, to encourage an entrepreneurship culture across the EU countries, and to create a business environment that is conducive to entrepreneurial activities.

Building (1) on the idea of the university is a key player in a local entrepreneurship ecosystem and (2) following Wang & Chug (2014) theoretical reasoning specifically in the context of startup firms, this article examines the ways that academia can play a vital role in creation of knowledge, expertise, and training that are essential in achieving some of the goals of the European Commission "Entrepreneurship 2020 Action Plan".

Keywords:
Experiential learning, Virtual, Simulation, Authentic learning, Entrepreneurial competencies, Entrepreneurship education and training, Entrepreneurship Ecosystem.

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The Gathering Storm: Trump's Tariffs and Their Impact on the US Economy

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ABSTRACT

The purpose of this paper is to analyze the impact of the adoption of protectionist tariffs (steel, aluminum) by the United States on trade between its major trading partners. The literature on protectionist tariffs has argued that there are benefits and costs for those countries adopting this policy. The risks from following this course of action are the uncertainties associated with impact on the US trade and exchange rate as well as retaliation from the affected countries

INTRODUCTION

On March 8th, 2018, President Trump imposed new trade tariffs on steel and aluminum. This could have major effects on industries tied into these resources and the economy as a whole. Car and auto parts manufacturers in the Southern United States rely on these resources imported into the Port of Charleston, South Carolina. Increasing tariffs on steel and aluminum, a key part in automobile manufacturing, will result in higher costs for consumers. Not only could this make cars and auto parts more expensive, but it could hurt the job market as well. Manufacturers paying more for raw materials will need to save money elsewhere, that being labor. There is also potential for car manufacturers to continue to move outside of the U.S. in an effort to avoid the higher cost of goods due to the new tariffs and keep the cost of employees' wages down.

Another consequence of these new tariffs will be retaliation from trade partners of the United States. Perhaps countries affected by steel and aluminum tariffs in the U.S. will impose tariffs on goods they import from the U.S

PURPOSE

The purpose of this paper is to analyze the impact of the adoption of protectionist trade by the United States on trade between its major trading partners, as well as the impact on the US economy. We will examine whether our analysis supports prevailing views that the proposed increase in tariffs will be highly disruptive to the US and its neighbors. As these have been recent actions, we expect to provide the preliminary results of our analysis at the conference.

WINNERS AND LOSERS

According to Hofshire et al (2018) the biggest losers would most likely be export oriented economies. Those countries highly dependent on exports for growth. See table below:
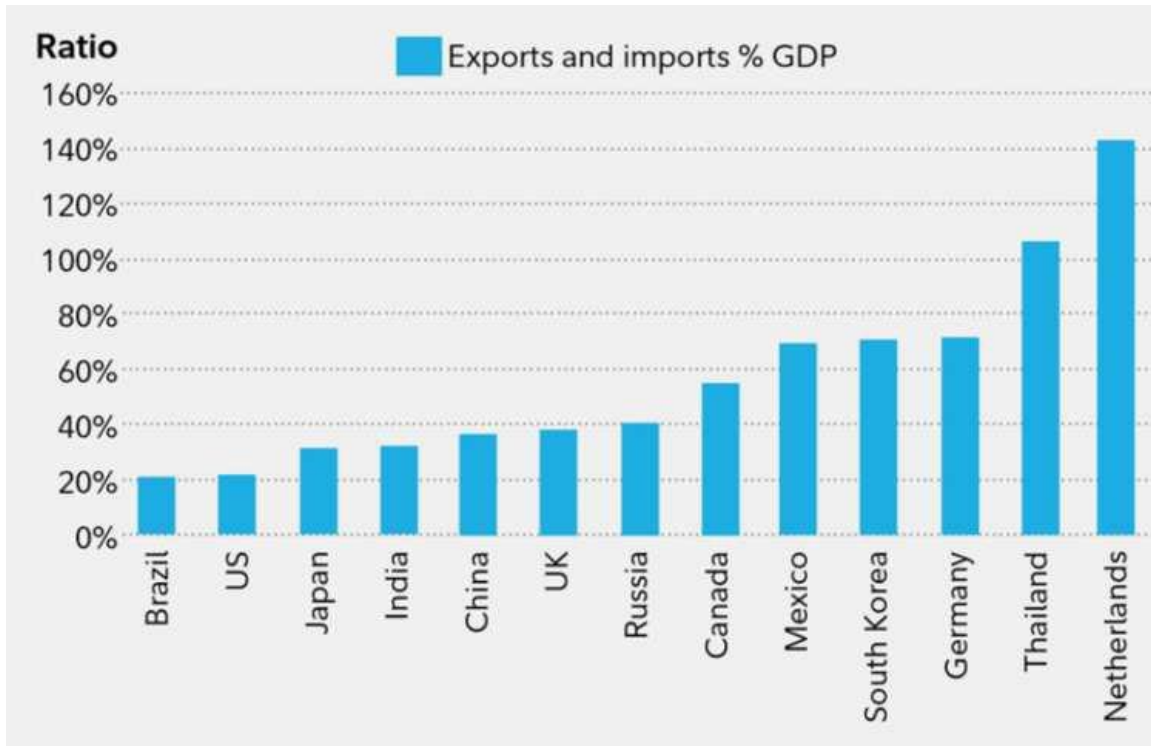
Source: World Bank, Haver Analytics, Fidelity Investments (AART), as of December 31, 2015.

In addition to export oriented countries being affected, certain US industries could also be significantly affected. The table below shows that those industries more exposed to international trade would most likely be significantly affected. Based on the table below, it can be seen that the utility and financial sectors earn the bulk of their revenues domestically (80-90%). On the other hand in the US information technology sector that number is around 50%. Hence utilities and financials will less impacted by tariffs.(Holfschire, et al. 2018).
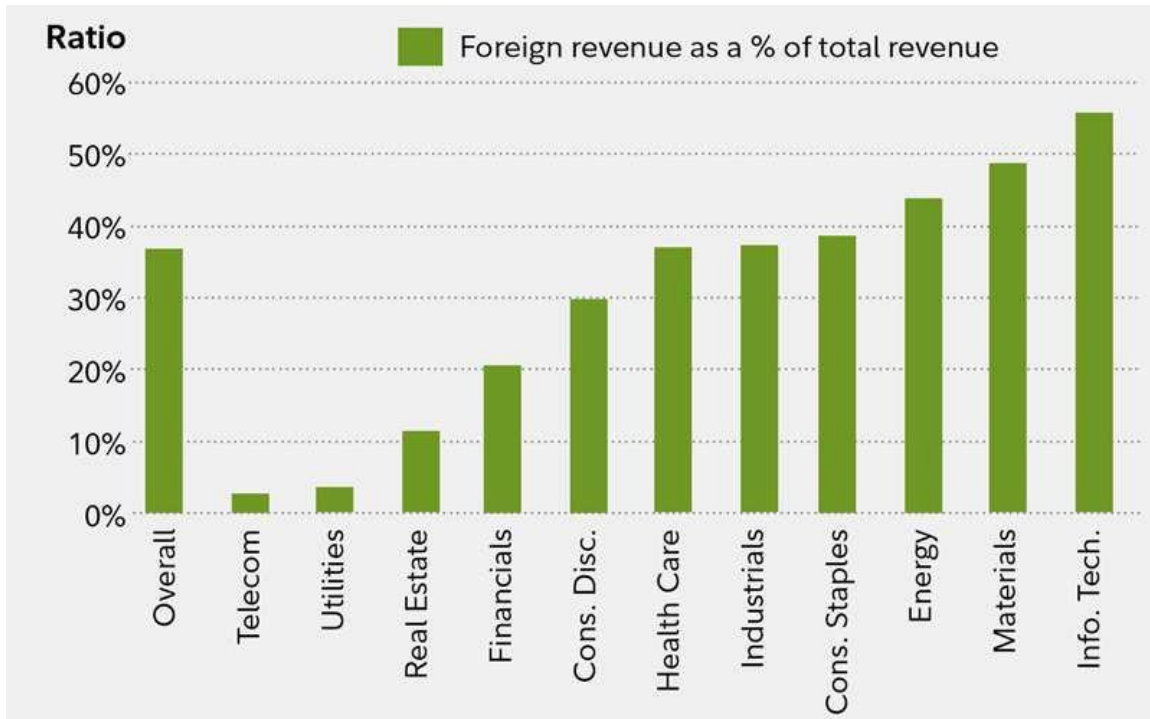
Source: S&P 500 company data. Sectors as defined by the Global Industry Classification Standard (GICS®); see additional information in the appendix. Source: FactSet, Fidelity Investments (AART), as of December 31, 2015.

SUMMARY

At the time of this writing, the events on tariffs are still unraveling. It is expected that at the time of the conference, we will have more concrete evidence as to the negative impact of these actions which may result in a serious trade war**.**

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Open Innovation Laboratory for Our Future Buildings: The Sustainable Vision of Elithis

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Mr. Johann Bourgoin - ICN Business School

Abstract

The concept of Smart City embraces several definitions depending on the meanings of the word "smart": intelligent city, knowledge city, ubiquitous city, sustainable city, digital city, etc. Many definitions of Smart City exist, but no one has been universally acknowledged yet. From literature analysis, it emerges that Smart City and Digital City are the most used terminologies in literature to indicate the smartness of a city (Cocchia, 2014). "Green City follows the Green Growth which is a new paradigm that promotes economic development while reducing greenhouse gas emissions and pollution, minimizing waste and inefficient use of natural resources and maintaining biodiversity" (OECD, 2010). Our paper focuses on the concept of sustainable city which includes the definition of green cities and the pillar of social inclusion. The understanding of sustainable cities by Elithis is that *"motivation, desire generates the energy which creates life"* (quote from Elithis CEO). The city is not only the place where we live but also where all energies concentrate for the development of human life. The vision of the company and his CEO is that a building is not only a technical project but should be thought in the ecosystem, understood here as a biotope habitat. (The idea is not to build …)

The research question of the case study is to analyze how the company Elithis looks for continuous development of open innovation techniques to answer the very pragmatic question how life settles in a tower. The case is divided into three sub-cases, which are based on a realized project (I-), another project under development (II-) and a study about future desires (III-). The first case shows a project of development of an "educative tower", where sensors give information so that consumers become responsible for their actions (collect, inform, propose). In addition to that, the tower is thought to be coherent within its environment and accepted by inhabitants. The second case enhances the ideas of the first tower. From an education point of view, the idea is to use different types of wood essence for different purposes to re-connect people to the benefits of wood. Moreover, the concept goes far beyond the traditional acceptation by citizens. In fact, we will show through the paper that the methodology which has been used to co-create the tower and how the ecosystem of the city will be reproduced in small version in the tower.

The third case will present an ongoing study on how to capture dreams and desires of Housing in 2050. The objective is to build the shapes and usages of tomorrow. When we face such a question, most techniques use prospective quantitative and qualitative studies, with questions about dreams. Methodologically speaking, it generates two issues: the first one is that people might not be aware of their dreams and that it takes several steps to be able to express dreams and desires. The second difficulty is that even for prospective studies 2050 from now is a long time. The paper will show how several methodologies from different areas are combined to enrich an exploratory research applied to different generations.

Student-driven Financial Modeling for New Business Ventures

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Abstract

The Gabelli School of Business (GSB), at Roger Williams University (RWU), Bristol, Rhode Island, United Sates, requires all of its business majors, in their first or freshman year to complete *BUSN100: Enterprise.* The course introduces students to the major business disciplines e.g. accounting, finance, marketing, management, and economics that they will pursue throughout their undergraduate studies. Perhaps more important *Enterprise*, utilizing and integrating business tools, applies and focuses analysis on the principles and factors that separate successful and financially sustainable businesses from those that struggle, forcing reinvention or decline.

A course requirement in *Enterprise* is the preparation of new venture Business Plan with full financials, including all assumptions. Freshmen, having little or no Accounting or Finance training, often struggle with understanding the principles and process of Business Plan financial planning. The purpose of this project, and resulting paper, was to develop a simple yet complete and accurate model for instructors and students to use together to prepare new venture financials.

A fundamental concept behind the project was to enlist a team of three upper division GSB Accounting students to develop a fully integrated set of Excel financial templates and complete instructions on how to use the Excel templates - for both instructors and students. This approach allows instructors and students to reduce the cumbersome and time-consuming calculations and frees up class and discussion time to focus on the "meaning" and "use" of basic financial statements supporting a Business Plan. The project and this paper were funded by an RWU Office of Advancement and Learning Open Educational Resource (OER) Fellow grant to the primary author and his student team in the 2017-2018 academic year.

SUCCESS IN TEACHING NEGOTIATION TO AN INTERNATIONAL GROUP OF STUDENTS

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ABSTRACT

Teaching a negotiation course to an international group of business students encompasses several components that truly mirrors the real-life environment. Different cultural and educational backgrounds and diversity of personalities and predispositions in approaching a contract negotiation are all components of real-life negotiation process.

Through step-by step instructions, exercises, and debates, we can build skills and enhance training with the potentials of creating a team that can deliver a successful negotiation. Discarding predispositions and harmonization of cultural differences and personalities are the first step in creating an effective negotiation team. Building congruency along the diverse cultural backgrounds and taking advantage of educational differences of the team members further enhance the skills needed for any productive negotiation.

This study explores how we can teach negotiation to a diverse group of students, students from different countries. The research sets forth different steps that are essential in teaching how to negotiate when negotiation parties are from different countries. In the first step, we need to direct students to discard any existing perception regarding how to approach a negotiation scenario. In order to achieve this goal, students are given a particular scenario for negotiation. They are then directed to develop objective criteria separate from their personal positions in order to engage in negotiation for the given scenario. All developed objectives are collected and shared with the entire class. Through in-depth discussions, students score the objectives (best to worst) relevant to their effectiveness in achieving consensus for a successful negotiation.

The outcome of this part of the course is to ensure students could recognize that their personal positions would not necessarily be the best remedy for achieving success in negotiations. By setting aside personal positions during negotiation sessions and developing objectives that are acceptable and of mutual interests to all parties involved, the team could pave the way for a successful negotiation.

In the second part of the course, students are introduced to different negotiation models (e.g., Coltri, L., 2004; Moran, R., Stripp, T., & William, G., 1991; Raiffa, H., 1982) and diverse negotiation scenarios. In this part of the course, students are grouped into teams in two stages. In the first stage, students of similar cultural background/county are put in a team. Real-life negotiation and simulation cases with diverse array of variables are used in this part of the course. Student teams are directed to study each case and relate it to a studied negotiation model. Then, each team is required to apply the learned knowledge to develop a new negotiation contract. The developed contract by each team is then examined in relation to the financial

go through the same exercise. The results of the negotiation exercises are shared and discussed with the entire class.

The goals of this part of the course are to demonstrate that even the teams with similar cultural/country background encounter difficulty in developing a homogenous negotiation strategy. Such difficulty manifests itself much stronger when a team is made up from people of different countries. For example, Peugeot PSA Group (a French corporation) acquired Opel (a Germany branch of General Motors). Thus, a negotiation team from this merged corporation will have people of different cultural/country backgrounds. Regardless of their cultural/country background, this team needs to negotiate in a uniform manner for the benefit of the Peugeot PSA Group.

Major obstacles in developing a mutually agreed upon and effective negotiated contract are due to different cultural, educational, and professional experiences of the negotiation teams. Such obstacles manifest themselves in a much serious manner in real-life environment when parties from different countries are at the negotiation table. Consequently, a main component of this course deals with incorporation of cultural and educational differences of the negotiation team members into international business negotiation process (e.g., Deloffre, G., 2009).

In the final part of the course, students are trained to recognize that a unified strategy in negotiating a contract is of the utmost importance to the survival and success of the company. As a result, training is heavily focused on enhancing cultural harmonization and taking advantage of educational diversity within a team. In addition, students are guided to set aside individual dimensions of cultural differences and take advantage of educational diversity of the team to evaluate different options (e.g., Radtchenko-Draillard, S, 2003; Semnani-Azad, J.,2015).

One of the examples given in this part of course is about a company's team made up of operations and finance employees. The contentious issue among the team members is over buying extra options as part of the contract. The operations management team members prefer purchasing these options for technical safety while the team members from the finance department are against it due to higher financial burden. Some student teams decide to buy the options while some other teams decide against it. These decisions are then dissected as to which decision would have been the best strategy and the least risky for the company.

The focus of this part of the course is to take advantage of different educational backgrounds in risk assessment and at the same time trying to harmonize the cultural differences while going through a negotiation process (e.g., Thompson, L. 2001, 2003; Wheeler, M. 2006).

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