

Evolving Human and Organizational Practices in the Intelligent Age

Proceedings of the 2020 Conf-IRM Conference

Virtual Symposium hosted by



Editors:

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ISBN 978-0-473-52544-6

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Welcome from the Conference Co-Chairs

COVID-19 has presented both challenges and opportunities for conferences such as the International Conference on Information Resources Management (Conf-IRM). The fact that we are not able to meet in person this year is both challenging and disappointing. Conf-IRM, an affiliated conference of the Association for Information Systems (AIS), is known to be an inclusive, collaborative, and friendly environment where colleagues from around the world meet each other to share research ideas as well as build personal relationships. That face-to-face dynamic will be missing this year. As with everything COVID-19, we have had to pivot to new ways of doing conferences. Thanks to available technology we can deliver an abbreviated conference online. As we have found with teaching, new opportunities for connecting and communicating are available in the online environment. So, while we cannot all be in Miami this year, we are afforded the opportunity to visit each participant in their own setting.

Conf-IRM is a venue for developing emerging scholars from every region of the world. We take great pride in seeing scholars who began their journey at one of our conferences go on to excel in the many ways they have. This is the 13th year for the conference. It builds on the traditions (with a twist) of previous conferences held in Canada, United Arab Emirates, Jamaica, South Korea, Austria, Brazil, Vietnam, Canada, South Africa, Chile, China, and New Zealand. While this year's conference will be in an online format, we have endeavored to put together a program that is substantive and meaningful. We wish that the two afternoons (Miami time) spent together will be both inspiring and rewarding for each participant. Although we will not have the usual opportunity to socialize in person, we hope you will be able to make beneficial and lasting contacts in our virtual meetups. Have a great time!

Karlene Cousins, Florida International University,
USA Gerald Grant, Carleton University, Canada

Message from the Program Co-Chairs

Welcome to the 2020 International Conference on Information Resources Management (Conf-IRM). Although many things have changed with COVID-19, we are pleased to have the opportunity through Conf-IRM 2020 to bring to you a programme featuring a range of technical, managerial, social and behavioural aspects of Information Systems, as well as a forum for one another to still meet and share with colleagues around the world.

In keeping with the international reach of Conf-IRM, we received submissions from across 20 countries this year. Each submission underwent a rigorous double-blind review process that included peer-evaluation by at least two reviewers, assessment by the conference track chairs, and quality assurance of the revised submissions. The final programme covers a range of Information Systems research topics and problems. Conf-IRM 2020 included over 170 authors and reviewers, alongside a dedicated conference committee. On behalf of the 2020 Conference Committee, we thank all our authors for their submissions. We also extend our sincere thanks and appreciation to the track chairs in addition to colleagues who served as reviewers. Especially for the time they have spent and the valuable contributions they have made to ensure the success of the conference. Indeed, our sincere thanks to everyone involved and particularly at this time given the challenges many face both personally and professionally – thank you!

Finally, we welcome you to our online symposium. We hope you enjoy Conf-IRM 2020, and we look forward to the opportunity to meet during the conference.

Annette Mills, University of Canterbury, New Zealand
Richard Klein, Florida International University

Conference Steering Committee

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- **Gerald Grant**, Carleton University, Canada

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- **Sherif Kamel**, The American University of Cairo, Egypt
- **Jairo Gutierrez**, Auckland University of Technology, New Zealand

Keynote Speakers

Michael A. Garcia

Michael A. Garcia is the vice president and chief information officer of Jackson Health System, one of the largest public health systems in the United States.

Prior to being named the chief information officer in 2012, Mr. Garcia was the corporate director of information services for Jackson Health System and previously worked at the University of Miami Miller School Of Medicine.

Mr. Garcia is a strategic, innovative thinker whose vision brings a unique blend of healthcare knowledge, information technology, and business acumen. He has more than 20 years of experience working with large complex healthcare organizations specializing in IT healthcare informatics, diagnostic imaging, health information management, and revenue cycle management.

He is well versed in establishing governance, policies and platforms for technology to facilitate collaboration between the business side of operations and the technical side. He has a proven record in successfully executing enterprise-wide clinical and financial information systems implementations. In addition to holding numerous professional and technical certifications, Mr. Garcia received his undergraduate and Master's of Science in Management Information Systems degrees from Florida International University's Chapman School of Business.

Michael will speak on AI in health care and initiatives and lessons learned in his role as a health care pandemic CIO in the COVID-19 era.

M. Lynne Markus

M. Lynne Markus is the John W. Poduska, Sr. Professor of Information and Process Management at Bentley

University and an associated researcher at MIT's Center for Information Systems Research. She has published extensively in the areas of digital business and interorganizational governance, enterprise systems and business processes, electronic communication and knowledge reuse, and organizational change management.

Her current research interests include digital innovation in the financial and health sectors, the responsible use of data and algorithms, and the changing nature of work. Markus was named a Fellow of the Association for Information Systems in 2004 and received the AIS LEO Award for Exceptional Lifetime Achievement in Information Systems in 2008.

Track & track chairs

Track01 - Big Data, Data Analytics, and Business Intelligence

- Dr. Monica Tremblay - College of William and Mary
- Prof. Kweku-Muata Osei-Bryson - Virginia Commonwealth University
- Prof. Norman Johnson - University of Houston

Track02 - Enterprise Systems & Knowledge Management

- Dr. Weidong Xia - Florida International University
- Mr. Kevin Gallagher - Cleveland State University

Track03 - Digital Services, Management & Governance

- Dr. Daphne Simmonds - University of South Florida
- Dr. Jyoti Choudrie - University of Hertfordshire
- Prof. Edward Bernroider - Vienna University of Economics and Business

Track04 - Information Security, Privacy, and Risk Management

- Dr. Lech Janczewski - University of Auckland
- Yan Chen - Florida International University

Track05 - Intelligent and Digital Information Systems in the Public Sector, Telecommunications, Transport and Education

- Dr. Marie Anne Macadar - COPPEAD/The Federal University of Rio de Janeiro
- Prof. Retha de la Harpe Cape - Peninsula University of Technology

Track06 - Intelligent and Digital Health Care Systems

- Dr. Lina Bouayad - Florida International University
- Dr. Pouyan Esmaeil Zadeh - Florida International University

Track07 - Digital Information Systems for Development and Inclusion

- Dr. Arlene Bailey - University of the West Indies, Mona
- Dr. G. Harindranath - Royal Holloway, University of London
- Mrs. Maria Alexandra Cunha - Fundação Getulio Vargas

Track08 - Digital Transformation, Entrepreneurship and Innovation

- Dr. Sanjay Mathrani - Massey University
- Dr. Sonja Wiley - Louisiana State University
- Dr. Peter Polak - Florida International University

Track09 - Digital Business Platforms, Blockchain, Social Networking, and the

Internet of Things

- Dr. Eusebio Scornavacca - University of Baltimore
- Hemang Subramanian - Florida International University
- Mr. Shaobo Ji - Carleton University

Track 10 - Intelligent and Digital Information Systems in Latin American & the Caribbean

Dr. Gunjan Mansingh - The University of the West Indies
Manjul Gupta - Florida International University
Dr. Ariel La Paz - Universidad de Chile

Track 11 - Designing Intelligent and Digital Systems

- Dr. Debra Van der Meer - Florida International University
- Dr. Hamid GholamHosseini - Auckland University of Technology
- Prof. Kaushik Dutta - University of South Florida

Track 12 - Workshops, Tutorials, and Panels

- Prof. Jairo Gutierrez - Auckland University of Technology
- Prof. Felix B. Tan - Auckland University of Technology

Doctoral Consortium

- George Marakas - Florida International University
- Miguel Aguire-Urreta - Florida International University

Conference schedule

Thursday, May 28

- 1:00- 2:00 p.m. [Welcome and Keynote Presentation](#)
Keynote Speaker: Professor M. Lynne Markus (Bentley University)
- 2:00- 3:30 p.m. Session 1A: Big Data, Data Analytics, and Business Intelligence (Track 1)
- P04: Big Data Evaluation Scorecard**
Anthony Koomson (University of Ghana, Ghana); Richard Boateng, Eric Afful-Dadzie and Acheampong Owusu (University of Ghana Business School, Ghana)
- P30: Use of Network Analysis Technique for Prioritizing Project Portfolio: A Case Study**
Gretta Carenine Paes Amorim Araújo and Claudio Luis Carvalho Larieira (EAESP/FGV, Brazil); Eduardo de Rezende Francisco (FGV EAESP, Brazil)
- P20: Integrated Management of Energy Consumption and Animal Welfare in the Milk Production Industry using Machine Learning**
Leonardo Santiago Benitez Pereira (Federal Institute of Santa Catarina, Brazil); Rafael Rodrigues (Instituto Federal de Santa Catarina, Brazil); Olli Koskela, Iivari Kunttu and Joni Kukkamäki (Häme University of Applied Sciences, Finland); Edison A. C. Aranha, Neto (Federal Institute of Santa Catarina, Brazil)
- Session 1B: Digital Transformation, Entrepreneurship and Innovation (Track 8)
- P15: Growing in the Digital Economy: The Case of a Digital Enterprise in a Developing Country**
Eric Ansong (University of Ghana, Ghana); Richard Boateng (University of Ghana Business School, Ghana)
- P10: Digital Entrepreneurship and Institutional Changes: Fintechs in the Brazilian Mobile Payment System**
Gabriel M Braidó (University of Vale do Taquari - Univates, Brazil); Amarolinda Klein (UNISINOS, Brazil)
- P25: Problems Associated with Older Adults' Adoption of Robo Advisors: An Empirical Study**
Shangjun Wang (Florida International University, USA)
- Session 1C: Intelligent and Digital Health Care Systems (Track 6) & Intelligent and Digital Information Systems in Latin American, the Caribbean (Track 10)
- P09: Designing Social Networking Mobile App for Diabetes Management**

Md Rakibul Hoque (Emporia State University, USA); Wahiduzzaman Khan (Leading University, Shylet, Bangladesh); Mohammad Zahedul Alam (Bangladesh University of Professionals, Bangladesh); Golam Sorwar (Southern Cross University, Australia); Md Hasan (Bhalo Achi Healthcare and Research Ltd., Bangladesh)

P31: The Effect of e-Filing on Tax Compliance among Micro Enterprises in Jamaica

Genee Tracey, Steven Rob and Lisandra Bartley (The University of the West Indies, Jamaica); Delroy Chevers (The University of the West Indies, Mona Campus, Jamaica)

P19: Innovation Capabilities and the Role of Strategic Intelligence

Fernanda M. Reichert, Raquel Janissek-Muniz, Mariana Heinze, Amanda S. Cainelli and Paulo A. Zawislak (Federal University of Rio Grande do Sul, Brazil)

4:00 - 5:45 p.m.

Session 2A: Information Security, Privacy, and Risk Management (Track 4, Part 1)

P07: Could Cyber-conflict be Avoided? Exploring Deterrence in Low and High Stakes Information Security Interactions

Carlos Parra (FIU, USA); Hemang Subramanian (Florida International University, USA); Suresh Malladi (Cybersecurity Researcher & Consultant, USA)

P28: Tailoring the Cyber Security Framework: How to Overcome the Complexities of Secure Live Virtual Machine Migration in Cloud Computing

Hanif Deylami, Jairo A Gutierrez and Roopak Sinha (Auckland University of Technology, New Zealand)

Session 2B: Intelligent and Digital Information Systems in the Public Sector & Health Care (Tracks 5 & 6)

:

P22: Manipulation of Online Reviews: Analysis of Negative Reviews for Healthcare Providers

Sojen Pradhan (University of Technology Sydney, Australia); Elina Amatya (eHealth NSW, Australia); Yijun Ma (IKEA, Australia)

P24: Open Government Data initiatives: Open by Default or Publishing with Purpose

Novy N.R.A. Mokobombang, Jairo A Gutierrez and Krassie Petrova (Auckland University of Technology, New Zealand)

P32: Who Should I Approach? Knowledge Sourcing in Enterprise System Implementation

Sharath Sasidharan (Bowling Green State University, USA); Bethany Niese (University of North Georgia, USA)

Session 2C: Digital Business Platforms, Blockchain, Social Networking, and the Internet of Things (Track 9)

P03: Achieving Organizational Agility through Application Programming Interfaces: The Effect of Dynamic Capability and Institutional Forces

Joshua Ofoeda (University of Professional Studies, Accra, Ghana); Richard Boateng (University of Ghana Business School, Ghana); John Effah (University of Ghana, Ghana)

P02: A Utility Theory Model for Individual Adoption of Bitcoin

Pouyan Esmailzadeh, Hemang Subramanian and Karlene Cousins (Florida International University, USA)

P01: A Framework for IoT-based Products and Services Value Proposition

Graziela Molling (UNISINOS University, Brazil); Amarolinda Klein (UNISINOS, Brazil)

5:45 – 6:30 p.m. Virtual Reception- BYOD

End of Day

Friday, May 29, 2020

- 1:00- 2:25 p.m. Welcome and Keynote Presentation
Keynote Speaker: Michael Garcia, CIO & Vice President, Information Technology, Jackson Health System
- 2:45 -3:45 p.m. Panel Discussion
Moderator: Guillermo Rodríguez Abitia (Universidad Nacional Autónoma de México, Mexico);
Panelists:
George M Marakas (Florida International University, USA)
Fred Niederman (Saint Louis University, USA)
Monica Tremblay (William and Mary, USA)
- 4:15 - 5:45 p.m. Session 3A: Intelligent and Digital Information Systems in Latin American & the Caribbean (Track 10, Portuguese)
- P17: Identificando as Competências Informacionais e o Potencial das TIC no âmbito da vulnerabilidade social: um estudo em Associação de Material Reciclável no Brasil**
Ana Carolina Silva and Taiane Ritta Coelho (Federal University of Parana, Brazil); Marcia Cassitas Hino (Positivo University & Fundação Getulio Vargas, Brazil)
- P05: Cocriação no desenvolvimento de sistemas de informação: O caso do software de gestão de processos eletrônicos de uma universidade federal brasileira**
Adrienne Andrade (Universidade Federal do Rio Grande do Norte, Brazil); Anátalia Ramos (UFRN, Brazil)
- P12: Elementos que afetam o desenvolvimento de Fintechs de Pagamentos Móveis: um estudo de caso no Contexto Brasileiro**

Gabriel M Braido (University of Vale do Taquari - Univates, Brazil);
Amarolinda Klein and Guilherme Papaléo (UNISINOS, Brazil)

Session 3B: Enterprise Systems & Knowledge Management (Track 2)

P06: Communities of Practice: Role of Shared Vision, Shared Goals and Accountability as Knowledge Transfer Enablers

Oluwatosin Araba and Kevin Gallagher (Cleveland State University, USA)

P33: Using Knowledge Management to Strengthen Information Security Policy Development in Developing Countries: Case - Jamaica

Nadine Barrett Maitland (University of The West Indies Mona & University of Technology Jamaica, Jamaica); Kweku-Muata Osei-Bryson (Virginia Commonwealth University, USA); Gunjan Mansingh (The University of the West Indies, Jamaica)

P13: Enterprise System Implementation: A Multimodal Approach to Social Network Knowledge Transfer

Sharath Sasidharan (Bowling Green State University, USA); Bethany Niese (University of North Georgia, USA)

Session 3C: Information Security, Privacy, and Risk Management (Track 4, Part 2)

P08: Cyberhate: Profiling of Potential Targets

Malcolm Garbutt, Jacques Ophoff and Manqola Tshidi (University of Cape Town, South Africa)

P26: Self-Serving Bias in Machine Learning and Artificial Intelligence Systems: A Case of Phishing Website Detection System

Yan Chen (Florida International University, USA)

P18: Impact of Security Awareness on Smartphone Security

Annette Mills, Yilun Huang, Xuan (Jade) Chen, Haolin Ding and Xiaohui Li (University of Canterbury, New Zealand)

Session 3D: Digital Information Systems for Development and Inclusion (Track 7)

P27: Solutions to Increase Mobile Merchant Payment Applications Value, Customers' Continued Intention to Use, and Loyalty

Karlene Cousins, Pouyan Esmailzadeh and Shangjun Wang (Florida International University, USA)

P23: Mobile Money and Financial Inclusion for the Unbanked - A Choice Analysis

Batloung Hlabeli, Pitso Tsibolane and Malcolm Garbutt (University of Cape Town, South Africa)

P11: Digital-by-Default: Exclusion Through Digital Public Service Channel

Javiera Fernanda Medina Macaya (Fundação Getulio Vargas & Regional Center for Studies on the Development of the Information Society Ceticbr NICbr, Brazil); André Francisco Alves (EAESP/FGV, Brazil); João Porto de

Albuquerque (University of Warwick, United Kingdom (Great Britain));
Maria Alexandra Cunha (Fundação Getulio Vargas, Brazil)

6:15 – 7:00 p.m.

Closing Remarks and Close of Conference

Conference papers

Paper locations:

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2	29	12	163	25	293
3	43	13	177	26	301
4	50	15	185	27	308
5	65	17	203	28	323
6	79	18	217	30	337
7	92	19	226	31	352
8	107	20	243	32	365
9	121	22	260	33	374
10	136	23	269		

P01: A Framework for IoT-based Products and Services Value Proposition

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Abstract

The Internet of Things (IoT) has the potential to help firms to innovate and to address new business opportunities. However, many companies face difficulties in developing value propositions for products and services based on this technology. Considering this, we aimed to answer the following research question: which elements need to be considered to develop value propositions for IoT-based products and services? We used the Design Science Research (DSR) method to answer this question through the creation and testing of a specific framework to support the development of this type of value proposition. The framework was evaluated by 31 academic experts and practitioners and applied to two real businesses. It considers critical elements related to the value proposition and the relations between the main architecture layers of the IoT (including capabilities and challenges), the different types of values that can be generated for different actors, as well as the strategic positioning of IoT-based products and services.

Keywords: Internet of Things, Value Proposition, Design Science Research.

1. Introduction

The Internet of Things (IoT) integrates the physical and the digital dimensions, and generates new business opportunities for organizations to leverage this technology and develop innovative products and services through the combination of sensors, ubiquitous connectivity, data, and analytics (De Cremer, Nguyen, & Simkin, 2017; Fleisch, Weinberger, & Wortmann, 2014). However, its adoption is still slow, requiring more proof of concept (Gartner, 2018). IoT presents several challenges that impact its widespread adoption (Hsu & Lin, 2018), such as security, privacy, storage, and use of data, the lack of usefulness of an intelligent object, among others. These challenges should be considered by organizations (Mani & Chouk, 2018).

The IoT can be used to create new business, products, and services, but requires new value propositions (Mani & Chouk, 2018). The value proposition is the presentation of the organization's products and services, identifying the values that they generate and for whom they are generated, being a fundamental factor in the adoption and intention to use IoT-based products and services (Hsu & Lin, 2018). Companies face a significant challenge to understand the potential and limitations of the IoT to generate

appropriate value propositions.

In this sense, we assume that specific elements need to be considered to develop the value proposition for IoT-based products and services. Existing frameworks for value proposition are very generic (Bocken, Short, Rana, & Evans, 2013), lack empirical application due to their complexity (Den Ouden, 2012), focus only on the customer (Osterwalder, Pigneur, Smith, Bernarda, & Papadakos, 2014; Rintamäki, Kuusela, & Mitronen, 2007), or focus only on the strategy positioning (Anderson, Narus, & Van Rossum, 2006). There is a lack of studies in the literature proposing specific frameworks or models to support the value proposition for IoT-based products and services. Some references suggest using the Value Proposition Canvas from Osterwalder et al. (2014) or the Anderson et al. (2006) model, which have the limitations mentioned.

Therefore, this research aims to answer the following research question: *which elements need to be considered to develop value propositions for IoT-based products and services?* We used the Design Science Research (DSR) method to answer this question through the creation and testing of a specific framework (the artifact of the DSR) to support the development of this type of value proposition.

We developed the framework through a systematic literature review and the application of the Delphi technique with 52 IoT experts and the evaluation by: 25 of these experts; in a workshop with four academic experts; applied in two companies with real IoT-based products; and passed through a final analytical evaluation with two practitioners. The generated framework, called Value 4.0, is multidimensional and allows analyzing the IoT-based product and services considering several elements, distributed in three dimensions (*Actors, Perspective, Strategy*) and associated to a fourth one, specifically related to the IoT, encompassing the five IoT architecture layers (as proposed by Fleisch et al. (2014)), considering both the unique IoT capabilities that can transform traditional products into smart, connected devices, providing new types of services of aggregate value. Next sections, we presented this study.

2. Internet of Things (IoT)

The IoT aims to make traditional objects intelligent, enabling them to interact with each other or with people, seeing, hearing, “thinking” and performing tasks, share information and coordinate decisions across technologies such as devices, sensors, the Internet and applications (Al-Fuqaha, Guizani, Mohammadi, Aledhari, & Ayyash, 2015). In the IoT, objects are equipped with identification, localization, communication, and the capabilities of sensing, actuating, adapting to rules, connecting to networks, and processing data (Al-Fuqaha et al., 2015; Lin et al., 2017). These capabilities enable objects to communicate with each other and with other devices and services over the Internet, allowing them to be located, identified, and operated to achieve a specific purpose (van Deursen & Mossberger, 2018).

To enable these capabilities, the IoT architecture involves several technology layers. Most references in the literature indicate at least three main layers (application, network, and perception). In contrast,

others indicate more layers (service, middleware, business, among others) with different names and divisions (Al-Fuqaha et al., 2015; Da Xu, He, & Li, 2014; Hammoudi, Aliouat, & Harous, 2018). Despite the importance of these layers for the IoT functioning, Fleisch et al. (2014) indicate that an IoT-based product or service is not only composed of technology layers. The integration process between the physical and the digital layers is where new values are created, as demonstrated in Figure 1.

IoT-based products and services depend on integrating all these layers to enable IoT capabilities (Fleisch et al., 2014) and applications, covering the most diverse areas and businesses. However, despite the capabilities and potentials of the IoT, it is still in an early stage of adoption, and it is necessary to overcome a set of barriers and challenges for its usage (Da Xu et al., 2014). The main challenges for IoT adoption include costs, hardware size and weight, power consumption, standardization, interoperability, availability, reliability, performance, scalability, size and storage (big data), security and privacy issues (Al-Fuqaha et al., 2015; Alioto & Shahghasemi, 2018; Hammoudi et al., 2018; Mani & Chouk, 2017). Many of these challenges were discussed by Atzori, Iera, and Morabito (2010) and continue to be presented in the most recent literature.

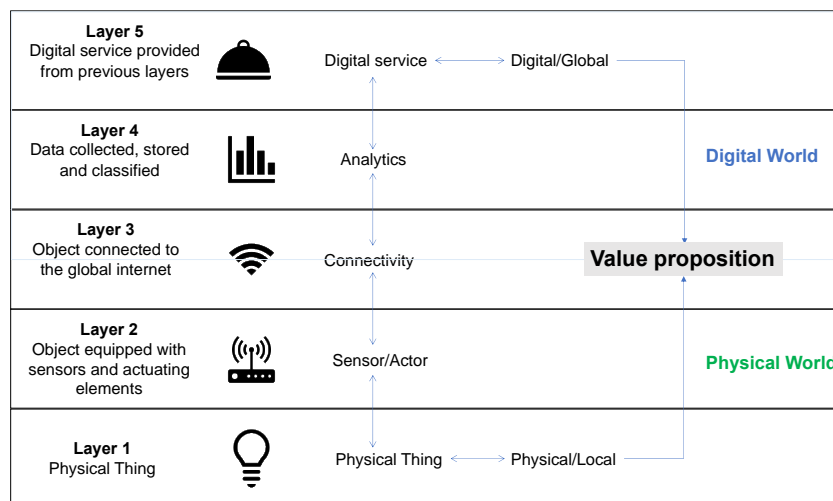


Figure 1: IoT layers

(Source: Fleisch et al., 2014)

3. Value Proposition and the IoT

The value proposition concept has been widely used (Payne, Frow, & Eggert, 2017). The first definitions of value proposition present it as a combination of price and benefits to be delivered to target customers (Lanning, 1998). This definition received later contributions but remains related to a promise or statement about the products and services that a company offers, and the benefits and values that will be delivered to customers, and how it differs from competitors (Payne et al., 2017).

There are several frameworks of value proposition in the literature that apply to products and services in general (Anderson et al., 2006; Barnes, Blake, & Pinder, 2009; Bocken et al., 2013; Den Ouden, 2012; Kambil, Ginsberg, & Bloch, 1996; Osterwalder et al., 2014; Rintamäki et al., 2007). These frameworks indicate essential elements of the value proposition besides benefits and price, such as performance, risk, effort, customer roles (Kambil et al., 1996). They also indicate different dimensions of value (functional, economic, emotional, symbolic, and ethical values), extending the understanding of value beyond tangible elements (Rintamäki et al., 2007). Actors that can be impacted by the value proposition should be considered as well, such as stakeholders, the society, or the environment (Den Ouden, 2012). There is a need for continuous innovation in the value proposition integrating economic, social, and environmental aspects, as technology evolves in the IoT scenario.

The potential of the IoT to enable the creation of smart products opened a space for creating new value propositions. The combination of traditional products with the IoT capabilities provides new functions and benefits related to both the physical objects and the digital services associated with them (Fleisch et al., 2014). Nevertheless, it is fundamental to consider the IoT challenges in the value proposition. For instance, privacy and security risks may impact IoT adoption more than the price of the product or service (Hsu and Lin (2018).

Lindley, Coulton, and Cooper (2017) highlighted simplicity, versatility, and pleasure as characteristics to consider when developing devices based on the IoT. Fiore, Tamborrini, and Barbero (2017), in turn, noted that, despite the growing IoT market such as smart home solutions, the lack of perceived benefits, the high prices, and the concern for privacy are barriers for adoption. Mishra et al. (2016) emphasized that it is also necessary to consider the socio-organizational context, cultural, social, and cognitive forces in the process of adopting IoT-based solutions. In sum, the challenge is to develop value propositions that integrate all these points without losing focus (Hudson, 2017). It is necessary to understand the potential and challenges of the IoT to create a successful value proposition for IoT-based products and services (Kiel, Arnold, & Voigt, 2017).

However, few authors have explored the relation between IoT and value proposition. Hudson (2017) described the need to revise value propositions in the context of IoT according to the type of business model and the strategic positioning adopted by the organization, following Anderson, Narus and Van Rossum (2006) model. Previous research also highlighted the need for reviewing the value propositions for IoT-based products and services (Kamble, Gunasekaran, Parekh, & Joshi, 2019), citing some elements to be considered in this value proposition. However, they do not comment or detail these elements.

Thus, in this research, we sought to consolidate the knowledge of existing studies about the value proposition and the IoT and identifying which elements are necessary for the development of value propositions for IoT-based products and services, as detailed next.

4. Method

Design Science Research (DSR) is a method that supports and operationalizes research when the goal is to develop an artifact to solve a practical problem (Aken, 2004). This research followed the DSR approach by Peffers, Tuunanen, Rothenberger, and Chatterjee (2007), comprised of six steps of research: (1) problem identification and motivation, (2) definition of the objectives for a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication of results.

The first step was the **(1) problem identification and motivation**. It started with an exploration of the literature on IoT and value proposition. As a problem, we identified that it was not clear which elements should be considered to develop value propositions for IoT-based products and services. Also, the existing frameworks to support the value proposition development did not address the specificities and complexities of the IoT, such as the IoT capabilities and challenges.

Moving to the next step, **(2) definition of the objectives for a solution**, we envisioned a framework as a solution to support the development of value propositions for IoT-based products and services. This framework has the following objectives: (a) to support the creation of new value propositions for IoT-based products or services; (b) to support the revision of existing value propositions; (c) to help companies to consider the IoT capabilities and challenges when developing the value proposition; (d) it must be understandable, intuitive, easy to use, simple and, parsimonious (considering only essential elements to the value proposition).

With these objectives, the next step was **(3) design and development**. A systematic review of the academic and grey literature was conducted (in August 2018), searching for (a) “value proposition” and (b) “value proposition” AND “Internet of Things” OR IoT. After the analysis of results, we selected 449 academic studies related to value proposition (out of 1180 initial results), and 39 academic studies (out of 89 initial results) and 206 publications from the grey literature (out of 701 initial results) related to IoT and value proposition. All the references selected went through an open coding process with the help of ATLAS.ti in order to identify the elements that need to be considered for the development of value propositions for IoT-based products and services.

Besides the systematic literature review, we applied the Delphi technique (Linstone & Turoff, 2011) to gather the views of experts on value proposition and the IoT. We conducted two rounds of Delphi. In the first round, a questionnaire was sent to 52 IoT experts around the world, asking which elements should be considered to generate value propositions for IoT-based products/services. The answers gathered in the first Delphi round also went through an open coding process of the elements that need to be considered to generate a value proposition for IoT-based products/services. We identified 99 elements in total (experts plus the literature), including elements to generate a value proposition in general and also elements related to the IoT layers, capabilities, and challenges. We grouped and organized these elements (considering different dimensions), as will be detailed in the Research Results section.

The next phases of the DSR were **(4) demonstration** and **(5) evaluation**. The first version of the framework was presented to the 52 experts participating in the Delphi, through the second round of this technique. In total, 25 of the 52 experts evaluated the framework. The evaluation was performed via an online questionnaire. The criteria adopted to evaluate the artifact (framework) were: functionality; utility; completeness; usability, or ease of use; fit with the organization flexibility; and parsimony (Prat, Comyn-Wattiau, & Akoka, 2015; Venable, Pries-Heje, & Baskerville, 2016). The online questionnaire contained (a) a 5-points Likert scale (Strongly disagree to Strongly agree) evaluating the framework according to these criteria; (b) a 5-points Likert scale (Not important to Very important) to assess the importance of each one of the elements of the framework and (c) one open questions asking for suggestions and improvements. Based on the evaluation by the Delphi experts, we made several improvements in the framework. After these adjustments, we submitted the second (improved) version, named “Value 4.0”, to a new demonstration and evaluation rounds: a group of academic experts (from the university in which the study was conducted); in real-life applications by two companies, with the participation of their owners; and two practitioners. We present the details of the four rounds of evaluations of the framework in Table 1.

Evaluation	Type	Mode	Date	Duration	Participant s
1 st : Analytical	IoT’s experts (2 nd round of Delphi)	Online – web questionnaire	Apr 14, 2019 to May 13, 2019	29 days (10 min. average per answer)	25
2 nd : Experimental (artificial)	Workshop with academic experts	Face-to-face meeting	June 26, 2019	85 min.	4
3 rd : Observational	Case 1 - Company A	Online work session - Skype	June 24, 2019	50 min.	1
	Case 2 - Company B	Online work session - Skype	June 11, 2019	50 min.	1
4 th : Analytical	Practitioner 1	Face-to-face meeting	June 5, 2019	1h30min	1
	Practitioner 2	Face-to-face meeting	Jul 10, 2019	54 min.	1
Total				579 min	33

TABLE 1: Rounds of evaluation of the artifact

We analyzed the answers to the individual questionnaires using descriptive statistic techniques (frequency, mode, averages). The answers to the open questions and discussions (which were recorded and transcribed) were saved in the ATLAS.ti database. We analyzed the content of these answers via open codification to identify the necessary improvements in the artifact, as well as to identify qualitative aspects of the artifact evaluation.

5. Research Results

The systematic literature review and the expert’s answers in the first round of Delphi allowed us to identify 99 elements to be considered in the value proposition for IoT-based products and services. These elements were reviewed, eliminating redundancies, resulting in a total of 67 elements grouped into three dimensions identified in the most cited value proposition frameworks found in the academic literature.

The first dimension, *Actors*, defines to whom the generated value can be created, who is impacted by it, or can co-create the value (Bocken et al., 2013; Den Ouden, 2012). These actors can be: (1) clients, whether in their roles as a buyer, consumer, user, co-creator or transferor of value; (2) the organization itself, including its employees; (3) ecosystem actors - involving stakeholders, partners, suppliers, government and others; (4) society; (5) environment; (6) bystanders - who are people indirectly impacted (positively or negatively) by the IoT-based product or service (Ferneley & Light, 2008); and (7) other objects.

The second dimension, *Perspectives*, is related to the type of value being generated or delivered. We identified the following perspectives: environmental or ecological, economic or financial, functional, psychological or emotional, social or symbolic, regulation, and political (Den Ouden, 2012; Rintamäki et al., 2007). In this dimension, we identified 54 (out of the 67 elements) that were grouped to create a more parsimonious framework and distributed within the five levels. This perspective is strongly related to the third dimension of the framework, *Strategy*, which refers to the value proposition positioning type.

These three dimensions (*Actors*, *Perspectives* and *Strategy*) were associated to a fourth one, specifically related to the IoT, encompassing the five IoT architecture layers (as proposed by Fleisch et al. (2014) as demonstrated in Figure 1: (1) physical object; (2) sensor/actant; 3) connectivity; (4) analytics and (5) digital architecture service. This dimension considers the unique IoT capabilities that can transform traditional products into smart and the challenges related to the IoT, such as the security of the data pervasively collected.

The conceptualization that served as the basis for the generated framework is depicted in Figure 2. A conceptualization is a “semantic structure which encodes the implicit rules constraining the structure of a piece of reality” (Giaretta & Guarino, 1995, p. 6). The novelty of this conceptualization relies on the consideration of unique features of the IoT and how it can create different types of value for different actors, resulting in specific strategic positioning.

Considering this conceptualization, we created one version of the framework that was evaluated by 25 IoT experts in the second round of Delphi. Based on the expert’s feedback, we adapted the framework and submitted them to three more different evaluations. The framework new version was named as “Value 4.0” (in reference to the industry 4.0). We submitted its second version to three new evaluation rounds: experimental, observational, and analytical, as already detailed in the methods section, Table 1.

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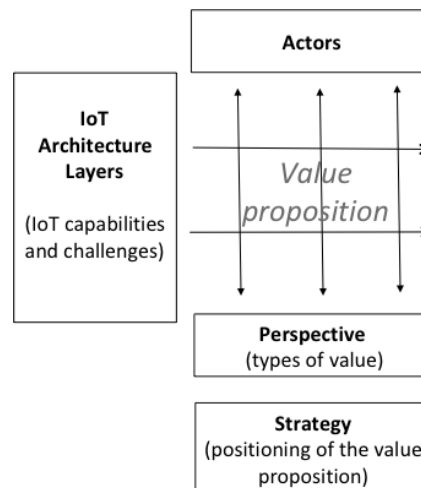


Figure 2: The conceptualization – foundations for the artifact (framework)

(Source: developed by the authors)

Overall, all participants rated the framework positively, they agreed that the framework is able to support the development of value propositions for IoT-based products/services, differs positively from other frameworks with a similar purpose, is easy-to-use, has the adequate number of elements (without excess), and is intuitive. The framework helped them to think about new elements that are not considered in other frameworks and helped to identify opportunities for the current value proposition. In sum, the second version of the artifact (Value 4.0) received positive evaluation results and suggestions for minor revisions. The final version of the framework is presented in Figure 3.

6. Discussion

The literature review and analysis, together with the views of IoT experts in the Delphi, has indicated several elements to be considered in the development of the value proposition for IoT-based products and services. These elements encompassed different types of value for different actors, interconnected with the levels of the IoT architecture and the correspondent capabilities and challenges of this technology. We inserted these elements into the framework and refined it, considering the results of the four rounds of evaluations.

Besides identifying the essential elements to be considered, the development process of this framework suggests implications for the design of artifact that address the same class of problems: supporting the development of value propositions for IoT-based products and services.

First, it is vital to consider the core elements presented by pre-existing frameworks that are already widely tested and widespread in the literature, which apply to products and services in general. However, the research data confirmed that these generic frameworks ignore specific IoT-related

elements (such as the capabilities and challenges) that are present in the proposed artifact.

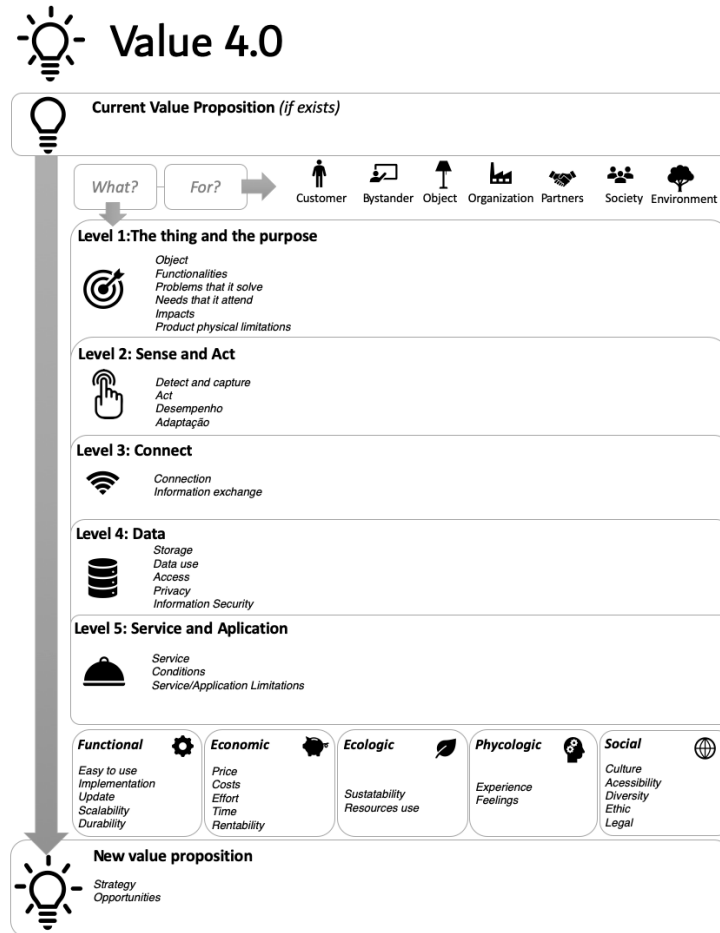


Figure 3: Value 4.0 Framework – final version

(Source: developed by the authors)

Second, the generated framework considers value proposition not only from a customer perspective (as happens in the most generic value proposition frameworks, for example, Osterwalder et al. (2014), quite cited in the literature) but from other actors, such as the society, the organization itself or bystanders. These other actors deserve consideration in the context of products and services created based on the IoT. For example, Klein, Sørensen, de Freitas, Pedron, and Elaluf-Calderwood (2020) examined challenges faced in the development of Google Glass (a smart product). These challenges are related to controversies on privacy and use of data, involving not only the users of Glass but also people around those users (bystanders) and societal aspects as a whole.

As a third implication, research results emphasize the need for a value proposition framework easy to use, objective, and intuitive. However, these characteristics are more difficult to achieve when there are

a large number of elements that need to be considered in different dimensions related to the value proposition. The aggregation of similar elements and the care with the layout and visual components (levels and intersection of dimensions, uses of icons, layout) are suggested for the design of similar artifacts.

After taking these design implications into account, we consider that the framework application process was satisfactory, as participants rated it positively regarding its functionality, utility, completeness, usability, suitability for the organization, flexibility, and parsimony. Besides, the participants agreed the framework presents the elements needed to develop value propositions for IoT-based products and services.

Final Remarks

We used the Design Science Research (DSR) as the method to answer this question through the creation and testing of a specific framework (the artifact of the DSR) to support the development of this type of value proposition. The assessment of the framework by academics and practitioners and its application in real business has shown that it can help to identify opportunities in existing value propositions or generate new ones.

In addition to core elements that are usually presented in the value proposition literature for products and services in general, we identified the need to consider specific elements related to the IoT to generate appropriated value propositions in this context. The conceptualization (Figure 2) that grounded the developed framework and the elements of the value proposition can be considered as the main theoretical contribution of this article. The discussion in the previous section points to implications for the design of similar artifacts.

The final version of the framework, called Value 4.0 (Figure 3), is the main practical contribution of the study. The framework can be used as a support tool for creating value propositions for IoT-based products and services by companies, entrepreneurs, inventors, and managers, helping them to reflect on this process and identifying opportunities in their current value proposition (if any) and in new value propositions. Besides, this framework can help companies to leverage the potential of the IoT and minimize the risk of innovating with this technology.

As future research, the final version of the framework presented here can be applied in new cases, with different product types, at different stages of product development, and in different sectors and company sizes. New applications can help to refine the framework and to understand if some elements can be removed, inserted, changed, or better grouped. Evaluating the value perception (by different types of actors) of IoT-based products and services is also an important topic for future research.

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P02: A UTILITY THEORY MODEL FOR INDIVIDUAL ADOPTION OF BITCOIN

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Abstract

In recent years, the growth of cryptocurrency prices, notably that of Bitcoin has garnered mainstream news coverage. However, very little is known about the factors that motivate an individual to adopt Bitcoin, though studies abound in the blockchain technology adoption and its use in various domains such as healthcare, supply chain, and finance. In the current paper, we argue that the existing, widely-used IT adoption models may not thoroughly explain the reasons (i.e., benefits, barriers, and specific factors) associated with the adoption of cryptocurrencies. We propose a research model based on UTAUT and utility theory to discover the perceived benefits, perceived risks, facilitating conditions, and social effects in the individual adoption of Bitcoin.

Keywords: Blockchain, Bitcoin, Adoption, Privacy, Multimethod Research, Construct Development

1. Introduction

Cryptocurrency adoption for individual activities remains a central concern of governments, the fintech (financial technology) industry, electronic commerce businesses, information systems (IS) researchers, and practitioners. Despite impressive advances in hardware (e.g., Powerful chips, ASIC design, and exchanges) and software capabilities (e.g., cryptography, software, and mass use of software in phones and computers) and computer networks, individuals can render financial transactions legally at almost negligible fees. Cryptocurrency systems are vastly underutilized but may have huge potential in the future (DeVries, 2016). The low usage of Bitcoin and other cryptocurrencies has been identified as a pressing concern with the blockchain sector (Hayes, 2017). Understanding and creating the conditions under which individuals and businesses will embrace cryptocurrency, and related systems such as payment gateways, electronic wallets, and vendor systems remains a high-priority research issue. How to facilitate a digital economy that provides financial access to the excluded is also a prominent research issue (Cousins, Subramanian, & Esmaeilzadeh, 2019).

Information Systems (IS) researchers have made significant progress in studies on the user acceptance of different types of information technology systems within organizations. This stream of research began with the Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989) and its variants. This effort was followed by the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003), the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (Ajzen, 1991). We conducted a multi-period multimethod study to discover the factors that influence an individual to adopt Bitcoin. Using a sequential approach, we conducted a qualitative research study followed by a quantitative research study over four years from 2016 to 2019. It is important to note that during this period, Bitcoin’s price was highly volatile, and by being a fringe economy instrument, every major government and business in the world has actively been affected by Bitcoin. We investigated the following two research questions; 1. “What factors influence an individual’s adoption of Bitcoin?” and 2. “How do these factors influence an individual’s adoption of Bitcoin?”.

2. A Multi-Method Research Design

A combination of qualitative and quantitative data collection and analysis methods were used on separate samples to examine Bitcoin adoption and usage. We conducted email interviews with one sample of users and non-users, followed by a survey study on a different sample. In line with prior multimethod studies (Mingers, 2003; Spears & Barki, 2010), we chose this multimethod approach based on the premise that separate and dissimilar data sets drawn on the same phenomena would provide a richer picture of the concepts and outcomes associated with Bitcoin adoption and use than would require a mono-method approach. Accordingly, we used a sequential design where a qualitative exploratory study informed a subsequent confirmatory survey. Thus, by combining qualitative and quantitative methods, we strengthened the results through triangulation and cross-validation across multiple samples and sources of data. Figure 1 describes the sequential design of our research study.

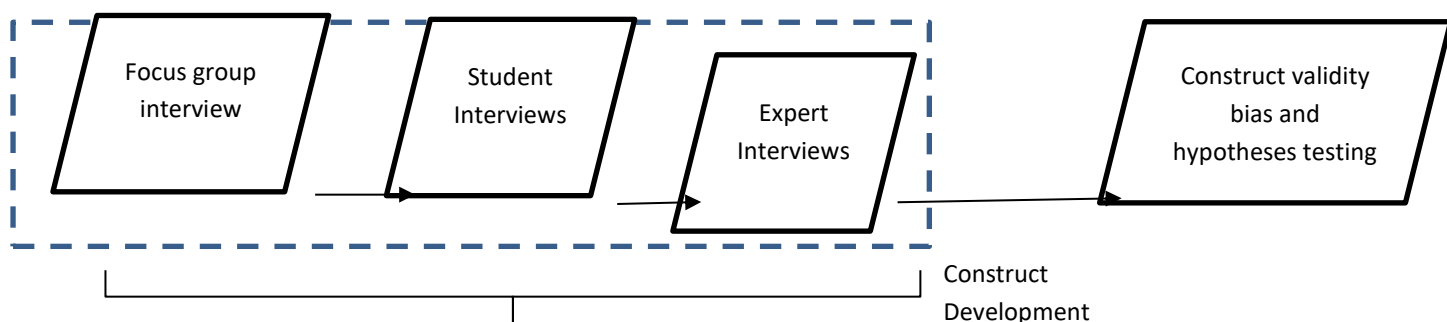


Figure 1: Multi-Method Research Design

3. Study 1: An Exploratory Study of Bitcoin Adoption and Use

First, we develop a conceptual definition of the constructs because the lack of a precise and detailed

conceptualization of the focal constructs can cause significant measurement errors during the testing phase (MacKenzie et al., 2011).

3.1 Data Collection

To conduct the exploratory study, we interviewed three groups of informants over three phases of data collection between 2016 and 2018. These three groups of informants included (1) Bitcoin experts, including early adopters, (2) Bitcoin users and non-users, and (3) Bitcoin stakeholders. This approach allowed us to triangulate our results across three groups of informants to explore Bitcoin adoption issues from various perspectives. In phase 1, our objective was to understand the perceptions of Bitcoin innovators who were early adopters – a group we referred to as Bitcoin experts. To achieve this goal, we conducted a focus group study where we interviewed 12 key members of a recognized Bitcoin meetup group in the southeastern United States (U.S.), who organized meetings through the website of meetup.com.

In phase 2, we were particularly interested in expanding our analysis to a larger population to understand general attitudes towards Bitcoin. Therefore, using a convenience sampling approach, we decided to interview 110 randomly chosen students enrolled in MBA and BBA programs at a large southeastern U.S. university. These students were both users and non-users of Bitcoin (who were familiar with Bitcoin but did not practically use it by the time of the survey). Using Qualtrics software, we emailed the interview protocol to these interview subjects. The interview protocol was designed around three main open-ended questions a 1. Compared to traditional payment methods (such as cash, credit card, debit card) or other online payment systems (such as Paypal), what do you think as the possible advantages of using Bitcoin? 2. Compared to traditional payment methods (such as cash, credit card, debit card) or other online payment systems (such as Paypal), what do you think as the possible barriers of using Bitcoin? 3. Considering both drivers and barriers of Bitcoin, will you use Bitcoin in your transactions in the future?

In phase 3, we wanted to understand how Bitcoin's stakeholders perceived Bitcoin. Our main criteria for identifying stakeholders were: (a) they were professionals engaged with the crypto-ecosystem on a day-to-day basis in one role such as miners, investors, application developers, media practitioners, or researchers; and (b) they understood the technology.

3.2 Data Analysis

The primary goal of the data analysis was to construct development and hypothesis development. This step was a sequential process involving; (1) construct development, (2) identification of Bitcoin's positive and negative utilities, and (3) hypothesis development. In qualitative data analysis, classification and connection of constructs from the basis of theory development. Seeing that we had no a priori theoretical framework or coding schema, we used grounded theory techniques to analyze the data. To guide this process, we posed the following questions: 1. What are the main benefits of Bitcoin (positive utilities) use suggested by the interviewees? 2. What are the key challenges (negative utilities) associated with Bitcoin use suggested by the interviewees? 3. What are the main social factors affecting the adoption of Bitcoin indicated by the interviewees?

These questions were used to systematically review and code the interviews. We use open, axial and selective coding procedures suggested by Strauss and Corbin (1990) to identify

conceptually similar themes mentioned by the interviewees. Open coding is an analytical process, which involved identifying concepts, properties, and dimensions. Axial coding involves relating categories to their subcategories. Selective coding represents the final stage of data analysis to be completed after core concepts that emerged from the coded data categories have been identified through open and/or axial coding. These selective codes represent theoretical constructs. We used open coding and axial coding techniques to identify constructs, which represented Bitcoin’s key characteristics and features. We then used cluster analysis to group the axial codes representing the identified constructs into selective codes. These selective codes represented Bitcoin’s positive and negative utilities. The next step of the analysis involved developing selective codes representing the positive and negative utilities associated with Bitcoin.

3.2.1 Identification of Bitcoin’s Positive and Negative Utilities

The axial codes we identified represent features interviewees believed represented Bitcoin’s benefits and challenges related to use behaviors. Table 1 shows the results of cluster analysis:

Table 1: Selective Codes Representing Bitcoin’s Positive and Negative Utilities

Positive Utilities	Percentage (%)	Negative Utilities	Percentage (%)
Anonymity	90%	Physicality	85%
Universality	98%	Volatility	98%
Investment opportunities	91%	Traceability	90%
Ease of use	93%	Potential scams	95%
Transaction time	90%	Irreversibility	89%
Transaction cost	91%	Technical flaws	91%
-----	-----	Regulation issues	96%

3.2.2 Second-order constructs

The second-order constructs and their definitions are shown in Table 2.

Table 2: Second-Order Constructs

Second-order construct	Definition
Positive utilities	The degree to which an individual perceives benefits from the adoption of Bitcoin.
Negative utilities	The degree to which an individual perceives risks from the adoption of Bitcoin.
Social effects	The degree to which an individual perceives social pressures to adopt Bitcoin.
Structural provision	The degree to which an individual perceives support and facilitating infrastructure for the adoption of Bitcoin.
Personality traits	The degree to which an individual perceives that he/she is confident in his/her ability to adopt Bitcoin.

3.2.3 Measure Development

The second step is the creation of items for the defined constructs. During the item development, the codes derived from the qualitative study were leveraged. We also searched the literature for previous studies that may have used similar constructs to identify items that may be relevant to the context of this research. Altogether, 112 items were initially developed to capture the essential aspects of the constructs. Then, we asked two Ph.D. and four Masters students to perform the face validity check. The participants in the face validity check were familiar with how the Bitcoin ecosystem works. They were asked to comment on the clarity of the questions. Totally, 13 items were reported as confusing or vague. Two of them remained after modifying the wording. As a result, a pool of 101 items was used in the next step.

3.2.4 Content validity assessment

According to MacKenzie et al. (2011), content validity explains whether a scale represents all aspects of a given construct. To perform this assessment, two measures should be taken: (1). each item represents a facet of the construct' content. (2). all the items together are representative of the entire domain of the construct. To do so, we followed the procedure suggested by Anderson and Gerbing (1991). Based on this approach, each item should represent a single construct. Since some constructs are developed by the authors, we mainly used content validity check to identify potentially overlapping across constructs. Due to the number of items and constructs and to avoid confusion, we used several matrix tables on Qualtrics to place items in the rows and list construct definitions at the top of the columns. We grouped the first-order constructs in one matrix to identify potential overlap across these constructs. Then, we asked 183 independent raters (Bachelors' students) to assign each identified items to one construct definition.

To check the content validity, we computed two indexes: the proportion of substantive agreement (PSA) and the substantive validity coefficient (CSV). PSA refers to the proportion of raters who assign items to their posited constructs, and CSV indicates whether raters assign items to the intended construct rather than to any other construct (Anderson & Gerbing, 1991). As recommended in other studies (Hoehle & Venkatesh, 2015), we used a threshold of .60 as a cutoff point for both indexes' values. This cutoff value suggests that more than 60 % of all respondents assign the items to the intended construct definitions. The values for PSA ranged between 0.69 and 0.91, and the values for CSV ranged between 0.72 and 0.87. Results show that the content validity ratios for all the 101 items met the .60 cutoff value, which implies that most raters associated the majority of items with their intended construct domains.

3.2.5 Measurement Model Specification

In this step, using a measurement model, we show the indicators relate to the constructs as well as the relationships between the first-order and second-order constructs. Our proposed measurement model is excluded from our discussion in this submission. In this study, we discuss that because positive utilities, negative utilities, social effects, structural provision, and personality traits do not exist independent of their components, and these components are not conceptually interchangeable, modeling these constructs as formative is more appropriate (Huang, Chengalur-Smith, & Pinsonneault, 2019). Since these components conceptually tap into different aspects of structural capital, and they are not expected to necessarily covary, making these constructs formative is appropriate.

4. Research Model

In order to develop a framework for this study, we used both UTAUT and utility theory as a base. The resulting research model, which is mainly based on a belief-attitude-intention framework proposes several causal relationships. The primary five constructs used to develop the model are positive utilities, negative utilities, social effects, structural provision, and personality traits. In this section, we articulate how these constructs may influence individuals' attitudes toward Bitcoin and their willingness to use it in the future. Figure 2 describes the key testable hypotheses and relationships among constructs.

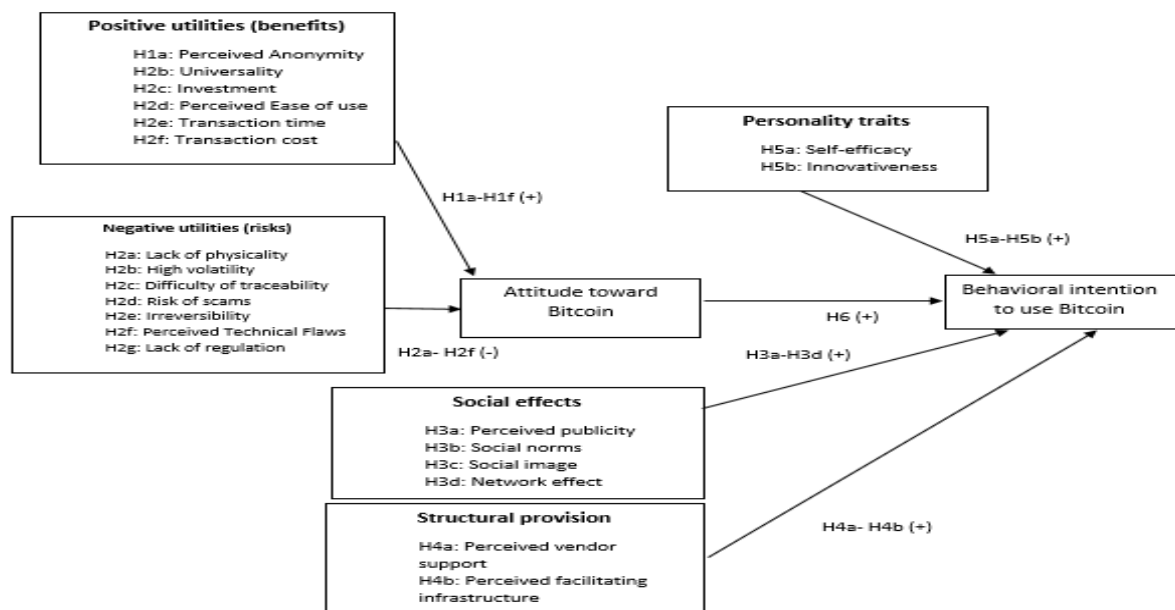


Figure 2: Research Model

5. Study 2: A Confirmatory Study of Bitcoin Adoption and Usage

5.1 Pretest Study

The next step is the pretest of the survey instrument. In this step, the convergent, discriminant, and nomological validity of the scales should be investigated (Straub, Boudreau, & Gefen, 2004). Before data collection, we asked four Ph.D. students to read the survey, complete it, and provide feedback on the items and survey structure. Only minor changes (e.g., pagination, change of terms) were proposed by these students, and they confirmed that the instructions were clear and easy to understand. We aimed to collect more than 500 responses that are necessary to investigate the psychometric properties of the scales (Hair, Black, Babin, Anderson, & Tatham, 2006).

5.2 Scale Purification and Refinement

In this step, we used the pretest data to refine the survey instrument. The authors discussed in some

rounds to refine the survey instrument, test the reliability of these measures, and find the unique proportion of variance in second-order constructs. We also assessed the item loading for the first-order constructs and the weights of each first-order construct on the intended second-order construct. Table 12 shows that all item loadings are above 0.70, which also supports convergent validity. The weights of the first-order formative constructs on the intended second-order constructs were significant ($p < .001$). This finding supported that each first-order construct significantly contributed to the respective second-order construct. Then, we checked for multicollinearity by computing the variance inflation factor (VIF) for all first-order constructs forming the second-order constructs. The resultant VIF values are between 1.62 and 3.83, which are below the cutoff value of 4 (Petter, Straub, & Rai, 2007). Thus, multicollinearity is not an issue in this research. Since all these findings were promising, we did not remove any items from the instrument.

5.3 New Sample Data Collection: The Main Study

Once the scales are pretested and refined, a new sample data collection should be performed to reassess the purified scales. To ensure that we collected data from a new sample, we designed and used an online version of the questionnaire (custom-developed using Qualtrics software) and utilized the Amazon's Mechanical Turk (MTurk) platform to survey a national sample of patients. Mturk has been used in several studies as a reliable and acceptable source of subject participants (Marge, Banerjee, & Rudnicky, 2010) to analyze the perceptions of samples that are quite representative of the general population of interest, including a broad range of ages, income levels, ethnicities and work experiences (Behrend, Sharek, Meade, & Wiebe, 2011). The incentive for participation was a monetary reward (\$1). Since the main objective of this study is to examine factors shaping individuals' perceptions about Bitcoin and investigate their willingness to use Bitcoin, we used a clear explanation to educate our potential respondents about Bitcoin. Thus, at the beginning of the survey, a detailed description of "what Bitcoin is and how it works" was provided to ensure that respondents completely comprehended the context and purpose of the study. Totally, 843 individuals within the U.S. attempted the survey.

As mentioned in previous studies, one general concern in data collection is the potential lack of attention and random responses (Huang, Curran, Keeney, Paposki, & DeShon, 2012). Consistent with other studies, we used "captcha" questions to prevent and identify careless, hurried, or haphazard answers (Mason & Suri, 2012). Based on answers to these questions, thirty-one responses were dropped. Previous studies that collected data using Mturk reported a similar ratio of dropped responses (O'Leary, Wilson, & Metiu, 2014). Thus, concerns that online respondents might reply randomly or haphazardly to complete the survey quickly were alleviated. The responses that failed the quality assessment were excluded, and the final set of usable responses that could be used in the study comprised of 812 samples. The average time for survey completion was found to be 15.18 minutes. With regard to the time spent on completing the survey and the number of questions included in the questionnaire, the mean response time implies that the answers can be acceptable.

The demographic characteristics show that the majority of respondents were female (52%), White (52%), with a full-time job (67%), had a bachelor's degree (43%) and aged between 20-29 years old (52%). All participants lived in the U.S. at the time of data collection, and most of them resided in suburban areas (47%). About their technology experience, around 72% reported that they were extremely comfortable with computers, and 82% stated that they were extremely comfortable with

the Internet, and 89% of respondents rated their computer skills either good or excellent. Finally, the majority of participants (62%) did not use any forms of cryptocurrencies, and among those who used cryptocurrencies before 72% used Bitcoin.

6. Results: Structural Model Analysis

The hypotheses were tested using IBM SPSS AMOS (Version 22) within a Structural Equation Modeling framework. Ho (2006) notes that the overall fit of the structural model can be assessed using the goodness of fit indices. The findings indicated that the χ^2 of the model was 11757.273, with 5231 degrees of freedom ($\chi^2/df = 2.24$). The indices values for GFI= 0.951, AGFI= 0.90. CFI = 0.920, NFI= 0.916, RFI= 0.917, and TLI= 0.934 were above 0.9 and the SRMR = 0.033 and RMSEA= 0.045 were below 0.08 (Byrne, 2001). The values of all these indices were found to be in the acceptable range. As the results indicate, at least four indices met the minimum recommended values, supporting a good fit between the observed data and hypothesized model following Kline (2015).

The results of the hypotheses testing are summarized in Table 3. H1a is not supported where there is no evidence found to support that perceived anonymity leads to an enhanced attitude toward using Bitcoin ($\beta = 0.006$, non-significant). Support is also not found for H1b, which indicates that perceived universality would significantly reinforce attitude toward using Bitcoin ($\beta = 0.043$, non-significant). H1c, which posits that perceived investment would directly affect attitude toward using Bitcoin, is supported ($\beta = 0.656$, $p < 0.001$). The analysis demonstrates that individuals' perceived ease of use positively influences their attitude toward using Bitcoin ($\beta = 0.165$, $p < 0.01$), and this positive relationship supports H1d. Support is also found for H1e, which argues that attitude toward Bitcoin would be positively influenced by perceived transaction time ($\beta = 0.122$, $p < 0.01$). Moreover, results provide evidence to support H1f, which posits that perceived transaction cost would enhance an individual's attitude toward using Bitcoin ($\beta = 0.079$, $p < 0.05$).

The path coefficient of the relationship between perceived physicality of Bitcoin and attitude toward using Bitcoin is significant, supporting H2a but in the reverse direction ($\beta = 0.163$, $p < 0.001$). Moreover, the effect of the perceived volatility of Bitcoin on attitude toward using Bitcoin is significant, supporting H2b ($\beta = -0.144$, $p < 0.05$). H2c argues that there exists a negative relationship between the perceived traceability of Bitcoin transactions with attitude toward using Bitcoin, which is not supported ($\beta = -0.098$, non-significant). The results provide evidence to support H2d, which indicates that perceived potential scams could negatively influence attitude toward using Bitcoin ($\beta = -0.079$, $p < 0.01$). H2e posits that there is a negative relationship between perceived irreversibility of Bitcoin transactions and attitude toward using Bitcoin, which is not supported ($\beta = -0.037$, non-significant). Support is also found for H2f, which indicates that perceived technical flaws would exert a negative effect on attitude toward using Bitcoin ($\beta = -0.175$, $p < 0.001$). H2g is supported where evidence found to support that perceived regulations associated with Bitcoin lead to unfavorable attitudes toward using Bitcoin ($\beta = -0.240$, $p < 0.001$).

The analysis indicates that public publicity about Bitcoin is a significant predictor of an individual's willingness to adopt Bitcoin, H3a is supported ($\beta = 0.101$, $p < 0.05$). Support is found for H3b, which posits that social norms could reinforce individual intention to adopt Bitcoin in the future ($\beta = 0.131$,

$p < 0.001$). However, support is not found for H3c, which indicates that social image would significantly reinforce an individual's willingness to adopt Bitcoin in the future ($\beta = 0.045$, non-significant). H3d posits that network effect exerts positive effects on Bitcoin adoption intention ($\beta = 0.478$, $p < 0.001$).

The path coefficient of the relationship between perceived vendor support and intention to use Bitcoin is significant, supporting H4a ($\beta = 0.138$, $p < 0.01$). H4b is supported where evidence found to support that perceived facilitating infrastructure associated with Bitcoin leads to higher intentions to use Bitcoin ($\beta = 0.150$, $p < 0.001$). Support is also found for H5a, which posits that higher self-efficacy will result in a greater willingness to adopt Bitcoin ($\beta = 0.323$, $p < 0.001$). The analysis demonstrates that individuals' innovativeness positively influences their willingness to use Bitcoin ($\beta = 0.267$, $p < 0.001$), and this positive linkage supports H4b. Moreover, the positive effect of attitude toward using Bitcoin on the intention to use Bitcoin is significant, supporting H6 ($\beta = 0.528$, $p < 0.001$).

Among the demographic characteristics (i.e., age, gender, education level, income, experience), the findings show that education level ($\beta = 0.135$, $p < 0.01$), income ($\beta = 0.76$, $p < 0.01$), and cryptocurrency experience ($\beta = 0.177$, $p < 0.001$) have a significant positive relationship with intention to adopt Bitcoin. Finally, the variables explained 45% of the variance in attitude toward using Bitcoin, and 53% of the variance in willingness to adopt Bitcoin. The R2 scores reflected that the model provides adequate explanatory power to predict the variance in the individual's attitude toward Bitcoin as well as the intention to adopt Bitcoin in the future.

Table 3: SEM Results

Hypothesis	Path	Standardized Coefficient	Standard Error	Critical Ratio	Results
H1a	PA \longrightarrow ATT	0.006	0.05	0.122	Not Supported
H1b	UNI \longrightarrow ATT	0.043	0.061	0.706	Not Supported
H1c	INV \longrightarrow ATT	0.656***	0.063	10.414	Supported
H1d	PEU \longrightarrow ATT	0.165 **	0.031	5.329	Supported
H1e	TT \longrightarrow ATT	0.122**	0.033	3.734	Supported
H1f	TC \longrightarrow ATT	0.079*	0.032	2.519	Supported
H2a	PH \longrightarrow ATT	0.163 ***	0.045	3.638	Supported-Reverse direction
H2b	VOL \longrightarrow ATT	-0.144 *	0.103	-1.105	Supported
H2c	TR \longrightarrow ATT	-0.098	0.061	-1.607	Not Supported
H2d	PS \longrightarrow ATT	-0.079**	0.032	-2.519	Supported
H2e	IRR \longrightarrow ATT	-0.037	0.056	-0.650	Not Supported
H2f	PTF \longrightarrow ATT	-0.175***	0.038	-4.629	Supported
H2g	REG \longrightarrow ATT	-0.240 ***	0.029	-8.389	Supported
H3a	PP \longrightarrow INT	0.101*	0.026	3.884	Supported

H3b	SN → INT	0.131***	0.024	5.474	Supported
H3c	SI → INT	0.045	0.043	1.048	Not Supported
H3d	NE → INT	0.478 ***	0.067	7.306	Supported
H4a	PVS → INT	0.138 **	0.041	3.365	Supported
H4b	PFI → INT	0.150 ***	0.038	3.966	Supported
H5a	SE → INT	0.323 ***	0.033	9.707	Supported
H5b	INO → INT	0.267 ***	0.041	6.510	Supported
H6	ATT → INT	0.528 ***	0.063	8.380	Supported
Attitude toward bitcoin R ² : 0.45 Intention to adopt bitcoin R ² : 0.53 (*P<0.05, **P<0.01, ***P<0.001)					

Table legend: PA = Perceived Anonymity; UNI= Universality; INV= Investment; PEU= Perceived ease of use; TT= Transaction time; TC= Transaction cost; PH= Physicality; VOL= Volatility; TR= Traceability; PS= Potential scams; IRR= Irreversibility; PTF= Perceived Technical Flaws; REG= Regulation; PP= Perceived publicity; SN= Social norms; SI= Social image; NE= Network effect; PVS= Perceived vendor support, PFI= Perceived facilitating infrastructure; ATT= Attitude toward bitcoin; SE= Self-efficacy; INO = Innovativeness; INT= Intention to use bitcoin

7. Discussion, Implications, and Conclusion

In this study, we developed and validated Bitcoin adoption conceptualization and survey instrument using a multimethod research design. Although a number of studies have focused on cryptocurrencies such as Bitcoin (Böhme, Christin, Edelman, & Moore, 2015; Kazan, Tan, & Lim, 2015; Li & Wang, 2017), there is no comprehensive model and scales to explain factors affecting individuals to use Bitcoin. Most of the previous studies focus on widely accepted adoption models such as TAM or UTAUT to explain how people decide to adopt (or reject) Bitcoin (Queiroz & Wamba, 2019). Therefore, they mainly articulate adoption intentions based on variables such as ease of use and usefulness of Bitcoin transactions. Studies on digital currencies suggest that usability problems can play a significant role in shaping people's willingness to adopt Bitcoin (Glomann, Schmid, & Kitajewa, 2019). Moreover, special characteristics of the blockchain (as the underpinning technology behind Bitcoin) may affect the mass adoption of Bitcoin (Hsieh, Vergne, Anderson, Lakhani, & Reitzig, 2018).

This study uses a multimethod research methodology to better explore main drivers and barriers from potential users' perspectives. Based on a qualitative study (interviews with a focus group, students, and experts) and literature review, we identify five main factors (second-order constructs) predicting individuals' use behavior of Bitcoin. We then develop a research model to provide insights into the conceptualization of Bitcoin adoption through an empirical study. The model posits that the perceived benefits of Bitcoin can attach more utility to the use of Bitcoin and improve individuals' attitudes toward adoption and use of Bitcoin in the future. The perceived benefits have a significant effect on the overall perception of utility and attitude because Bitcoin can yield positive utilities through providing investment opportunities, improving the easiness of financial transactions, reducing transaction time and cost. The direct linkage between potential benefits of Bitcoin and attitude toward Bitcoin can encourage prospective users to switch from traditional payment methods to Bitcoin. Consistent with Hughes et al. (2019), the potential benefits associated with the

use of Bitcoin are the driving force for individuals to perceive more utility, and, in turn, may increase their willingness to adopt Bitcoin. Our study shows that investment opportunity is the most important driving factor from the perspectives of potential users. This point is consistent with previous studies that stored values of Bitcoin that motivates users to adopt Bitcoin (Lu, Papagiannidis, & Alamanos, 2018).

Moreover, considering potential barriers, many scholars have brought risks to the forefront of cryptocurrency adoption (Raymaekers, 2015). According to the findings of several studies, fraud and security issues have been indicated as the most critical barriers to the widespread adoption of Bitcoin (Böhme et al., 2015). Individuals are concerned about the security of Bitcoin transactions because bitcoin can be vulnerable to fraud, theft, technical flaws, and subversion by skilled computer hackers (Yermack, 2015). Security and regulatory risks associated with Bitcoin may influence individuals' attitudes and the likelihood that they will use Bitcoin. Our study indicates that regulation issues are the most important barrier for potential users. As Bitcoin is not supported by any official banks and financial institutions, individuals may believe that Bitcoin transactions are not reliable yet. This is in line with previous studies arguing that the blockchain economy needs new governance approaches in terms of transparent decision rights and accountability (Nærland et al., 2017). Thus, the risk perceptions related to the use of Bitcoin can be a significant utility reducer.

Drawing upon utility maximization theory for explaining this trade-off, results show that individuals' utility function is defined as follows: Utility (X) = Benefit related to use of Bitcoin- Risk associated with the use of Bitcoin. The benefit is derived from an investment opportunity, digital form of currency, ease of use, transaction time, and cost compared with the traditional exchange options. Risk is a function of high volatility, risk of scams, risk of technical flaws, and lack of regulation. Therefore, findings indicate that the function of positive utility associated with the use of Bitcoin is described as follows: perceived benefit = f (investment, digital form, ease of use, transaction time, and cost). The negative utility function is proposed as follows: perceived risk = f (volatility, scams, technical flaws, unregulated currency). Findings imply that the trade-off between these two functions significantly influences individuals' attitudes toward the use of Bitcoin.

Our findings also imply that social effects can significantly shape the willingness to use Bitcoin. The rationale behind the inclusion of social effects and facilitating conditions is because even if individuals are aware of possible benefits and risks, they may not necessarily adopt Bitcoin in the present form (Sadhya & Sadhya, 2018). Without a clear picture of social image and beliefs associated with Bitcoin, IT behaviors such as adoption and feature use may be compromised. Consistent with previous studies (Mai et al., 2018), a social image about Bitcoin is developed based on how Bitcoin is discussed in social media, how many people are using Bitcoin, and how Bitcoin is used for different purposes (legal or illegal). According to Hughes et al. (2019), social influences can drive people to adopt Bitcoin. Our study indicates that the network effect is the most important contributor to the social effects. Thus, if potential users believe that many people are using Bitcoin for legal purposes (e.g., online shopping), they become more willing to adopt it in the future.

Our results show that a lack of vendor support and facilitating infrastructures will lead to a lack of user acceptance. As suggested by previous studies, developing the necessary infrastructure is identified as a key predictor of behavioral intention to use Bitcoin (Francisco & Swanson, 2018). Thus, adequate outlets must offer the facility to support Bitcoin payment services. If a majority of

businesses and vendors accept Bitcoin, people are more likely to adopt Bitcoin in their day-to-day activities. For instance, facilitating infrastructures such as distributed apps for buying/ selling Bitcoin, Bitcoin ATMs, and Bitcoin consulting services should be accessible to potential users to increase the widespread adoption of Bitcoin. This is in agreement with Queiroz and Wamba (2019), suggesting that integration of blockchain technology with vendors' systems facilitates user adoption.

Finally, we developed two research models: first-order and second-order models. Consistent with prior research, we used the χ^2 -difference test (Tanriverdi, 2005) and comparative model fit. The results indicate that the model, including the second-order constructs, has a slightly lower χ^2 but is statistically significantly different from the first-order model. The second-order model explains 54% of the variance in attitude toward using Bitcoin, and 64% of the variance in willingness to adopt Bitcoin in study 1 and 57% and 63% respectfully in study 2. Moreover, the parsimony in predicting variables that comes with the second-order model caused us to favor this model. Further, all of the fit statistics were better for the second-order model and in the acceptable range (Straub et al., 2004). Thus, we propose that the second-order model formed based on five constructs (i.e., positive utilities, negative utilities, social effects, structural provision, and personal characteristics) is a more parsimonious and statistically significant model with higher explanatory power to predict Bitcoin adoption among non-users.

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P03: Achieving Organizational Agility through Application Programming Interfaces: The Effect of Dynamic Capability and Institutional Forces

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Abstract:

Digital platforms have contributed enormously to the success of businesses. Whereas the Information Systems literature is dominated by digital platform research, less is mentioned about Application Programming Interfaces (APIs), the fiber that connects digital platforms. Critically, the normative literature seems to be silent on how developing economy firms achieve agility through API integration. In addressing these research gaps, this research seeks first to investigate how developing economy firms achieve agility when they integrate APIs. Furthermore, the study aims to understand which forms of institutional forces enable or hinder the API integration process. Philosophically, this study will be approached from a critical realist perspective and will adopt a qualitative method of inquiry.

Keywords: API, Organizational Agility, Digital Platforms, Dynamic Capability, Institutions

1. Introduction

The business environment these days has become very dynamic. Economic forces such as demand and supply are responsible for such dynamism (Sturm, Pollard, & Craig, 2017). Moreover, are the changes in the kinds of products and services customers demand. As such, organizations need to strategically position themselves to sense changes as they occur in the business environment (Panda & Rath, 2017). The volatility of the various markets in which firms operate also influence firms to become dynamic and remain relevant and competitive. By this, firms should have an attitude of sensing and respond to changes that are related to the markets they belong to (Overby, Bharadwaj, & Sambamurthy, 2006; Panda & Rath, 2017). Consequently, firms become more innovative by transforming their challenges into opportunities (Panda & Rath, 2017). Digital platforms drive such innovations by ensuring that organizations introduce new offerings.

Digital platforms are perceived as the ideal technologies for organizations that seek to innovate. There is no doubt the IS literature is flooded with the research on digital platforms (Tiwana, Konsynsky, & Bush, 2010; Ghazawneh & Henfridsson, 2013; Gawer, 2014) at the expense of APIs – the tissue that connects digital platforms and the digital ecosystems. Most application providers quickly lose sight of the fact that APIs are the essential elements that form digital platforms and ecosystems (Pettey, 2016).

A crucial component of the software ecosystems that relate to software architecture are APIs (Manikas, 2016). The importance of interfaces vis-à-vis the way software is developed and managed is evident in past research (Cataldo & Herbsleb, 2010; Robbes & Lungu, 2011; Manikas, 2016). Application Programming Interfaces (APIs) have become ideal for applications, systems, and platforms to connect. The attention APIs are receiving has led to extant research in that area (Qiu et al., 2016; Shatnawi et al., 2016; Santos et al., 2016; Diprose et al., 2016).

APIs, are drivers for most of the innovations that are taking place across businesses today (Petthey, 2016). APIs are becoming enablers for turning businesses into platforms. APIs afford easy integration and connection of people, systems, places, and help create user experiences (Petthey, 2016; Anuff, 2017). Research on APIs, in general, has undergone some considerable growth over the last couple of years though the concept itself is not new in the world of information technology (IT). This notwithstanding, past research on APIs have focused on the technical dimensions such as tools used in API development; thus, neglecting the social concerns (Spinellis & Louridas, 2007; Qiu et al., 2016).

Prior studies on dynamic capability have shown that firms can deploy resources and build capability to adapt to changes in both their internal and external environments. However, for firms to enjoy maximum performance over a more extended period, they need to have some agility (Panda & Rath, 2017; Sturm et al., 2017). This allows firms to sense for changes in the environment and respond to such changes. This study seeks to investigate how firms can achieve agility through APIs. Nevertheless, integrating IT innovations such as APIs within firms is either hindered or enabled by some institutional forces (Scott, 2014; Effah, 2016). The institutional theory seems to be very appropriate when considering external influences that come from social, technical, political, and even organizational levels on the assimilation of technology innovations.

The purpose of this study is to investigate how developing economy firms achieve agility through API integration. Based on the institutional theory and dynamic capability theory, this study seeks to achieve the following: a) understand the nature of API integration within developing economy context; b) investigate the users' perspective on API enabled services in developing countries; c) explore the firms' perspectives on API user outcomes; d) Examine the forms of agility present after API integration e) investigate the institutional effects occurring during the API integration process.

The rest of this paper is organized as follows: the next section provides a brief literature review on APIs. The section that follows presents the proposed theory that underpins the study. Next, the authors briefly discuss the methodology for the study. Finally, the authors outline the potential contribution of the study.

2. Literature review

This section primarily reviews the literature on APIs. APIs fall within a body of knowledge. Establishing how this research is related to past research is very critical.

2.1 Framing Application Programming Interfaces Research

The past couple of years has seen a dramatic increase in the use of mobile devices to transact business. Consequently, the 21st-century consumer prefers to interface with a company through their mobile devices. Due to the competitive and volatile business environment coupled with the power customers wield, businesses are also becoming more agile by responding to the dynamic nature of customers and the business market (Sturm et al., 2017). This trend has enabled firms to become more innovative by transforming their challenges into opportunities. APIs are undoubtedly becoming the building blocks

for mobiles and for fulfilling most of the innovations that are taking place across businesses (Petthey, 2016).

A thorough review of existing literature on APIs has shown a rather one-way trend; thus, existing studies tend to focus on more technical issues such as the development (Zibran, Eishita & Roy 2011; Qiu et al., 2016; Shatnawi et al., 2016; Santos et al., 2016; Diprose et al., 2016). For instance, the scope or research covers issues such as tools used in developing APIs (Qiu et al., 2016). Consequently, existing research seems to overlook the other equally important social issues (Ofoeda, Boateng, & Effah, 2019). Recent works by some scholars on value creation, for instance, resonates calls for more in-depth action on the social aspects of APIs (Wulf & Blohm, 2020; Ofoeda, 2020). Whereas it is established that APIs drive innovation (Abigee, 2016), the current trend of API research seems worrying. This is because it has failed to offer a wholistic insight into both the technology (API) and the people that make sense of the technology (consumers). There is a dearth in current research on the two sub-systems; thus, the technology and the people (Avgerou, 2008; Orlikowski & Baroudi, 1991). Exploring these sub-systems will enable us to have an in-depth understanding of how APIs advance the course of firms. Besides, the current discourse on API innovation has failed to provide the outcomes of API-enabled services such as agility (Benzell *et al.* 2016). These knowledge gaps have, therefore, necessitated the current study, notably from a developing country context.

3. Theoretical Basis

The theoretical framework for this study is based on two major theories in the IS field; thus, the Dynamic Capability (DC) theory and the new institutional theory. These two theories have been used extensively in mainstream IS literature to investigate various kinds of IS phenomena (Agarwal & Selen, 2009; Baptista, 2009). What is, however, missing in the literature is the use of these two theories to investigate a particular IS phenomenon like APIs. Yoo, Henfridsson, and Lyytinen, (2010) have called for a generalizable theory provides an explanation to API design and integration research amid their consequences (Wulf & Blohm, 2020). This study arguably addresses this gap by combining these two theories.

The DC theory focuses on a company's ability to integrate, build, and reconfigure internal competencies to address, or bring about, changes in the business environment (Teece et al., 1997; Teece, 2007). Previous studies on DC have shown that firms can deploy resources and build capability to adapt to changes in both their internal and external environments. By its application, the author seeks to identify the various forms capabilities available in the case organizations and to understand how these capabilities contribute or influence the API development and integration process. Moreover, for firms to enjoy maximum performance over a more extended period, they need to be agile. Agility allows firms to sense for changes in the environment and respond to such changes. Furthermore, a grey area relative to DC research is further investigation into the process of sensing (for changes), learning, integrating, and coordinating various capabilities in firms (Miles, 2012). The current study seeks to explain how firms achieve agility through APIs.

Apart from the DC theory, the new institutional theory also underpins the current research. The normative literature has shown that integrating IT innovations such as APIs within firms is either hindered or enabled by some institutional forces (Scott, 2011; Effah, 2016). The institutional theory posits that institutions comprise "cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life (Orlikowski & Barley, 2001; Butler, 2003, Scott, 2008).

From these two theories that researcher argues that though resources are crucial for the survival of firms, it does not guarantee success. Adopting and using innovation within a firm is primarily driven by a firm's environment and pressures and not just forces such as the IT used (Teo et al. 2003; Doolin & Troshani, 2007; Awa et al., 2015; Awa et al., 2015b). The institutional theory seems to be very appropriate when considering external influences that come from social, technical, political, and even organizational levels on the assimilation of technology innovations.

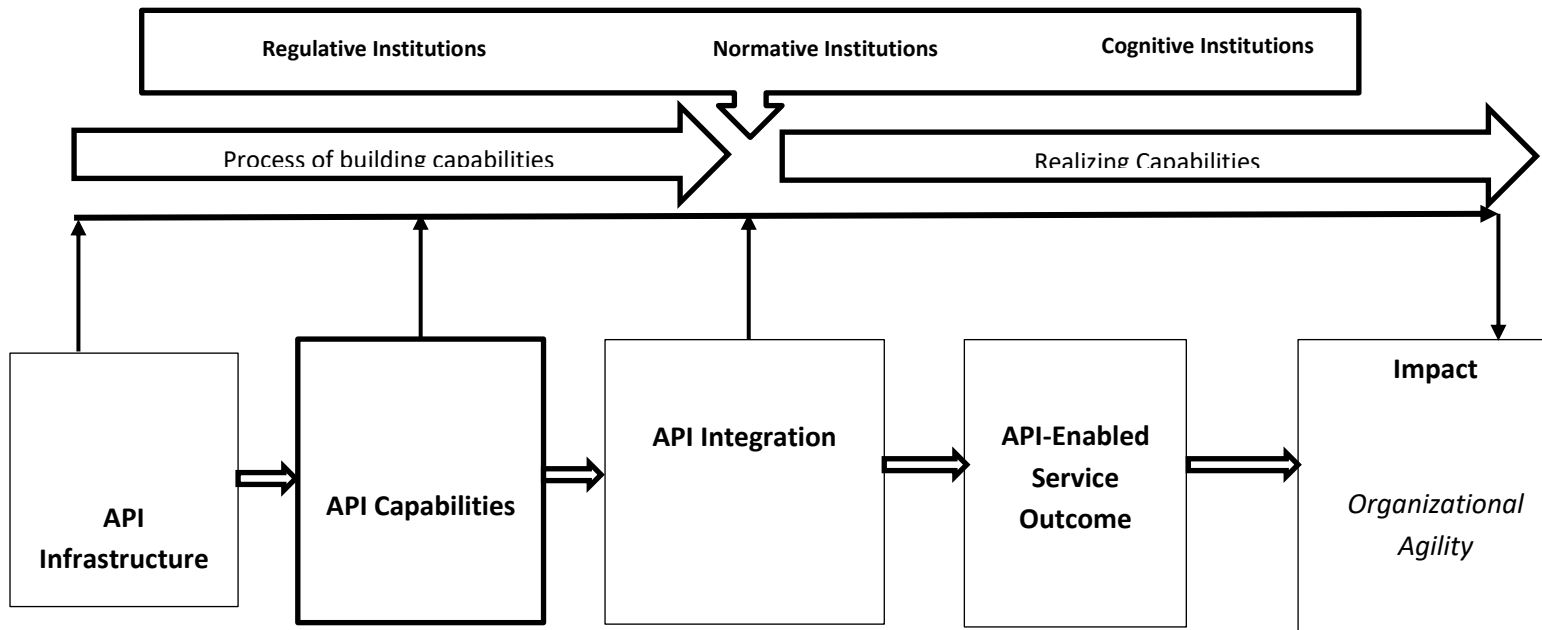


Figure 1: Conceptual Framework

(Source: Author's Construct)

Figure 1 presents the conceptual framework of the study based on the review of the DC framework and the new institutional theory. The argument raised in this research is that for firms to integrate APIs, they need to possess some capabilities such as API capabilities, IT and human resource. When firms integrate APIs as part of their innovative strategies, it could make them agile in the long run. Studies have shown that capabilities such as IT capabilities (Bi et al., 2012) and human capabilities (Teece, 2007) contribute to the agility of organizations. However, various institutions, such as regulative, normative, and cognitive institutions, shape multiple kinds of innovation, such as APIs. The new institutional theory has been used in extant research to investigate the social contexts that shape IS innovation (Scott, 2011; Wiredu, 2012; Kent et al., 2014; Effah, 2016). The regulative, normative, and cognitive forces of the new institutional theory help us to understand better both the internal and external effects of social and technical issues that will arise from the use of every IS. Consequently, this study seeks to explore which forms of institutional forces shape the API integration process. Furthermore, the study aims to investigate which types of agility are experienced by developing economy firms when they integrate API innovations.

4. Research setting and methodology

The current study is ongoing research at the University of Ghana Business that will lead to the award of a PhD in Information Systems. The study seeks to investigate how developing economy firms achieve agility through API integration. This study will be undertaken from a critical realist philosophical perspective and will be based on a qualitative case study research (Mingers, 2004). Qualitative research allows the researcher to investigate the meaning of how people live under certain real-world conditions. The choice of qualitative research is also to ensure that the views and perspectives of the study participants are brought to bear (Yin, 2011). Case studies are one of the predominant qualitative methodologies because of they have been legitimized and have a structured protocol (Yin, 2002; Yazan, 2015). Yin (2002) further argues that case studies are ideal when the research seeks to address the “why” or “how” types of research questions. Qualitative data collection instruments will include the use of interviews, observations, and official documentation.

4.1 Research Setting

The setting for this research is Ghana, which is a developing economy in Sub-Saharan Africa. Ghanaian firms are leveraging APIs in their business operations. The level at which firms open up their applications to other firms is also increasing steadily. Besides, there is also an increase in the number of firms that develop APIs for both internal and external consumption. This trend is promoting the growth of the digital ecosystem in Ghana. Also, the use of mobile technology to transact business is also rising among Ghanaians. This and any other cases make Ghana an appropriate setting for a study like this.

4.2 Data collection

Data will be conducted between November 2019 to April 2020. This will ensure that data is collected from multiple sources to enrich the analysis and findings. Twenty-one firms were sampled, but currently, data will be collected from 10 participating firms. This is because some of the firms chose to drop out of the research. Qualitative data will be collected through means such as phone calls, formal interviews, observations, and business documents. Preliminary data will be collected to help reshape some of the questions (Wiredu, 2012). Concerning the interviews, formal, semi-structured interviews will be conducted with five participating firms (15 participants). The interview questions will be focused on how the firms develop and integrate APIs. Other questions solicit views on how APIs have shaped the business processes of the selected firms, and the institutional forces that make the integration of APIs possible or the vice-versa.

4.3 Mode of analysis

Primarily, we do data analysis to reduce the quantity of the data but also lose the meaning of the data. The analysis of qualitative data will be based on the techniques of Miles and Huberman. Miles and Huberman (1994) provide a thematic analysis framework based upon which researches can analyze their data. The analysis framework has themes such as data reading, summarization, reflection, and categorization (Miles, Huberman, & Saldana, 2013). Based on the theoretical framework proposed, the authors will identify and categorize data that are related to DC, and elements of the institutional theory such as regulative, normative, and cognitive issues.

5. Potential contribution

The potential contribution of this study is as follows: for research and theory, the study seeks to provide a framework for the integration of APIs and provide a multi-level analysis of perceptions of developers and consumers. The findings will also strengthen the literature within the IS discipline since findings will emanate from a generalized theory. For practice, the study will illustrate the critical forces needed to address the development and integration of APIs. For policy, the study will explore the policies that determine how enterprises connect their data, software with others. Concerning originality, this study will prove to be the first to provide a multi-level analysis of API services (developer and consumer perception) and conceptualization of the API economy in Ghana. It will be the first research to explore how organizations in developing economies achieve agility amid their institutional frames; thus, moving beyond the predominant technical analysis on APIs into some social dimensions such as value creation.

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P04: BIG DATA EVALUATION SCORECARD

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Abstract

This study seeks to examine the evolution of issues that have been espoused by both junior and senior scholars to aggregate out of literature, a criterion that can guide firms in evaluating their Big data analytic (BDA) projects. The systematic review approach took stock of varied socio-technical understanding, requirements, and capabilities used in addressing Big data issues and synthesized these issues for value accruals.

The study strongly argues that Big data benefits accrue to firms whose economic activities require distributed collaborative effort, operational visibilities, cost, and time-sensitive decisions who adopt and implement the concept in their strategic, tactical, and operational levels. Though the trend shows steady growth in scholars' interests and expectations in BDA, a significant percentage of the reviewed studies were not informed by any theory. The study contributes to BDA literature by affording scholars issue gaps and for practitioners, an analytical competency and evaluation scorecard that links strategic business goals to operational outcomes.

Keywords: Big data analytics, socio-technical challenges, analytical scorecard

1. Introduction

Recent capabilities to process and derive business value from “big data” (BD) has increased the attention and interest of both academia and practice in the phenomena. Existing evidential findings attribute this attention to BD’s propensity to transform the narrative of management theory and practice (Chae, Yang, Olson & Sheu, 2014; Mishra, Gunasekaran, Papadopoulos & Childe, 2017). Perhaps, the interest stems from the promise of enhanced decision insights that strategically improve operational agility, enhance performance, and enable expected return from an investment (Kiron, Prentice & Ferguson, 2014).

According to Lyytinen and Grover (2017), BD capabilities provide the necessary data-driven visibility to assist firms in offering unique customized services, detect anomalies before they affect performance, increasing firm growth, and competitive advantage. Quantitatively, IBM asserts that

organizations that fully adopt BD are likely to maximize revenue growth by 1.6 times per annum, double their earnings before interest, tax, depreciation, and amortization to appreciate stock price by 250% (IBM Corporation, 2013). Full adoption, according to Ridge, Johnston, and Donovan (2015), spans across the firms' strategic, tactical and operational levels in distributed collaborative works, operational visibility, accurate decisions, and reduction in operational cost and time.

Although the prospects for BD analytics are primarily positive, concerns such as information overload (Whelan & Teigland, 2010), investment not yielding expected benefits in legacy firms, and BD investments accruing dividends after five to ten years of full implementation, have been raised (Bughin, LaBerge & Melbye, 2017; Power, 2016). These challenges informed the call by Ransbotham, Kiron & Prentice (2015) for the better elucidation of the issues, paradigm, theories, and methodologies driving the use of BD in business processes to identify unexplored gaps necessary to explain the phenomenon better.

Regardless of extant BD scholarly review works carried out so far, (Fosso Wamba & Mishra, 2017; Fosso Wamba, Akter Edwards, Chopin & Gnanzou, 2015; Mishra et al., 2018), minimal effort, if any, got invested in developing theories (evaluation criteria) amidst the issues reviewed (Siddaway, Wood, & Hedges, 2019). In a typical literature stock-taking exercise, this paper seeks to bridge the gap identified above by answering the question: How can the current issues, themes, and conceptual approaches in BD literature assist practitioners in evaluating implementation and performance? Specifically, the paper aims to:

- Examine the evolution of issues that have been espoused by both junior and senior scholars to aggregate out of literature, a criterion that can guide firms in evaluating their Big data analytics (BDA) projects and broaden their socio-technical understanding, requirements, and capabilities for BD initiatives.

The next section of the paper outlines the research approach and the adopted protocol that informed the research boundary. Section 3.0 presents the results of the study, while section 4.0 discusses the research findings, limitations, and future gaps. The final section summarizes and concludes the study.

2. Research Approach and Protocol

Like most studies that are grounded in literature, approaches conceived were narratives, meta-analysis, vote counting, and descriptive analysis espoused by King and He (2006). However, the authors agreed on systematic review because of its theory development support, the implication for practice (Siddaway et al., 2019), and the ability to aggregate available peer-reviewed papers to address the research question (Fahimnia, Sarkis & Davarzani, 2015). Convenience and appropriateness (Petter & McLean, 2009) limited the search for articles to electronic databases. Specifically, the database search encompassed the association of information systems (AIS) electronic library of journal collections, Emerald, Web of Science, Ebscohost, ScienceDirect, and Scopus.

In trying to have a glimpse of recent issues in BD publications, the study restricted reviewed publications span to five years, from 2013 to 2017. The researchers combined key search strings such as 'big data analytics*', 'business analytics*' AND 'Business process*' AND 'Business Intelligence*', "Advanced Analytics*" AND "Business process*" which resulted in a total of 498 papers. These were manually filtered to eliminate duplications, conference papers, editorials, workshops, notes, and tutorial summaries. Only English peer reviewed completed studies in journal publications from 2013 to 2017 with relevance to the purpose study were considered. A total of 88 publications met the inclusion and exclusion criteria and got reviewed to identify the issues, theory, and methodology.

For example, through the lens of qualitative, mixed-methods, experiments, and quantitative research protocols (Duncombe & Boateng, 2009), the research methodology was classified. Thus, articles that were highly objective with the positivist structured questionnaires for survey research were under the classification "Quantitative" (Babbie, 2011), while methods such as ethnography, hermeneutics, phenomenology, case studies adopting focus group discussions, interviews, and observations got categorized as "Qualitative."

Similarly, studies that complimented the weaknesses with the strengths of both qualitative and quantitative epistemological orientation got classified as "Mixed Method" (Allana and Clark, 2018). The category "Experiment" got assigned to studies that imitated and model real-world events, processes, and operations to unearth new or improve the existing processes. However, studies with no means of identifying their methodological orientation got assigned to "Conceptual" instead of the "No Method" category adopted by Senyo et al. (2018).

2.1 Research themes

Over the years, IS scholars have encapsulated issues in themes to ease theorization. For instance, in analyzing business maturity models, Chen and Nath (2018) had data and analytics technology environment, strategic alignment, top-level sponsorship and support, analytics talents, performance management, and organizational impacts as themes emerging from their review. Similarly, Sivarajah, Kamal, Irani, and Weerakkody (2017) conceptualized Big data challenges under themes such as data challenges, process challenges, and management challenges. However, the authors adopted the IT/IS resource capabilities classification of "human capabilities, technological capabilities, and organizational capabilities" espoused by Ross, Beath, and Goodhue (1996) because it absorbs most taken for granted resource capabilities and implementation assumptions (Marfo, Boateng & Effah, 2017).

2.1.1 Human Capabilities

Human capabilities constitute a blend of requisite IT/IS human expertise and analytical competencies that are coordinated in business knowledge to identify proactive opportunities that resolve challenges at the firm level (Armstrong & Shimizu, 2007). In order to compete on talent, the human capabilities theme got stratified into three personified actors, namely: the consumers, producers, and enablers (Cosic, Shanks, & Maynard, 2012). Analytical team members with the

requisite competency of linking analytical results to the business use-case logics for daily decision-making insight and value-creating actions known as consumers (Gartner, 2014). Whereas personnel vested with the technical capabilities to code, define domain-specific business rules, analyze data and events to generate descriptive, predictive, and prescriptive analytics reports and dashboards for necessary insight are known as producers (Gartner, 2014). Enablers include system architects, project managers, and data scientists who design, build, implement, and maintain the systems used by consumers (users) and producers (analysts) (Chen, Chiang & Storey, 2012).

2.1.2 Technological Capabilities

This theme includes technological infrastructures, both physical and logical artifacts, designs, and configurations that strategically support the firm's operational, process, and analytical journey from problem identification, data mining, data sourcing, integration, and analysis for insight generation (Chae & Olson, 2013). According to Marfo et al. (2017), this theme combines analytical capabilities, data management capabilities, and infrastructural capabilities. Analytical capabilities deal with the integration of IT enablers, producers, and consumers in understanding and producing tools that shape information delivery (reports and dashboards) and analysis (Isik, Jones & Sidorova, 2011). Data management capabilities include the ability to organize and control within the analytic space, the envisaged problems and opportunities, resources, and processes. It oversees data sourcing, acquisition, processing, and data-sharing aspects of the big data capability agenda (Elgendy & Elragal, 2016). Finally, infrastructure capabilities include everything database technologies, network technologies, and communication artifacts, both hard and software.

2.1.3 Organizational Capabilities

A firms' organizational capabilities drive their fixed and variable investment in strategic structures that respond to both internal and external industry conditions inimical to growth (Minbaeva, 2017). These structures include controls and monitoring systems that continuously optimize routines and practices in conformity with industry benchmarks (Csaszar, 2012). These capabilities align IT/IS risk and responsibility competency with that of business goals to create enterprise-wide shared responsibility, accountability, ownership, and prudent priorities for effective management (Rathnam, Johnsen, & Wen, 2005). Currently, the Information System Audit and Control Association (ISACA, 2008) (ITGI, 2007) provides practitioners with an audit and control framework for firms' IT/IS governance, allowing managers to implement controls that bridge the gap between control requirement, technical issues, data-driven culture, data transparency, ethical concerns, data privacy, and business risk.

3. Presentation of Results

3.1 Search outlets and year of publication

This section analyzes the distribution of articles within a specific repository and the respective year of publication. Scopus recorded the highest number of articles (24 papers), Web of Science recorded (20 papers), AIS electronic library recorded (9 papers), ScienceDirect recorded (13 papers), Ebscohost recorded (12 papers), while Emerald had (10 papers) as represented in Fig. 1.

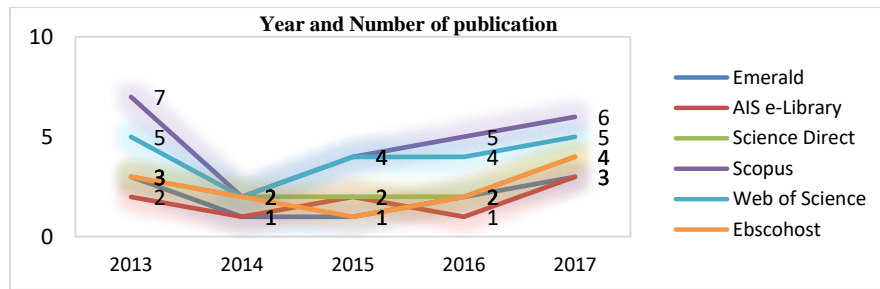


Fig. 1 Distribution of papers by year and repository

3.2 Methodology Distribution

Methodology in every research endeavor seeks to answer the question, “How do we uncover the social reality we seek to study?” (Crotty, 1998). This section examines the methodologies that were adopted to uncover the identified research reality. Of the articles reviewed, the qualitative approach recorded the highest count (40), followed by quantitative (28), Conceptual (3), mixed-method (7), and experiments (10) (see Figure 2).

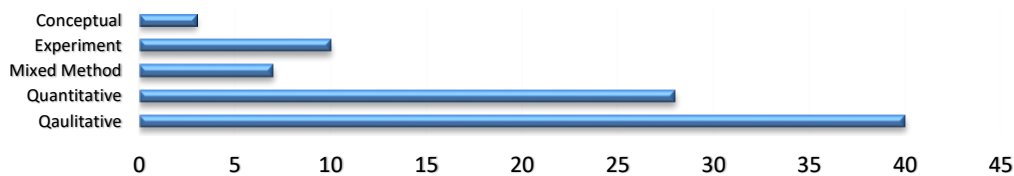


Fig. 2 Methodology Distribution

3.3 Adopted Theories

Most studies derive or build their insights from existing theories (Ravitch & Riggan, 2016). This section examines the research theories underpinning the articles reviewed. Though 44% of the studies were without any identified theory, dynamic capabilities (DC) dominated the count with 14, representing 16%, the resource-based view (RBV) recorded nine articles to represent 10%. Socio-technical theory, systematic review models, organization information processing theory, and new theories conceptualized or developed by authors recorded three articles each, representing 3.4%.

Table 1. Distribution by Theory (> a paper)

Adopted Theories	Frequency	%
Dynamic capabilities (DC)	14	16
Socio-technical theory	3	3.4
Systematic literature review	8	3.4
Resource-based view (RBV)	12	10
Technological, organizational, and environmental framework (TOE)	2	2.2
Author's theory	3	3.4
Organization information processing theory	3	3.4
No theory	30	44.3

Theories such as technology, organizational, and environmental (TOE) recorded two articles,

representing 2.2%. Adaptive capabilities, affordance theory, absorptive capacity, contingency theory, acceptance theory, organizational design theory, task-technology fit theory, technology acceptance model (TAM), cognitive capability, current learning theory, and organizational motivation theory each appeared once in the study (see Table. 1).

3.4 Trending Issues

Figure 3 depicts the issues embedded in the adopted themes and displays the trend in the research area from 2013 to 2017. Out of the human, technical and organizational capabilities, the authors identified issues bordering on BD integration strategies, BD economic impacts, informational benefits of BDA, BD frameworks, BD socio-technical implications, BD quality constraints, analytics as a service, BD typology, constraints in BD decisions, challenges in interpreting BD output, BDA value creation models, ethical concerns, performance theories, performance frameworks, Big data integration challenges, and process innovation.

It was further discovered that for each issue addressed in a reviewed paper, the authors prescribed one or two useful use-case questions that seek to resolve either a technical, business or social issue or a bottleneck in the implementation stage of the BDA initiative. These use-case questions were collated and themed according to the IT/IS resource capabilities classification of “human, technology, and organizational capabilities” (Ross et al. 1996) with specific constructs to form an evaluation scorecard, as shown in appendix 1.

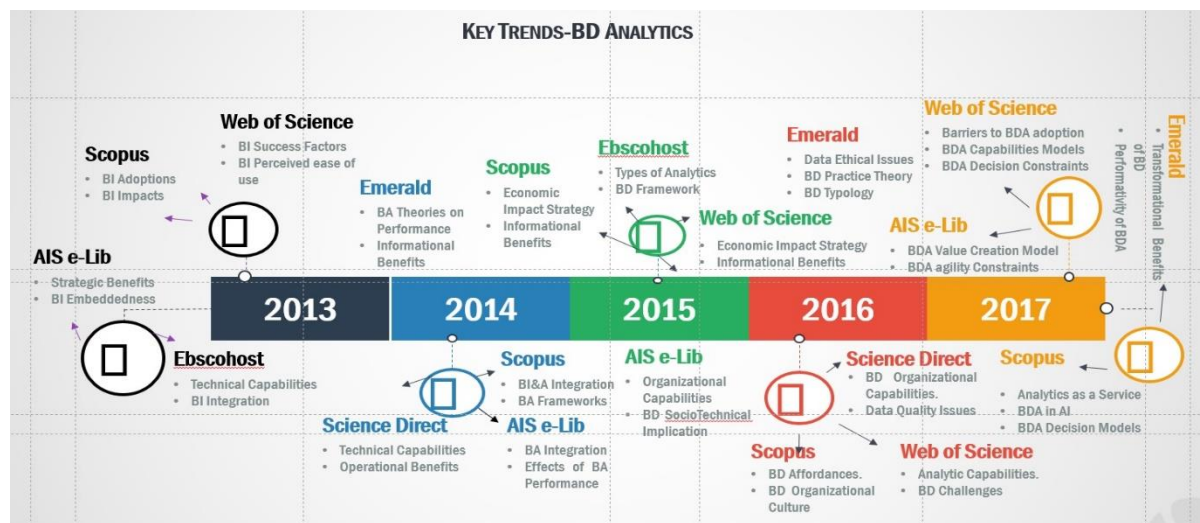


Fig. 3. The Issue Trend

3.5 Firm Evaluation Score Card

Both industry and academia often devise means of measuring performance and feedbacks on actions borne out of strategic initiatives. For instance, while Ban et al. (2016) designed the first nationwide ProPublica surgeon scorecard to measure complication rates, Tan, Zhang, and Khodaverdi (2016) applied their performance scorecard in measuring client feedback in the automotive service industry. Similarly, the Sohar University in Oman established a strong association between the implementation of a strategic road map and a performance scorecard. Literature

makes a case for low expected BDA investment benefits and performance for legacy firms (Bughin et al., 2017). Leading to the need to aggregate from literature, a criterion that can guide firms in evaluating their BDA projects and broaden their socio-technical understanding, requirements, and capabilities for BDA. The BDA Competence / Evaluation Scorecard (Appendix 1) got designed to assist firms that are considering partial to full analytical migration to track, monitor, and evaluate operational, tactical, and strategic decisions. The respective dimensions on the scorecard were further stratified into constructs and rated based on the score assigned and to a particular chosen answer to a question. The formula for rating a firm's total analytic competency stage is as follows:

$$\frac{\sum(s)}{\sum(x)} (100\%)$$

The summation of a firm's score on each competence criterion is $\sum(s)$, while $\sum(x)$ is the sum of all the default maximum scores of the framework. The scorecard framework is tied to the Davenport and Harris (2007) analytical maturity model to aid firms in situating their performance scores in the analytical maturity model's growth stages. The growth stages are categorized as follows: 90%–100% score is Stage #5 (Analytical Competitors), 89%–80% is Stage #4 (Analytical Company), 79%–70% is Stage #3 (Analytical Aspirations), 69%–60% is Stage #2 (Localized Analytics), and 59% or less is Stage #1 (Analytically Impaired) (Table 2).

For example, based on Davenport and Harris (2007) analytical maturity model, every firm that seeks to compete on analytics, must aspire to reach "Stage 5" of maturity, where the search for new data and metrics are endless with essential analytical resources managed centrally and enterprise-wide. The leadership of this firm must have a strong passion for competing and supporting the firm's distinctive capabilities and strategy with analytics while engaging or training amateur analysts to world-class professionals. However, before "stage 5", firms can establish their maturity stage by using the BD evaluation scorecard, which is in the form of a five (5) Likert scale questionnaire. Each box ticked as an applicable gets assigned to the scale number, these scale numbers are summed up representing $\sum(s)$, which is further divided by the sum of all default maximum scores of the framework $\sum(x)$. A percentage of this value is compared to the score range of the maturity model to establish the firm's stage.

4. Discussion and Future Research Gap

This section discusses the results presented in the earlier section. From the results, we can posit that BDA drives operational insight for actionable decisions with some level of certainty in the artifacts outputs, which is something highly sought after in every business decision (Davenport, Barth, & Bean, 2012). Within the information systems discipline, the interest in and attention on BDA is evident in the number of research articles received even in the queried repositories. In the early stages of BDA, as evidenced in Figure 1 and Figure 3., the interest and expectations were very high with issues such as factors affecting adoption (Mahrt & Scharrow, 2013), adoption and impacts of social media analytics on businesses (Esteves & Curto, 2013) were identified. Other scholars noticed the strategic benefits of aggregating and linking heterogeneous data (Mithas, Lee, Earley, Murugesan, & Djavanshir, 2013) and frameworks for understanding enterprise analytic success factors (Mungree et al., 2013). Finally, agility through new technology (Demirkan & Delen, 2013; LaValle, Lesser, Shockley, Hopkins, & Kruschwitz, 2013) and latency between data acquisition and

decision (Leonardi, 2013) got researched to reflect the issues inhibiting firm’s BDA capital investments drive.

ANALYTIC MATURITY MODEL					
	DATA	ENTERPRISE	LEADERSHIP	TARGETS	ANALYSTS
STAGE 5 Analytical Competitors	The relentless search for new data and metrics	All key analytical resources centrally managed	Strong leadership passion for analytical competition	Analytics support the firm’s distinctive capability and strategy	World-class professional analysts and attention to analytical amateurs
STAGE 4 Analytical Companies	Integrated, accurate, common data in a central warehouse	Critical data, technology, and analysts are centralized or networked	Leadership support for analytical competence	Analytical activity centered on a few key domains	Highly capable analysts in central or networked organization
STAGE 3 Analytical Aspirations	Organization beginning to create a centralized data repository	Early stages of an enterprise-wide approach	Leaders beginning to recognize the importance of analytics	Analytical efforts coalescing behind a small set of targets	The influx of analysts in key target areas
STAGE 2 Localized Analytics	Data usable, but in functional or process silos	Islands of data, technology, and expertise	Only at the function or process level	Multiple disconnected targets that may not be strategically important	Isolated pockets of analysts with no communication
STAGE 1 Analytically Impaired	Inconsistent, poor quality, poorly organized	N/A	No awareness or interest	N/A	Few skills, and these attached to specific functions

Table 2. Analytics Maturity Model (Source: Davenport and Harris 2007)

Though accounts of some waning interest and unmet expectations borne out of the difficulties encountered by early adopters (Bughin et al., 2017), the issues dealt with by researchers from 2014 to 2016 were somewhat an extension of those encountered by early adopters—specifically, data integration challenges affecting decision quality (Abawajy, 2015; Amankwah-Amoah, 2016), lack of frameworks and theories for policy, legal, regulatory, and performance concerns linked to business value (Amankwah-Amoah, 2015; Gandomi & Haider, 2015; Simonet, Fedak, & Ripeanu, 2015; Zhang, Hu, Xie, Zhang, Su, & Liu, 2015) were addressed. Most of these researchers also examined the impact of economic strategy on culture, analytic investment, agility, performance, and value realization (Akter, Wamba, Gunasekaran, Dubey, & Childe, 2016; Dobrev & Hart, 2015; Marshall, Mueck, & Shockley, 2015). Finally, socio-technical complexities in ethical and data quality concerns got identified as issues that might have caused the waning of interest and expectations of early adopters (Metcalf & Crawford, 2016).

Though Figure 1. Showed a trend of rising interest and expectations in 2017, as evidenced by the number of publications in all the six repositories, the issues were not distinctively different from the issues encountered in the years 2014 to 2016. The research community addressed issues such as

adoption barriers, value-creating models, agility constraints, BDA decision constraints, Decision models, BDA as a service, and its associated transformational benefits. Based on the apparent rising trend in terms of volumes (Fig.1) and the sensitivity of issues depicted in Fig. 3, we predict a rise in interest and expectations (high number of research publications) of BDA in enterprise-wide business processes to continue. Generally, the issues examined yearly in the various repositories addressed technological, human, or organizational capability challenges inimical to BDA value creation and performance benefits. However, further studies should be encouraged to view capabilities from socio-technical or socio-material perspectives with broader scope and depth to Big data strategy, adoption, implementation, and practice. The imbrication of the technical, human, and organizational capabilities should minimize the challenges associated with poor data-driven culture (Kiron et al., 2014), data integration and ethics (Bialobrzeski, Ried & Dabrock, 2012), data quality (Bose, 2009), and process innovation bottlenecks that are common with legacy firms.

We further suggest that legacy firms adopt well-defined data management policies, goals, and strategies (McAfee & Brynjolfsson, 2012) to inform deliberate, analytical skill development policies for personnel and executives of business processes (Chang, Kauffman, & Kwon, 2014). Junior scholars should take a keen interest in critiquing new concepts, theories, and methodologies that seek to explain how to overcome concerns such as data ethics, data quality, data privacy, and data security. These challenges pose the most significant obstacle to realizing the fundamental socio-economic viabilities of BD initiatives (Nelson, Todd, & Wixom, 2005).

In analyzing the theory results, an interesting skewed trend was observed. Though 44.3% of the studies were not informed by any specific theory (Cervone, 2016; Janssen, Van Der Voort, & Wahyudi, 2017), most studies relied on dynamic capabilities (DC) theory (16%) and the resource-based view (RBV) (10%) to best explain and inform their inquiries. It is worth noting that dominant theories, such as Socio-Technical Theory, Organization Information Processing Theory, and Technology Organizational and Environmental (TOE) theory, appeared only once in the 88 papers reviewed. While some of these theories were combined to optimize outcomes, this study directs future research efforts in the knowledge generation process to dominant theories different from the list in Table 1 for different insight on the subject.

Besides the establishment of a firms' maturity stage, the objective answers to the developed evaluation scorecard in appendix 1 will further assist firms in identifying implementations gaps regarding the scores in individual dimension and their corresponding constructs. Where areas or questions of lower scores can get the attention of leadership for the needed interventions for higher scores, which progresses the firm closer to the stage (5) of the maturity framework.

5. Conclusions

This study sieved through six well-known repositories for peer-reviewed studies on Big Data analytics in business processes published within the year 2013 to 2017. The sieving criteria resulted in 88 articles that got analyzed for the conceptual approach, research methodology adopted, and thematic issues identified. The study also enacted out of the 88 articles an analytical scorecard to assist business executives in evaluating progress and tracking the performance status of their firm's analytic journey for gaps. The study affirms that legacy firms with an improved socio-technical approach to addressing data quality constraints, data privacy complexities, ethical and security

concerns could increase their propensity to generate expected benefits (Davenport, Barth & Bean, 2012). The findings further identify relevant gaps in theory, issues, context, and methodology. Combined with the scorecard, these identified gaps should benefit scholars in situating future research direction and practitioners in their attempts to embed big data analytics in business processes, evaluate BD implementation for competitive advantage. We posit further that BDA's infusion into business processes must take into account the formulation and enforcement of cultural and formalized data-driven process strategies that enable constant monitoring and reconstruction of operational processes.

Several limitations have been identified in the study, regardless of the adopted methodology. The study's result is likely not to reflect the exact trend since the study was limited to the English language, spans from 2013 to 2017, and did not also cover all repositories. That led to the exclusion of equally relevant articles in other languages, repositories, and years. The scorecard yet to be tested; therefore, future works can apply the scorecard framework to establish its reliability for purpose. This study will benefit the efforts of a broad range of researchers and practitioners. The findings will assist researchers in identifying new research questions and gain an overview of current research directions that align with their work. Practitioners will gain insight into challenges associated with integrating data, whether "big" or otherwise, into business processes and use the evaluation scorecards to track and evaluate their BD implementation and operations. Young scholars may use these findings as a guide to locate and publish various types of related articles and to gain further insight into the emerging field of advanced analytics.

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P05: Cocriação no desenvolvimento de sistemas de informação: o caso do software de gestão de processos eletrônicos de uma universidade federal brasileira

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Resumo

O desenvolvimento de sistemas de informação (SI) é um processo complexo que frequentemente está associado a falhas, inconsistências ou deficiências. Para lidar com essa complexidade, novas abordagens têm sido estudadas, como a cocriação, um fenômeno pautado em interações e experiências entre consumidores e organizações. Apesar da relevância desse conhecimento, há relativamente poucos estudos relacionando os temas da cocriação e da gestão de SI, especificamente no campo do desenvolvimento de software. Para endereçar esta lacuna, foi feita uma pesquisa de estudo de caso que investigou o processo de cocriação no desenvolvimento de um software de gestão de processos eletrônicos em uma universidade federal brasileira. O estudo de caso identificou canais, práticas favoráveis, características e métodos de cocriação aplicados em um contexto de desenvolvimento de software de uma universidade federal que podem ser adotadas por outras organizações públicas congêneres.

Palavras-chave: Sistemas de Informação, Cocriação, Desenvolvimento de software, Processos eletrônicos.

Abstract

The information systems (IS) development is a complex process that is often associated with failures, inconsistencies or deficiencies. To deal with this complexity, new approaches have been studied, such as co-creation, a phenomenon based on interactions and experiences between consumers and organizations. Despite the relevance of this knowledge, there are few studies relating the themes of cocreation and IS management, specifically in the field of software development. To address this gap, a case study was conducted investigating co-creation process in the development of electronic process management software at a Brazilian federal university. The case study identified channels, favorable practices, characteristics and co-creation methods and applied to the context of software development at a federal university that can be adopted by other public organizations.

Keywords: Information System, Co-creation, Software development, Electronic processes.

1. Introdução

O desenvolvimento de software é um processo complexo que requer habilidades para lidar com mudanças (Dybå, 2000). As organizações têm adotado abordagens que integram recursos de várias entidades, incluindo clientes, fornecedores e redes colaborativas com o intuito de minimizar falhas e inconsistências no processo de desenvolvimento de software (Kazman & Chen, 2009). Uma dessas abordagens é a cocriação, que tem como ponto central a atuação conjunta entre os consumidores e o mercado, alterando a forma como o valor é criado (Galvagno & Dalli, 2014). Esse fenômeno ganhou força nos últimos dez anos com o advento da internet, das redes sociais e das tecnologias móveis, e tem gerado oportunidades de colaboração entre produtores e consumidores em diversos segmentos (Degnegaard, 2014; Ramaswamy & Ozcan, 2016).

Os estudos sobre cocriação são amplos e multidisciplinares, destacam-se trabalhos sobre o processo de desenvolvimento de produtos e serviços (Filiari, 2013; Pee, 2016); a cocriação de marcas (Juntunen, 2012); a geração de inovação (Russo-Spena & Mele, 2012) e sistemas complexos de serviços business-to-business (B2B) (Breidbach & Maglio, 2016).

Apesar da relevância, evidenciou-se na revisão de literatura que poucos estudos abordam a cocriação no campo de desenvolvimento de SI. Paralelamente, os estudos sobre cocriação de produtos e serviços apontam melhorias e benefícios em envolver os consumidores na linha de frente do processo de desenvolvimento de produtos (Filiari, 2013; Sigala, 2012), enquanto Nakki (2011) indica que o uso de modelos e iniciativas de cocriação pode contribuir com a melhoria do escopo do *software*, obtenção de requisitos claros e maior nível de engajamento. Esses indicativos levam a endereçar o problema de pesquisa: “como a cocriação está presente no processo de desenvolvimento de um sistema de informação?”

Para responder ao problema de pesquisa, este trabalho tem como objetivo investigar empiricamente o fenômeno da cocriação no desenvolvimento de um SI, em particular, o software Mesa Virtual que gerencia processos eletrônicos administrativos voltados para a esfera pública e possui mais de 50.000 usuários espalhados por diversas instituições do Brasil. |

2. Cocriação e Desenvolvimento de SI

2.1 Desenvolvimento de software

O *software* pode ser definido como um conjunto de planos técnicos para a operação e o uso de um sistema de processamento multidistribuído por uma organização de pessoas em sua evolução natural ao longo do tempo (Mills, 1980). O processo produtivo do *software* difere do processo de produtos manufaturados. O *software* é desenvolvido a partir de um processo de concepção ou design que se dá normalmente de forma coletiva, baseado em habilidades artesanais e conhecimentos tácitos dos indivíduos envolvidos e em processos não automatizáveis (Roselino, 2006). Existem diversos tipos de software, como comercial, embutido, científico. O tipo de *software* estudado nesse trabalho é o sistema de informação aplicado em um ambiente organizacional.

A perspectiva dominante no desenvolvimento de software (DS) é voltada para o uso de métodos, modelos e técnicas baseados na engenharia voltados para a identificação de fases pré-definidas, permitindo um controle durante todo o projeto de desenvolvimento (Dybå, 2000). Outra perspectiva aponta para o papel da improvisação e da *bricolage* no desenvolvimento de um SI como forma de superar as contingências e mudanças em torno do projeto original, as quais acarretam ajustes contínuos ou mesmo o desenvolvimento de soluções novas e úteis em um curto período de tempo (Ciborra, 1991; Magni, Provera, & Proserpio, 2010).

Percebe-se que, além da natureza técnica e sistematizada do processo de construção do *software*, também coexiste um processo coletivo, criativo, intensivo em conhecimento que tem influência de capacidades humanas (Diegues Jr, 2010; Dybå, 2000). Podemos caracterizar como processo de cocriação como um meio de inserir atores que usam a experiência de cada situação para interpretar informações, utilizar os recursos existentes de maneira eficiente e gerar situações criativas (Edvardsson, Kristensson, Magnusson, & Sundström, 2012). O tópico a seguir descreve mais detalhes do fenômeno da cocriação.

Cocriação

A cocriação é concebida como fonte de valor caracterizada pelo engajamento direto dos consumidores na produção e distribuição de valor (Kambil, Friesen, & Sundaram, 1999). Desenvolvendo o conceito posteriormente, Prahalad e Ramaswamy (2004a) defendem que a cocriação é pautada na interação de alta qualidade e no conjunto de experiências que a empresa propicia aos consumidores para a criação de valor. A criação de valor é expandida em três sentidos fundamentais, que são: i) concepção e construção intensiva de valor, que é construído a partir da manifestação da capacidade humana de agir e interagir por meio de plataformas de engajamento; ii) natureza real do valor que passa a ser incorporado em domínios dialógicos, transparentes, acessíveis e reflexivos das experiências dos *stakeholders*; iii) fontes virtuais de valor que podem emergir de vários meios, como nos ecossistemas inclusivos, interconectáveis e evolutivos (Ramaswamy & Ozcan, 2016).

A cocriação pode ocorrer de diversas formas e em diversos momentos na organização, tais como a coconcepção, codesign, coprodução, copromoção, copricing, codistribuição, coconsumo, comanutenção, codisposição e coterceirização (Sheth & Uslay, (2008). Russo-Spena e Mele (2012) dividem o processo de cocriação em cinco fases (coideação, coavaliação, codesign, cotestes e colançamento) que são resultantes de interações dinâmicas e em curso entre recursos, ações e um grupo de atores, que estão interligados por intermédio de uma rede.

Tradicionalmente, a cocriação tem sido estudada no desenvolvimento de produtos e serviços (Breidbach & Maglio, 2016; Filieri, 2013). A área de desenvolvimento de *software* se refletiu como propícia à cocriação, como em projetos de desenvolvimento de *software* livre (Viana & Las Casas, 2014). O tópico a seguir apresenta os estudos que integram os temas de Desenvolvimento de *software* e de Cocriação.

2.3 Cocriação no desenvolvimento de software: estudos relacionados

Um dos primeiros estudos a associar a cocriação ao desenvolvimento de *software* foi publicado por

livari (2010), no âmbito de software livre (SL) A pesquisa mostrou que o desenvolvimento do SL é caracterizado como um processo de cocriação contínuo, em evolução e ininterrupto, incluindo sugestões dos usuários, suporte dos usuários entre si, negociações entre os usuários e desenvolvedores, constante aprimoramento incremental das soluções e formação contínua de identidade entre os participantes. Outros estudos constataram que o uso de métodos ágeis é propício à cocriação e fornece uma estrutura adequada para o envolvimento dos usuários, os quais podem participar ativamente do processo de design, ter poder de decisão, se envolver na geração de ideias, no compartilhamento de desejos e influenciar os produtos futuros (Babb Jr. & Keith, 2011; Nakki et al., 2011; Noordman, Driesenaar, van Bruinessen, & van Dulmen, 2017).

Novas perspectivas emergiram nesse campo, como o *crowdsourcing*, que abrange o desenvolvimento de ferramentas colaborativas, a participação aberta e o uso plataforma de ecossistemas de *software* (Machado, Kroll, Prikladnicki, de Souza, & Carmel, 2016) e o *crowdtesting*, uma aplicação específica de *crowdsourcing* que envolve um grupo diversificado de pessoas dispersas geograficamente, conectadas pela internet e testam *software* em ambientes reais usando seus próprios dispositivos (Leicht, Blohm, & Leimeister, 2016). Tanto o *crowdsourcing* como o *crowdtesting* habilitam a cocriação entre o desenvolvedor e o cliente ao longo dos estágios do ciclo de vida de um sistema.

A análise da revisão de literatura revelou que o desenvolvimento de *software* apresenta características e peculiaridades favoráveis à cocriação, entre elas: 1) necessidade de interação com o usuário, desenvolvedores e outros agentes para definição do conceito do *software*; 2) realizações constantes de ajustes e correções de erros e, para isso, o contato com o usuário é essencial; 3) setor dinâmico, em crescimento e marcado pela competitividade; 4) propensão à inovação; 5) existência de *softwares* e ferramentas colaborativas que podem ser usados como canal importante para a comunicação entre as equipes.

3. Procedimentos Metodológicos

Trata-se de um estudo exploratório com abordagem qualitativa realizada para estudar os significados dos participantes e as relações entre eles, desenvolvendo uma contribuição teórica ao campo de conhecimento (Saunders, Lewis, & Thornhill, 2016). A estratégia de investigação escolhida foi o estudo de caso único porque investigou-se um SI delimitado da vida real por meio da coleta de dados em profundidade envolvendo múltiplas fontes de informação, seguindo as recomendações de (Creswell, 2014; Yin, 2015).

O caso escolhido foi o desenvolvimento dos sistemas integrados de gestão (SIGs) da Universidade Federal do Rio Grande do Norte (UFRN), especificamente o módulo Mesa Virtual, que gerencia processos eletrônicos administrativos de órgãos públicos, associado ao Sistema Integrado de Patrimônio, Administração e Contratos (SIPAC). Este SI foi desenvolvido internamente, mas tem ampla disseminação, sendo adotado em outras 23 instituições e/ou órgãos federais do Brasil, tais como, institutos e universidades federais, Polícia Federal, INSS, ANAC e outros. Esses sistemas auxiliam na gestão e na rotina de organizações por meio de convênios e cooperação técnica. Atualmente os SIG contam com mais de 50 mil usuários cadastrados (ver <https://info.ufrn.br>).

O Mesa Virtual surgiu para atender ao conjunto de normativas referentes ao Processo Eletrônico Nacional (PEN) pelo Governo Federal do Brasil, especificamente ao Decreto nº 8.539 de 8 de Outubro de 2015, o qual determinou que todos os órgãos e entidades da administração pública federal direta, autárquica e fundacional instaurassem o processo eletrônico com o objetivo de assegurar eficiência, eficácia, efetividade as ações; promover a transparência; ampliar a sustentabilidade ambiental e facilitar o acesso do cidadão às instâncias administrativas (Decreto no 8.539 8 de Outubro, 2015). Em sua versão original, o módulo do SIPAC (anteriormente desenvolvido internamente pela UFRN) não atendia o decreto. Desta maneira, foi preciso “reescrevê-lo” e desenvolver um novo módulo. Essa peculiaridade, relevância e a magnitude do sistema foram os critérios para elegê-lo como estudo de caso.

Como método de coleta de dados, a pesquisa combinou entrevistas semiestruturadas e observação direta. Os dados foram coletados no período de março a maio de 2019. O método principal de coleta utilizado foi a entrevista semiestruturada com uso da fotoelicitação para estimular a memória dos entrevistados e possibilitar que o informante explique e identifique o conteúdo de fotografias pré-selecionadas apresentadas (Merriam, 2009). Os questionamentos de partida foram: 1) *Como as pessoas ou atores participam do desenvolvimento ou aprimoramento dos sistemas SIGs?* 2) *Como se dá o envolvimento delas nesse processo?* 3) *O que esta pessoa representa para os sistemas SIGs? (fotoelicitação)* 4) *Como contribui com o desenvolvimento ou aprimoramento dos sistemas?* *Os dados utilizados neste artigo são parte de uma pesquisa mais ampla para a tese de doutorado de uma das autoras.

A estratégia utilizada para selecionar os sujeitos da pesquisa foi a bola de neve, que identifica casos de interesse de uma amostra de pessoas que conhecem outras pessoas que têm informações ricas sobre o caso estudado (Patton, 2002). Inicialmente, foi feito o contato com um gestor e um analista de requisitos do sistema em desenvolvimento. Por meio dele, chegamos aos demais atores à medida que estes eram citados nos relatos dos entrevistados. Ao final, foram selecionados 13 participantes, sendo 11 entrevistas presenciais e duas a distância para aqueles que residiam em outros estados da federação. A duração das entrevistas variou de 30 a 60 minutos. Com o consentimento devido, as entrevistas foram gravadas e transcritas. Para preservar a identidade, foram criados nomes fictícios. Além disso, houve uma diversidade de entrevistados de acordo com funções: cinco usuários; quatro gestores e quatro técnicos da equipe de desenvolvimento.

A coleta de dados por observação foi realizada durante reuniões formais dos gestores e representantes dos usuários sobre o desenvolvimento do módulo, no comitê interno. Foi utilizado um protocolo de observação para registro de ações, interações, comportamento dos participantes, conversas casuais.

O conteúdo das entrevistas e os registros das observações foram transcritos para um *software* de apoio à análise qualitativa (Atlas.ti® v.8.4.2). Por meio da técnica de Análise Temática, o processo de codificação utilizado nesta pesquisa mescla duas abordagens. A primeira se baseia na literatura (abordagem dedutiva) e a segunda é fundamentada pelos dados empíricos (abordagem indutiva), ambas com o propósito de classificar, codificar e enxergar padrões nesses dados. Foram realizados dois ciclos de codificação e geradas subcategorias que refletem relações e explicações sobre o fenômeno (Boyatzis, 1998). As subcategorias encontradas foram: **CAN_Canais de interação**,

ancorada em Zwass (2010), Ramaswamy e Ozcan (2016); **PRA_Práticas de cocriação**, baseada em Suerdem e Oztaysi (2016), van Limburg, Wentzel, Sanderman, e van Gemert-Pijnen (2015) e Leicht et al. (2016); **CAR_Características da cocriação** pautada em Galvagno e Dalli (2014), Prahalad e Ramaswamy (2004a), livari (2010), Demirezen, Kumar e Shetty (2016), Nakki *et al.* (2011); e **MET_Métodos de desenvolvimento**, apoiada por Boehm (2012), Magni, Provera e Proserpio (2010), Demirezen, Kumar, & Shetty (2016), Nakki *et al.* (2011); Ciborra (1991) e Kautz (2009).

4. Análise e Discussão dos Resultados

A instituição do estudo delineou um conjunto de estratégias e ações ancorado em interações entre grupos de atores, os quais colaboraram mutuamente para criação e aprimoramento do sistema, o qual caracterizamos como processo ‘Cocriador’. Com base na análise temática, foi possível descrever a categoria central “COC_Cocriação de SI” e os aspectos que descrevem a cocriação, compreendidas em quatro subcategorias: CAN_Canais de interação; PRA_Práticas adotadas; MET_Métodos de desenvolvimento e CAR_Características cocriação. Cada subcategoria se desdobra em códigos que a representam. A figura 1 traz a rede semântica das categorias e códigos.

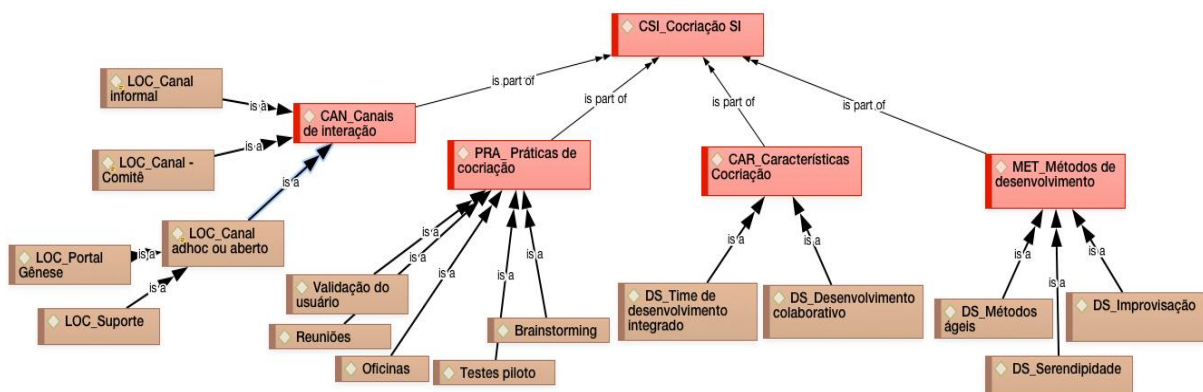


Figura 1: Rede das categorias criadas

Fonte: Elaboração própria, 2020

4.1 Canais de interação

Para que a cocriação ocorra, é recomendada a existência de canais para diálogo e recebimento de demandas, solicitações e ideias. No estudo de caso em questão, as ideias emergem por meio de três canais específicos, que são os códigos “Canal adhoc ou aberto”, “Canal Comitê” e “Canal informal”. O canal aberto é constituído pelo Portal Gênese (17 citações) e o Suporte técnico (17 citações). No Portal Gênese, que é uma plataforma digital nova desenvolvida internamente para receber indicações de erros e sugestões de melhoria por parte de usuários dos SIGs, as postagens são visualizadas por toda a comunidade de usuários que, por sua vez, podem votar nelas ou apenas deixar o seu “gostei” ou “não gostei”. Isso gera uma maior validade à cocriação e atende às necessidades universais da comunidade, conforme elucida Kátia: “Aí tudo que a gente vê de dificuldade e que pode melhorar, a gente vai lá no GÊNESE e coloca uma contribuição [...] Aí como

são melhorias que influenciam a universidade inteira, a gente coloca no GÊNESE. Eu costumo olhar constantemente”. A literatura estuda o papel de plataformas de engajamento disponibilizadas pela organização para que a cocriação ocorra (Zwass, 2010, Ramaswamy & Ozcan, 2016). Constata-se então que o uso de plataforma de engajamento é um importante canal de validação de sugestões e ideias para cocriação.

O Suporte técnico é voltado para dúvidas ou solicitações de correções de erros com que se depara o usuário no dia-a-dia. É o canal mais utilizado pelos usuários finais que não têm acesso ao comitê ou acesso direto à equipe de desenvolvimento. Por meio do suporte, ideias são direcionadas para um fluxo geral de todos os módulos e sistemas integrados da Instituição. Em seguida, recebem um primeiro filtro da equipe de suporte que as redirecionam para a equipe de desenvolvimento. Esse é o canal em que a ideia percorre um maior caminho e pode demorar mais tempo para ser implantada. A fala de João retrata isso: “mais de 99% ligam para o suporte. E eles não dão suporte só para o Mesa Virtual”.

Outro tipo de canal que emergiu dos dados é o Institucional com 28 citações. Esse canal é retratado por um comitê criado internamente para conduzir o desenvolvimento do software em tela, composto por atores/*stakeholders* ligados ao sistema. As ideias são concebidas a partir da interação e da discussão entre atores que compõem esse comitê ou chegam no comitê por meio de algum ator que leva a demanda. A partir daí são avaliadas a prioridade, viabilidade e forma de implantação, e posteriormente direcionadas para a equipe de desenvolvimento. Percebe-se que esse canal é efetivo pois emana poder de decisão, tem *stakeholders* representativos do processo que discutem as demandas, as prioridades e redirecionam para os *stakeholders*-chave do desenvolvimento. Isso foi identificado na fala de USR_Lucia, durante as observações: “Abra um chamado explicando tudo isso, mas eu também vou passar para Márcia que é a nossa representante lá na comissão e ela levando é mais rápido de ser resolvido.”

O canal informal emergiu nos dados como outra fonte de diálogo. Foram vinculadas 11 citações a esse código. Apesar da instituição solicitar o uso dos canais institucionais, os usuários utilizam mais o *WhatsApp*® para entrar em contato com os principais *stakeholders* do desenvolvimento do sistema e levar as suas demandas. Isso surgiu nos relatos de USR_Lucia e USR_Marcelo. Além disso, essa ferramenta de mensagem instantânea também é utilizada para discussão e geração de ideias com outros atores.

“... conheço alguns desenvolvedores [então] de vez em quando eu mando um *WhatsApp* pra eles perguntando assim ‘E isso aqui não ia ser acolá?’, aí eles vão, quando eles podem, responder, eles respondem. Mas, eles pedem que a gente utilize o canal formal (...) abrir um chamado ou através do nosso representante lá no comitê.” (USR_Lucia).

“Daí eu conversei, a gente tem um grupo no *WhatsApp*, eu, a pró-reitora e a coordenadora da equipe de informática da universidade, só que é sobre bolsas, módulo Bolsas. Então a gente leva as demandas lá e nós três acabamos discutindo, né, então eu tenho bastante experiência.” (USR_Marcelo).

Percebe-se que a disponibilização de canais possibilitou o diálogo durante o processo de construção do Mesa Virtual, permitindo que a organização alcançasse melhor os usuários e atores envolvidos. Isso corrobora com a literatura que preconiza que o diálogo é um elemento importante na cocriação

que implica interatividade, engajamento profundo, capacidade e disposição para agir tanto por parte do cliente como da empresa em busca de uma solução compartilhada (Prahalad & Ramaswamy, 2004b).

4.2 Práticas adotadas de cocriação

A segunda subcategoria foi denominada de PRA_Práticas adotadas. Essas práticas deram respaldo ao processo de cocriação por meio da interação contínua como testes pilotos (5 citações), validações (4 citações), reuniões (3 citações), *brainstorming* (2 citações) e oficinas (1 citação). A realização de reuniões é uma prática comum retratada pela literatura de desenvolvimento de software.

Entretanto, evidenciou-se que, no processo de cocriação aqui estudado, essas reuniões diferem das tradicionais e são associadas com validações individuais dos usuários e os testes-piloto. Essa foi uma prática essencial para decidir as especificações e construir os processos mais críticos da Universidade.

As oficinas interativas foram identificadas como uma prática dinâmica para interação entre os atores e geração de soluções. Para a geração de ideias e soluções foi o *brainstorming* que pareceu ser eficaz para a cocriação do *software*, em especial na fase de ideação.

“A gente faz isso muito numa visão de oficina. A gente traz os *stakeholders* mais os servidores, normalmente não é um grupo grande, quando é um grupo grande a gente traz uma representação, colocam dentro de uma oficina pra que eles mapeiem o processo, eles levantam os problemas do processo e desses problemas a gente pensa em soluções que a Mesa pode atendê-los” (GST_Antonio).

“E nessa ideia de validação, de *brainstorming*, eles trazem, né, nas concepções deles, mas não tem uma coisa estruturada. É quando a gente pede... sempre tem uma demanda que a gente sobe e leva pra eles” (GST_Antonio)

Esses achados corroboram com a literatura que evidencia o uso de *brainstorming* com especialistas (Suerdem & Oztaysi, 2016; van Limburg et al., 2015) e testes dinâmicos com usuários (Leicht et al., 2016) para cocriação de ferramentas.

4.3 Características da cocriação

A terceira categoria criada foi a CAR_Características da cocriação abrangem: “Time de desenvolvimento integrado” (5 citações) e “Desenvolvimento colaborativo” (18 citações). Essas são características de um processo cocriador identificadas nos relatos e especificadas pela literatura (Galvagno & Dalli, 2014; Prahalad & Ramaswamy, 2004a). Os técnicos relataram que os formatos tradicionais de divisões das equipes atrapalhavam a visão do processo como um todo e a integração entre os atores. Ao adotar um time integrado, as atividades são direcionadas para todos. As falas abaixo exemplificam os achados:

“A gente tinha esse formato de equipe separada, mas aí se resolveu colocar dentro dos times agora.” (ANP_Anderson)

“Antes a gente tinha a equipe de requisitos, né, a equipe de testes, a equipe de movimento e

hoje tá todo mundo junto... A gente tem a equipe do SIPAC, então dentro da equipe do SIPAC a gente tem desenvolvedor, testador e analista negocial. E... Assim, são os, os soldados que, que criam a fera, né.” (ANS_Alexandre)

Outra característica evidenciada nos relatos foi o desenvolvimento colaborativo. Os usuários e outros *stakeholders* são vistos pela equipe técnica como parceiros ao longo do desenvolvimento. Os entrevistados retrataram a participação dos usuários ao longo de todo o processo, desde a concepção até a fase de testes e correções. A voz dos usuários é levada em consideração em diversas etapas do desenvolvimento.

“A opinião, a voz de cada um deles (atores) foi muito importante, tanto que na nossa comissão nós temos representantes de diversas áreas. Tem da Pró-Reitoria de Gestão de Pessoas, tem da PROGRAD, tem do Gabinete da Reitora, tem da PROAD e por aí vai. Foi muito importante a construção de todos.” (USR_Raul)

Esse achado contradiz livari (2010) que identificou um certo viés autoritário dos desenvolvedores, agindo como decisores finais. Por outro lado, o estudo de caso identificou o espírito colaborativo dos usuários, facilitadores e desenvolvedores em ambientes de cocriação em projetos de TI, o que corrobora a literatura (Demirezen *et al.*, 2016; Nakki *et al.*, 2011).

4.4 Métodos de desenvolvimento

Essa categoria contém três códigos que representam métodos e forma de desenvolvimento do software. Os técnicos relataram o uso de métodos ágeis (4 citações) e a metodologia Scrum, especificamente, para estreitar a relação com os usuários, disseminar o conhecimento no time de desenvolvimento, reduzir o risco e realizar entregas parciais do *software*, bem como reduzir a ansiedade do usuário e fazer com que eles acreditem no sistema. As falas abaixo retratam isso.

“E um bom fluxo da gente, a gente tenta aplicar algumas coisas, de alguns métodos ágeis que tentam estreitar mais isso, né, tentar um ciclo menor de desenvolvimento pra alguns métodos faz sentido, é... A gente tenta mostrar durante o desenvolvimento, depois disso já prontas, mesmo que isso não esteja ainda, ou que já, já estavam prontas talvez pra ver se, se era aquilo mesmo.” (ANP_Anderson)

“[...] O pessoal tá trabalhando bastante no Scrum e o... que *sprint* vai entrar, é o risco, a equipe que vai ser alocada pra fazer.” (ANS_Alexandre)

A improvisação no desenvolvimento de *software* Mesa Virtual foi retratada no código DS_Improvisação (1 citação) como resposta para um desajuste imprevisto que ocorreu no sistema. Em uma nota da observação direta, foi retratada uma interação entre *stakeholders* que discutiam sobre um problema em uma funcionalidade. Em meio à discussão e, como forma de resposta imediata ao problema, o analista de requisitos sugeriu fazer um improviso para resolver o problema já que ele não tinha controle por completo do processo naquela situação. Mesmo não obtendo citações nas entrevistas, é um aspecto a considerar, pois percebeu-se que essa ação improvisada se deu para corrigir uma situação inesperada que partiu de uma demanda de um *stakeholder*. A improvisação parece estar presente durante a cocriação do software, uma vez que as situações inesperadas podem acontecer e a equipe desenvolve sua capacidade para lidar com a situação. Isso corrobora com a literatura que mostra a existência de ações improvisadas no desenvolvimento de SI

(Bansler & Havn, 2004; Ciborra, 1991; Kautz, 2009).

Outro elemento que se relaciona com essa questão é o código DS_Serendipidade (1 citação). Esse código retrata uma solução que surgiu de maneira inesperada, com base na solicitação de dois *stakeholders* e que coincidiram com a mesma ideia. Ao refletir, o analista de requisitos viu que era uma ideia importante a ser incorporada ao sistema. ANR_João destacou: “E aí são coisas, que são coincidências, hoje eu passei a manhã no TJ e uma das coisas que o pessoal pediu foi justamente depois na hora do almoço que USR_Glauria me mandou foi a mesma coisa. Aí eu ‘Rapaz, isso aqui é mesmo importante.’”

A serendipidade representou uma coincidência “feliz” ou descoberta inesperada que surgiu durante as interações com diferentes *stakeholders*. Isso está de acordo com a literatura que destaca a abertura a soluções inesperadas no desenvolvimento de *software* (Ciborra, 1991). O fenômeno da serendipidade como elemento presente na cocriação de um *software* foi um achado interessante que pode ser mais bem explorado em outras pesquisas de campo.

5. Conclusões

O estudo de caso identificou canais, práticas favoráveis, características e métodos de cocriação aplicados em um contexto de desenvolvimento de software de uma universidade federal. A pesquisa empírica mostrou que a existência de canais propicia o diálogo, envolvimento e interação dos atores durante a cocriação. É por meio dos canais que os atores contribuem com ideias, solicitações e sugestões para o aprimoramento do sistema. Dentre esses canais, tem-se aquelas plataformas próprias disponibilizadas pela organização, como o portal Gênese e o suporte; um canal institucional mais restrito do tipo comitê que emana poder de decisão, priorização e validação das demandas e o canal informal, o *WhatsApp*®, que emergiu como uma solução alternativa (*workaround*) para acesso aos desenvolvedores e discussão de ideias em grupo.

Constatou-se também que o espírito coletivo entre usuários, gestores e técnicos, a integração do time de desenvolvimento e o uso de métodos ágeis são características presentes na cocriação de um SI. Adicionalmente, a abertura à improvisação e a serendipidade são soluções inesperadas que acontecem durante a interação e atuação de todos os envolvidos no processo de desenvolvimento do software em questão. Além disso, constatou-se que as pessoas e atores participam do desenvolvimento e aprimoramento do SI por meio de práticas específicas identificadas no caso pesquisado, como oficinas interativas, testes-piloto, *brainstorming* e reuniões. Essas práticas emergiram como efetivas à cocriação de *software*. Em relação ao contexto estudado, percebe-se que a Instituição viabilizou e convergiu ações para estimular e disseminar a participação dos atores.

Dentre as limitações da pesquisa, têm-se a coleta de dados restrita devido à dificuldade de acesso, conciliação de horários com todos os atores que atuaram no projeto, assim como a não generalização dos resultados.

Este estudo de caso traz contribuições para a literatura sobre cocriação, é apresentado o conceito da cocriação e como pode ser usado no processo de desenvolvimento de um SI. São destacadas práticas

efetivas e canais de diálogo (formais ou alternativos) que possibilitam interações para agregar valor ao software. Os projetos mais recentes estimulam essa colaboração e o campo de pesquisa precisa de uma compreensão mais profunda da dinâmica desse processo colaborativo. As ações de improvisação e serendipidade indicam a potencialidade de estudos futuros nessa temática, assim como estudos comparativos que analisem o mesmo fenômeno em outros contextos. Estudos futuros podem também ser desenvolvidos para entender o engajamento em comentários e relatos dos usuários presentes em portais de colaboração (como o Gênese) e em outros canais institucionais. Indica-se também a investigação do uso de ferramentas de gestão de projetos na cocriação de sistemas de informação.

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<p>BDA Management Tenets</p> <p>[Bumblauskas, Nold, Bumblauskas & Igou, 2017; Cao & Duan 2017; Hazen, Skipper, Ezell & Boone, 2016; Khan & Vorley, 2017; Laux, Seliger & Springer, 2017; Mawed & Aal-Hajj, 2017; Pauleen, 2017; Rothberg & Erickson, 2017; Sivaraiah, Kamal Irani, & Weerakkody, 2017]</p>	<p>BDA Planning</p>	<p>4. Our analytics personnel work closely with customers and maintain productive user/client relationships.</p> <p>1. We frequently adjust big data analytics plans to better adapt to changing conditions.</p> <p>2. We perform Big data analytics planning processes in systematic and formalized ways.</p> <p>3. We continuously examine innovative opportunities for the strategic use of big data analytics.</p> <p>4. We enforce adequate plans for the introduction and utilization of big data analytics.</p>	1 1 1 1	
	<p>BDA Investment Decisions</p>	<p>1. When we create big data analytics, we estimate the effect they will have on the productivity of the employees' work.</p> <p>2. In analytics investment decisions, we consider how much these options will help end-users make timely decisions.</p> <p>3. We can secure the investment needed to build big data and analytics (infrastructure, skill, and training).</p> <p>4. When making big data analytics investment decisions, we think about and estimate the cost of training for end-users.</p> <p>5. In data analytics investment decisions, we estimate the time managers will need to spend overseeing changes.</p>	1 1 1 1 1	
	<p>BDA Coordination</p>	<p>1. In our organization, business analysts and line people coordinate their efforts harmoniously.</p> <p>2. There are buy-in and engagement around the benefits of big data, and barriers to change can be overcome.</p> <p>3. Our business analysts and line people from various departments frequently attend cross-functional meetings.</p> <p>4. We share information widely for business analysts and job performers to make decisions based on available know-how.</p> <p>5. Our business analysts and line people frequently meet to discuss essential issues, both formally and informally.</p>	1 1 1 1 1	
	<p>BDA Control</p>	<p>1. We are confident that Big data analytics project proposals are appropriately appraised.</p> <p>2. There is no challenge in defining the scope of big data projects in the firm.</p> <p>3. We can develop critical indicators for big data and analytics performance reporting.</p> <p>4. We ethically use the data and ensure all areas of the firm are using it acceptably.</p> <p>5. In our organization, the responsibility for Big data analytics development is clear.</p> <p>6. We continuously monitor the performance of the Big data analytics function.</p> <p>7. Our analytics department is clear about its performance criteria and privacy policy.</p>	1 1 1 1 1 1 1	
	<p>Process-oriented dynamic capabilities</p> <p>[Braganza, Brooks, Nepelski, Ali & Moro, 2017; Wamba et al. 2017]</p>	<p>1. Our company is better than competitors at connecting (e.g., information sharing) with parties within a business process.</p> <p>2. Our company is better than competitors at reducing costs within a business process.</p> <p>3. We manage the complexity of Big data processes (e.g., generating, storing, cleaning data, and producing analytics).</p> <p>4. Our company is better than competitors at bringing sophisticated analytical methods to bear on a business process.</p> <p>5. Our company is better than competitors at bringing detailed information into a business process.</p>	1 1 1 1 1	
	<p>Value</p> <p>[Akter et al. 2016; Côte-Real, Oliveira, & Ruiyo, 2017; Dobrev & Hart, 2015; Hartmann, Zaki, Feldmann & Neely, 2016; Ram, Zhang & Koronios, 2016; Schlatke, Silvi, & Moller, 2013; Seddon, Constantinidis, Tamm, & Dod, 2017; Trieu, 2017; Vera-Baquero, Palacios, Stantchev & Molloy, 2015]</p>	<p>Process Efficiency Benefits</p>	<p>1. We have improved business process efficiency.</p> <p>2. We have increased personnel productivity.</p> <p>3. We have improved the cost of effective decision making.</p> <p>4. We have reduced operational costs.</p>	1 1 1 1
		<p>Customer Intelligence Benefits</p>	<p>1. We have reduced marketing costs.</p> <p>2. We have reduced the time to market products/services.</p> <p>3. We have reduced customer return handling costs.</p> <p>4. We have increased responsiveness to/from suppliers.</p> <p>5. We have increased inventory turnover.</p> <p>6. We have reduced the loss of sales/loss services provided.</p> <p>7. We have reduced inventory levels.</p> <p>8. We have increased the geographic distribution of sales/services provided.</p> <p>9. We have increased the revenues/services provided.</p> <p>10. We have reduced the costs of transactions with business partners/suppliers.</p> <p>11. We have increased the efficiency of utilizing assets.</p> <p>12. We have improved competitive advantage.</p> <p>13. We have an increased return on investment (ROI).</p>	1 1 1 1 1 1 1 1 1 1 1 1 1

P06: COMMUNITIES OF PRACTICE: ROLE OF SHARED VISION, SHARED GOALS AND ACCOUNTABILITY AS KNOWLEDGE TRANSFER ENABLERS

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Abstract

Knowledge is increasingly important to the effectiveness of organizations, as most can be categorized today as being knowledge-based, at least to some degree. Transfer of knowledge, thereby, is a critical challenge. The purpose of this paper is to explore the antecedents and relationship between variables that can enable knowledge transfer within the context of communities of practice in an organization. Communities of practice are often employed in organizations, with varying levels of success, to capture and share information relevant to the community. This paper looks at the interactions between a shared vision, shared goals, and accountability, and their potential for increasing knowledge transfer. This paper takes a systems perspective and integrates the theory of social learning and goal-setting theory of motivation to develop a model that explores and hopes to predict greater knowledge transfer. Contributions to theory and practical implications are discussed.

Keywords: Knowledge Transfer, Communities of Practice, Shared Vision, Shared Goals, Accountability.

1. Introduction

As organizations evolve in an economy where growth is highly dependent on the information and knowledge available to their workers, knowledge management efforts continue to increase, and, simultaneously, these efforts face difficult challenges. Knowledge management activities are often complex and difficult to sustain for these knowledge-based organizations, which depend on the ability of individuals to create, acquire, and apply knowledge to the production of goods or services (Zack, 2003). Within knowledge-based organizations, the workers' knowledge is a critical resource, often providing a competitive advantage for the organization. According to Chiu (Chiu, Hsu, & Wang, 2006), a high proportion of the critical knowledge within the organization exists at the individual

level. Therefore, organizations could benefit from mechanisms that would enable the transfer of knowledge between individuals, within teams, and across teams or departments. Effective knowledge transfer can ensure that critical knowledge becomes known and can be applied, sometimes for repeatable gains and positive business outcomes such as innovation, competitive advantage, and growth of the business (Grant, 1996; McDermott, 1999).

Communities of practice encompass a widely researched topic under the umbrella of knowledge management (Wenger, McDermott, & Snyder, 2002; Wenger, 2010). Organizations, however, continue to experiment with communities of practices to facilitate knowledge transfer, with inconsistent outcomes (Brown & Duguid, 1991; Kietzmann et al., 2013). While the benefits of communities of practice within organizations are generally agreed upon, such as increased innovation, problem-solving, and competitive advantage, these benefits are only realized when knowledge transfer occurs (McDermott, 1999). In other words, knowledge transfer is a critical element of successful communities of practice. For the purposes of this paper, communities of practice are defined as informal groups of people with similar interests and expertise within organizations to achieve certain outcomes (Wenger, 2010; Lesser & Storck, 2001). Viewing these organizational communities from a systems perspective, this paper explores shared goals and shared vision as antecedents that can lead to higher levels of knowledge transfer. We also consider the mediating effects of accountability among community members and leaders to further explain how shared goals and shared vision can lead to knowledge transfer.

This paper seeks to answer the following questions: What is the relationship between shared goals and knowledge transfer? What is the impact of a shared vision on knowledge transfer? Does accountability mediate the relationships between shared goals and shared vision on knowledge transfer within communities of practice? To answer these questions and better understand the relationship between knowledge transfer in communities of practice and knowledge transfer enablers, this paper first looks at communities of practice from the perspective of the systems theory. Goal-setting theory and social learning theories are then applied within the context of communities of practice and knowledge transfer. This paper contributes to the literature by looking at the interactions between the goal-setting theory of motivation and social learning theory to explain the relationship between shared goals, shared vision and knowledge transfer, and the mediating effects of accountability. While previous research has looked at communities of practice and knowledge sharing or knowledge management, there is limited research regarding what antecedents can predict knowledge transfer in communities of practice. This paper, therefore, seeks to close this gap by exploring antecedents to knowledge transfer in communities of practice. Practical implications and future research are also explained.

2. Theoretical Background

To understand knowledge transfer, it is important to understand the system in which transfer occurs. This paper looks at communities of practice as a system that includes those community members as actors. This paper also builds on social learning theory to inform interactions within the community of practice that will lead to knowledge transfer. Goal-setting theory of motivation is also applied in explaining how shared goals, shared vision, and accountability impact knowledge transfer within a community of practice. From the perspective of the social learning theory, a community can be viewed as a simple social unit with characteristics of a social learning system. According to

Wenger (2010), learning in a social context (face-to-face or virtual) requires participation and engagement from members of the social unit. Thus, this paper applies the concepts of system theory, social learning, goal setting, and motivation to understand the antecedents for knowledge transfer within communities of practice.

Social Learning theory, as theorized by Bandura and Walters (1977), suggests that individuals learn from interactions with one another in a social context by observing, imitating, and modeling. This helps to provide not just the knowledge needed but the context and proper application. Thus, the peripheral participation of the person sharing their knowledge can help inform and contextualize that knowledge (Lave, 1988). Without the proper context, information is not likely to result in meaningful learning or knowledge transfer. For knowledge transfer to occur, actors within the community require commonalities that inspire interactions and learning (Chow & Chan, 2008). Shared vision and goals can help to foster such commonalities. Also, observing, imitating, and modeling may take different forms within the community of practice, which is more likely to occur when members are engaged and committed to learning from one another. Members can then apply observed learning to accomplish their shared goals and, ultimately, the shared vision of the community of practice.

It is also important to note that for learning to occur, motivation, in addition to attention and memory, are key elements according to the social learning theory. Thus, we look at motivation as a critical element of social learning theory that explains when knowledge transfer will occur in a community of practice. According to Bandura (1988), learning is influenced by the individual's motivation, which is enhanced via goal systems. Research also shows that goals universally influence behavior and hence performance at both the individual and organizational levels (Locke & Latham, 2002). This influence demonstrates the important link between goals and performance according to the goal-setting theory of motivation (Locke & Latham, 2002; Lunenburg, 2011). Within the community of practice, performance reveals if knowledge transfer is occurring. Thus, knowledge transfer is the output of interactions between elements of the community as a subsystem of the organization's goals.

These two theories, goal-setting theory of motivation and social learning theory, uniquely interact within the framework of communities of practice and knowledge transfer. Shared goals and shared vision will motivate those who have the knowledge to transfer know-how to individuals who are motivated to observe, imitate, and model such that learning occurs, and the new knowledge gained can be applied. In other words, knowledge transfer will likely occur when the vision of the community of practice is shared by participants who also have shared goals and are motivated to transfer known knowledge or acquire new knowledge. Accountability of both the community members and leadership to the shared vision and shared goals may help to explain why shared vision and shared goals will result in knowledge transfer in communities of practice. The level of accountability of community members to the shared goals and shared vision is also a sensor to indicate the progress of the transfer of knowledge. Community leaders can then adjust accordingly based on feedback received to ensure knowledge transfer occurs and is sustainable. This paper now looks at the knowledge transfer model and its variables.

3. Introduction to the Model

3.1 Communities of Practice

Communities of practice are a collection of individuals who share a common concern or need to solve a common problem. These individuals share a passion for similar topics, interests, or activities with the intent of learning how to do things better based on regular interactions with others in the community (Wenger et al., 2002). This paper looks specifically at communities of practice within organizations. While the initial concept of communities of practice was not traditionally rooted in systems theory, it does have its foundations in the social element of human learning (Lave, 1988). A community of practice can, therefore, be looked at from the perspective of an open system, specifically a social system. Katz & Kahn (1971), recognize the presence of such subsystems within organizations. Communities of practice can be seen as such a subsystem. Communities of Practice will, therefore, share the characteristics of an open system such as input, outputs, and a feedback mechanism.

Communities of practice are also social learning systems based on characteristics such as its emergent structure, relationships, organization mechanisms, boundaries, identity, and in some cases, cultural elements (Wenger, 2010). Meaningful learning in social settings requires a combination of participation and reification, both of which are critical in communities of practice (Wenger, 2000). For meaningful learning to occur in communities of practice, knowledge needs to be transferred from one person to another (or within and between groups of people). This transfer of knowledge can be enabled by certain antecedents as inputs to better produce the desired output in the form of learning (both occurring and being applied). Ongoing feedback within the community also helps to ensure that adjustments and learning take place based on input from the environment to validate the vision and goals as defined by the community.

3.2 Knowledge Transfer

This paper adopts the definition of knowledge articulated by Davenport and Prusak (1998), which helps to depict the complex nature of knowledge and its transfer. The authors define knowledge as "a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information. It originates in and is applied in the minds of knowers" (P. 5). This paper draws on the types of knowledge, tacit, and explicit knowledge to further contextualize the complexity of knowledge and the importance of identifying critical knowledge transfer enablers within organizations. This paper also builds on existing research on communities of practice as one of the adopted means of knowledge transfer within organizations (Wenger et al., 2002). Explicit knowledge is the knowledge that can be easily transmitted using formal means of communication, including letters and numbers. Tacit knowledge, on the other hand, is knowledge known to an individual based on their experience, which gives knowledge a personal element making it difficult to transfer via formal communication methods (Nonaka, 1994; Polanyi, 1966).

While this paper does not focus on the distinction between tacit and explicit knowledge as a part of our model and propositions, it is important to note that tacit knowledge is a personalized type of knowledge. According to Polanyi (1966) and Nonaka (1994), tacit knowledge involves action, commitment, connection, and participation in context-specific situations. It is ingrained in the human mind and body and will require engagement and connections with like-minded individuals for any form of learning and transfer to occur. As Polanyi (1966, p.4) stated, "We can know more than we can tell." Knowledge transfer, therefore, needs to be intentional with a focus on practices that enable transfer within communities of practice.

This paper acknowledges that knowledge transfer in organizational settings can be challenging based on the type of knowledge (tacit or explicit), the time commitment required, and trust (Nonaka, 1994). Knowledge-based organizations, therefore, spend a considerable amount of resources to establish communities of practice based on known benefits of these communities such as efficient problem solving, promotion of best practices, generating new ideas, new line of business, innovation, developing expertise, training and creating competitive advantage (Wenger & Snyder, 2000). These benefits, however, may not be realized if knowledge transfer does not occur within the communities of practice. When knowledge transfer is realized, novices within organizations can acquire the knowledge-base and expertise required to solve problems, and experts can learn from other experts, or even novices, in some cases. According to Wenger et al. (2002), community members will need to understand what is important to the community and how to engage with other members of the community. If understanding what matters is a critical element of meaningful learning within communities of practice from the perspective of social structures and the social learning theory (Wenger et al., 2002), this paper then looks at shared goals, shared visions and accountability to the vision and goals as critical elements of the knowledge transfer process.

The Proposed Knowledge Transfer model is displayed below (see Figure 1):

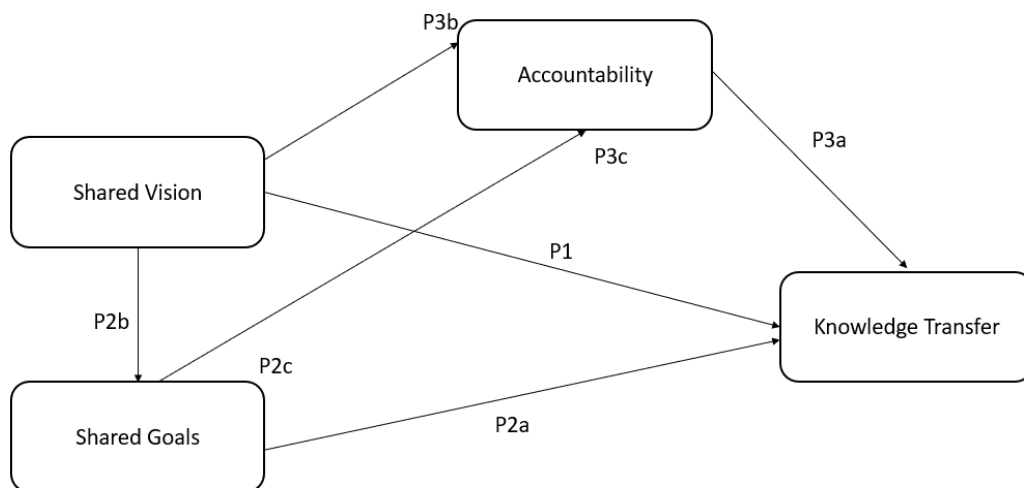


Figure 1: Knowledge Transfer Model

3.3 Shared Vision

According to Prusak and Cohen (2001), cooperative action between members of networks and communities is made possible through a common understanding of shared values and expected behaviors. This paper, therefore, argues that a shared vision in communities of practice provides an agreed-upon understanding of values and behaviors which enable knowledge transfer to occur. While goals and vision have been used interchangeably, this paper differentiates between goals and visions and conceptualizes vision as a long-term perspective. Research shows that organization members who share the same vision are more likely to be committed to the organization and share resources with other members of the organization (Tsai & Ghoshal, 1998). Shared vision represents the aspirations of the community of practice and the bonding mechanism that helps its members to combine resources towards meeting shared goals and hence their shared vision (Tsai & Ghoshal, 1998).

Drawing on communities of practice as a social system, this paper explores shared vision as an element within a system that, when combined with other variables, leads to knowledge transfer. Shared vision informs community practices and creates an environment where members identify with the vision and are committed to contributing resources to meet the aspirations of the community and its members. Lack of a compelling, shared vision will negatively impact the ability to establish norms that will motivate members to share and transfer knowledge (Chow & Chan, 2008). Previous literature suggests that shared vision is an important aspect of a cooperative relationship (Li, 2005) and that a shared vision should incorporate the organization's culture to help foster a sense of identity, thereby creating commitment.

Shared vision has also been shown to increase trust and is considered an important element for an exchange to occur within formal and informal networks (Abrams, Cross, Lesser, & Levin, 2003). While common interests, topics, language, etc. are necessary to cultivate communities of practice, they are not sufficient for knowledge transfer to occur (Grant, 1996). This paper, therefore, proposes that a shared vision will likely promote mutual engagement and collaboration around that vision and create an environment that is conducive to sharing and learning such that transfer occurs.

Proposition 1: There will be a positive relationship between shared vision and knowledge transfer.

3.4 Shared Goals

If shared vision provides a destination, shared goals provide defined critical outcomes. According to Grant (1996), in his discussion of a knowledge-based theory of the firm, cooperation is a common problem in all forms of social organization or social systems. Organizations, therefore, continue to look for ways to reconcile the conflicting goals of its members. Looking at communities of practice from the perspective of a social system and, therefore, a form of social organization, members in a community of practice share concerns, interests and seek to increase their knowledge and expertise in related areas via continued interaction (Wenger et al., 2002). Thus, the community is also subject to conflicting and competing goals (Boland & Tenkasi, 1995). It is, therefore, important for a community of practice's members to share and learn each other's perspectives in the formulation of their shared goals.

Communities of practice with shared goals will minimize the risks associated with conflicting goals and promote a sense of community and belonging such that community goals are prioritized over personal goals (Wagner, 1995). Considering a hypothetical example of a systems transformation program where an organization is implementing a new business system, initiating a community of practice seems logical. Members will have shared concerns and an interest in learning the new system, thereby ensuring minimal or no disruptions to regular operations. Knowledge transfer is therefore likely to occur if goals important to all members of the community are identified, established, communicated, and agreed upon. The presence of shared goals will help to promote an understanding of what is important and what is at stake if these goals are not accomplished. Shared goals are, therefore, an antecedent to knowledge transfer within communities of practice such that members will share what they know and its context to ensure that learning occurs.

According to Gobbi (2010), communities of practice consist of three foundational dimensions: the domain, the community itself, and the practices within the community. A community's effectiveness as a complex social learning system will be based on the cumulative strength of all three dimensions. The focus and interests of a community of practice define its identity and domain, and hence what is important to the community. A collective passion for the same topics and interests accompanied by shared goals is, therefore, crucial for knowledge transfer. Also, the sense of community exemplified in the practices of both its committed leaders and members further binds its members, creating a sense of identity and belonging fostered by shared goals.

In the goal-setting theory of motivation, goals and performance are linked (Locke & Latham, 2002). Goals also have a motivational impact and can create commitment in a group or individual setting (Locke & Latham, 2002; Lunenburg, 2011). Furthermore, goals with deadlines and those that are compatible with a combination of the group and the individual will be more effective than individual or group goals by themselves (Lunenburg, 2011). This paper, therefore, looks at shared goals as those that are time-bound and a combination of individual and community goals. Shared goals that are relevant to members of the community of practice will promote a sense of community and belongingness where members are committed to meeting those established shared goals.

As organizations continue to work in groups or teams, working on established shared goals becomes important. Studies show that when a member of a team observes that other team members share similar goals, it creates an environment of collectivism. This increases the overall contributions to the team and its effectiveness (Kristoff-Brown & Stevens, 2001). Applying this concept to communities of practice, collective or shared goals reflect the community's vision and ensures that knowledge transfer occurs and is sustained. For example, a shared vision of increased innovation will be critical to developing shared goals of increased knowledge sharing to promote innovative solutions. Experts sharing the same vision and goals as novices will be committed to transferring explicit and, even more importantly, endeavor to transfer tacit knowledge related to the development of prior innovative solutions. Novices will, in turn, seek to understand the related context and how this knowledge can be applied for repeatable successes.

Proposition 2a: There will be a positive relationship between shared goals and knowledge transfer.

Proposition 2b: There will be a positive relationship between shared vision and shared goals.

Proposition 2c: Shared goals will partially mediate the relationship between shared vision and knowledge transfer.

3.5 Accountability

In Wenger's (2010) writings, he explains a community of practice as social systems. Based on the systemic nature of communities of practice, this paper now looks at accountability and its mediating role in explaining why shared goals and shared vision will result in knowledge transfer.

Accountability is a common component of decision-making environments. Accountability is what helps to connect individuals to institutions or social systems to which they are a part, be it work-related or personal (Tetlock, 1999). Accountability reminds people to act according to expected norms. Thus, social systems cannot remain functional or sustainable for an extended period without individual accountability to what the greater system stands for, believes in, or is intending to accomplish (Axelrod, 1984).

As previously stated, shared goals and shared vision provide the required motivation for knowledge transfer to occur within communities. When members of the community have a shared vision and short-term goals to accomplish the vision, participation, and sharing occurs due to some level of accountability to the community. Members make the decision to participate, contribute, and apply learnings leading to knowledge transfer. This conscious decision to share experiences and provide the context for meaningful learning to occur is deeply rooted in accountability to the social system, in this case, the community of practice (Tetlock, 1999). Another way to look at this is through the lens of social covenants. The word community stands for common, sameness, shared by many, performing services together (Gobbi, 2010). A community represents a form of a social covenant maintained by a sense of identity and belongingness, reciprocity, obligation, duty, responsibility, and kinship (Sergiovanni, 1998). This paper, therefore, looks at accountability as the link to shared goals and shared vision resulting in stronger outcomes of knowledge transfer in communities.

Accountability to the community's challenges, aspirations, and what it stands for, is critical to the community's members contributing and learning (Wenger, 2010). Accountability to the competence of the community and its role within the broader organization fosters an environment of mutual understanding and acceptance of shared goals and shared vision resulting in knowledge transfer. Based on their level of accountability to its shared vision and shared goals, members who have their identity invested in the community are more likely to contribute and participate in community-related activities such as virtual discussion posts and face to face interactions. Thus, accountability to the community's present and future goals enables knowledge sharing and learning to occur. Members have a greater understanding of what is important to both the community and its individuals to drive greater contribution and learning by members.

As previously stated, knowledge transfer can be complex, especially due to its tacit nature. Tacit knowledge is derived from personal experience and requires key enablers for transfer to occur (Nonaka, 1994; Kreiner, 2002). While the extant literature looks at trust as an important factor in the knowledge transfer process and argues that risks and uncertainty that can be associated with knowledge transfer are mitigated by trusting relationships (Li, 2005; Lucas, 2005; Roberts, 2006), this paper seeks to contribute to the existing literature on knowledge transfer and proposes

accountability as a key knowledge transfer enabler mediating the relationship between shared goals and knowledge transfer and shared vision and knowledge transfer. Accountability goes beyond contractual agreements to social covenants based on a shared vision and shared goals within communities of practice such that knowledge is more freely exchanged for enhanced problem-solving, innovation, and growth.

Proposition 3a: There is a positive relationship between accountability and knowledge transfer.

Proposition 3b: Accountability will partially mediate the relationship between shared vision and knowledge transfer resulting in increased knowledge transfer.

Proposition 3c: Accountability will partially mediate the relationship between shared goals and knowledge transfer, resulting in increased knowledge transfer.

4. Discussion

In this paper, several antecedents have been proposed to enable knowledge transfer within the framework of communities of practice. Based on the literature review on communities of practice, knowledge transfer, and enablers such as shared goals, shared vision, and accountability, the importance of creating an environment where members feel a sense of community, identity, and belonging via shared vision and goals have been explored. While the complexity of knowledge transfer has not been ignored, the paper proposes that shared goals, shared vision, and the partial mediating effect of accountability enables knowledge transfer in communities of practice. Members are motivated to contribute, share, and apply learnings when goals and vision are shared, and members are accountable to those goals and vision due to a shared covenant. Risks associated with knowledge transfer are mitigated when shared vision and goals are established, communicated, and understood. The remainder of the paper offers the contributions to theory, limitations, future research, and practical implications.

4.1 Contributions to Theory

One of the biggest challenges in any community of practice is the level to which members ultimately contribute to the transfer of knowledge. This paper integrates elements of the goal-setting theory of motivation and social learning theory to pose research questions regarding the relationship between shared goals, shared vision, and knowledge transfer, such that goals and shared vision will lead to knowledge transfer. Viewing this model through the lens of communities of practice and a social systems perspective, this paper contributes to existing theory by drawing on Bandura's (1977) social learning theory, especially the elements of learning in a social context based on interactions that occur within the social system. The elements of observing, imitating, and modeling, which form the foundational features of the social learning theory helps to support knowledge transfer within the context of communities of practice. According to Wenger (2010), communities of practice require participation in the form of contribution and engagement from its members for learning or knowledge transfer to occur. Knowledge shared without the proper context simply remains information, information that will be difficult to observe, imitate, or model, thereby limiting learning

or transfer.

This paper also incorporated motivational elements of both social learning theory and goal-setting theory (Locke & Latham, 2002; Bandura & Walters, 1977). Contributors to the system are motivated to share their experiences and provide the appropriate context based on the intersection of shared goals, shared vision, and a sense of accountability to the community. Knowledge is therefore transferred from one individual to the other such that the recipient can observe, imitate, and model behaviors that lead to repeatable successes and outcomes. This paper identifies shared goals and shared vision as motivations for both contributors and learners to ensure that knowledge shared is observable and can be modeled. This paper also extends social learning theory by highlighting the role of the contributor in the learning process within communities of practice. Contributors who feel a sense of accountability to shared goals and visions of the community (and its members) are a critical component of knowledge transfer. They provide the knowledge, experience, and context via various means to ensure that learners can apply the knowledge shared, resulting in greater knowledge transfer.

4.2 Limitations and Future Research

This paper recognizes that, while shared goals, shared vision, and accountability are explored here, there are other variables related to additional elements such as a dedicated community leader or coordinator, as well as a committed core team that could also impact the effectiveness of communities. The larger organizational culture, support for knowledge sharing efforts, and incentives will also impact knowledge transfer. Contributors may be motivated by incentives and rewards to share their experiences with others. Employees may also withhold knowledge based on perceived risks and politics associated with sharing what they know. The work environment may also impact knowledge transfer based on certain stressors such as workload, deadlines, and changing responsibilities.

This paper also acknowledges future research should consider the relevance of perspective in communities of practice. Perspective-making is known to strengthen the core knowledge of the community. In contrast, perspective-taking can enhance the community's abilities to take the knowledge of other communities into account in knowledge production (Boland & Tenkasi, 1995). Perspective-making and perspective-taking can therefore be applied to knowledge transfer within communities.

Further empirical research is needed with hypothetical or real examples of shared goals and shared values and how the level of accountability to these shared values and goals can impact knowledge transfer. Additional research is also needed to examine competing variables and determine critical enablers that lead to knowledge transfer. Finally, the theories explored require additional review to understand the interactions or additional constructs that can be tested as a part of the empirical research.

4.3 Practical Implications

As with many organizations, communities of practice are a means to enable knowledge transfer within specific domains that are critical to the operational and strategic effectiveness of the

organization. Effective knowledge transfer, however, remains a major challenge as communities depend on individuals who are committed and motivated to share their knowledge such that others can model successful best practices and behaviors. It will be essential for organizations to be intentional about a shared vision and shared goals that encompass what is important to the organization, the community, and its members.

While communities of practice might be tempted to skip the visioning and goal-setting stages based on demand and immediate needs, knowledge management owners within organizations may benefit from establishing a framework for a community of practice development. This framework can help provide the various elements required to create a shared vision and goals that will ultimately enable knowledge transfer. Goals that are one-sided and not shared by participating members may negatively impact knowledge transfer. Vision and goals should be developed with input from critical members of the community to ensure a mutual understanding and agreement of what is important to the community and its members. Expectations should also be set around the accountability to the shared vision and goals of the community and what the benefits are. A feedback mechanism ensuring that shared goals are continually reviewed for relevance to both the community and its members may also provide some benefits to communities of practice and, ultimately, the organization. These goals should be short-term and long-term and celebrated once accomplished. Feedback should be monitored as a way to gauge the pulse of community members as to their level of accountability, which might indicate whether vision and goals are perceived as common and shared. As such, each component will work in synergy to impact accountability and enable knowledge transfer.

5. Conclusion

Although knowledge transfer is not a novel concept, it poses continued challenges for communities of practice within organizations. This paper has proposed key enablers of knowledge transfer when established as core elements of communities of practice. Critical components of communities of practice: shared goals, shared vision, and accountability, are reviewed, showing how these elements work together to result in knowledge transfer. The complexity involved with knowledge transfer is not ignored but helps to inform why shared goals and shared vision enable knowledge transfer via accountability to a shared vision and goals. Recommendations to leaders were offered to help ensure shared vision, shared goals, and accountability, elements of a community's development.

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P07: COULD CYBER-CONFLICT BE AVOIDED? EXPLORING DETERRENCE IN LOW AND HIGH STAKES INFORMATION SECURITY INTERACTIONS

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Abstract

This study explores deterrence, using bargaining games, in information security interactions under two scenarios: first, considering low stakes (corporate and intermediary) information security disclosure platforms; and second, considering a direct high stakes interaction between heavyweight actors. Low stakes results indicate that conflict may be avoided and deterrence advanced by engaging in trade, albeit under exacting circumstances. Now, when stakes are high, and heavyweight actors are involved, derivations and simulations showcase how it is even more difficult to avoid conflict and advance deterrence. We also illustrate using real world scenarios and explain the relevance of Black-Market Brokers.

Keywords: Cyber-conflict, Deterrence, Bargaining Games, Information Security Disclosure Platforms, Black Market Brokers.

1. Introduction

Information security interactions are of two types: (i) those facilitated by information security disclosure platforms (ISDPs) such as Bug Bounty Programs and private corporate disclosure platforms, and (ii) those in which adversaries engage with one another. ISDPs facilitate trade of information security products such as vulnerabilities, patches, or services. Information security researchers (ISRs) are either white hats (WH) (Zhao et al., 2014) or black hats (BH). WHs abide by law, identify vulnerabilities and responsibly disclose them on ISDPs. Crowdsourcing to identify and patch vulnerabilities using ISDPs has increased both disclosures and interactions between WHs and

software vendors (Malladi & Subramanian, 2020). Shallow vulnerabilities are easy to find and to fix. Zero Day Vulnerabilities (ZDVs), often unknown to vendors, are expensive to detect and need significant effort to be fixed (Miller, 2007). While exploits based on shallow vulnerabilities may cause minimal to moderate damage to information systems, exploits based on ZDVs cause extensive damage. Information security interactions involving shallow vulnerabilities are deemed to be low stakes and to entail low risks (to software vendors) and low rewards. Shallow vulnerabilities are here deemed commodities traded at market determined prices. Contrastingly, high stakes interactions involve exploits of deep vulnerabilities, and thus comprise high risks and high payouts. These interactions usually involve heavyweight actors such as nation states, their defense and law enforcement agencies, multinational enterprises, global organized crime, etc. Our question is whether deployment of both types of exploits (cyber-conflict between respective actors) could be avoided. Thus, we explore ways of advancing deterrence in low stakes and high stakes scenarios using bargaining games. This paper is organized as follows. Section 2 reviews recent literature. In Section 3, we present our models and discuss corresponding real-life occurrences to illustrate the relevance of results. In this section, we also discuss the role of Black Market Brokers. Finally, Section 4 summarizes our results and state limitations of our research

2. Literature Review

In this section, we provide an overview of ISDPs, different information security marketplaces, and on game theoretical approaches applied to information security.

2.1 Information Security Disclosure Platforms (ISDPs)

ISDPs facilitate legal marketplaces for trading information security products through three approaches: Corporate Bug Bounty Programs (C-BBPs), Intermediary Bug Bounty Programs (I-BBPs) and Private Bug Bounty Programs (P-BBPs) (Malladi & Subramanian, 2020). While, C-BBPs remunerate ISRs for disclosing vulnerabilities and for providing patches to pre-empt attacks on software vendors, C-BBPs are neither cost nor time efficient (McKinney, 2007; Rescorla, 2005). C-BBPs have difficulty retaining ISRs and face issues with appropriate policies and compensations (Ring, 2014; Siponen, 2006). Platform network effects make I-BBPs more effective, by attracting more software vendors, which in turn attracts more ISRs. ISRs multi-home by simultaneously participating in various C-BBPs and I-BBPs. Thus, clearer understanding of interactions is needed to improve ISDP's effectiveness (Zhao et al., 2014). Next, we describe different types of marketplaces.

2.2 Marketplaces for Vulnerabilities

Scholars have studied differences between legal, grey and black markets (Miller, 2007; Radianti et al., 2009). Legal markets are ISDPs. Grey markets facilitate trade between ISRs and either malicious or non-malicious actors such as government agencies or large corporations. Buyers in grey markets require Proof Of Concept (PoC) in the form of a pseudo-exploit (Zhao et al., 2014). Black markets facilitate ZDV trade between malicious actors (i.e., specialized re-sellers, rouge states, criminal organizations, etc.) and BHs (Libicki et al., 2015). These specialized re-sellers, whom we refer to as

Black Market Brokers (BMBs) act as shadow brokers: “right person to help facilitate contacts and intermediate” (Ablon et al., 2014, p. 28). Scholars differ in their opinion about equilibrium prices in these markets. Some researchers estimate prices in grey and black markets as being orders of magnitude higher than those in legal markets (Libicki et al., 2015), while others assert that mean prices are similar (Allodi, 2017). Heavyweight actors with unlimited budgets and access to technical resources may resort to black markets (Miller, 2007; Radianti et al., 2009). However, empirical research on economics of black markets and Private BBPs has been hindered due to data availability. Next, we discuss game theoretic approaches to information security interactions.

2.3 Game Theoretical Approaches to Information Security Interactions

Scholars have recently reviewed game theoretical applications to cybersecurity and information security interactions. Pawlick et al. (2019) develop a taxonomy that classifies them into three types: *Stackelberg games* involving a one-shot leader and follower structure in which the follower moves after observing the leader’s actions. *Nash games* between symmetric players in a simultaneous move structure where each player commits to a strategy before knowing the other player’s move. And *Signaling games* entailing a one-shot sender and receiver structure in which the sender sends a message to the receiver. Meanwhile, Do et al. (2017) present a more granular classification of game theoretical approaches involving: Prisoners’ dilemma games, Static games, Stackelberg games, Coalition games, Cooperative games, Stochastic games, Bayesian games, Dynamic games, Repeated games, Markovian games, and Evolutionary games. Which can be classified based on usage (i.e., cyber-physical security, communication security and privacy). Bargaining games, used in this study, would fall under signaling games as described by Pawlick et al. (2019), but not included in Do et al. (2017). In fact, neither of these recent reviews consider (or even mention) deterrence, which is probably why they do not allude to Bargaining games. On the other hand, Cram et al. (2017) provide a review of organizational information security policies that considers deterrence in terms of disincentives or sanctions -in the context of preventing employees’ negative computing behaviors- to prevent organizational disruptions. However, this approach focuses on an internal micro-meso interaction not intended to avoid conflict with external parties. In the following section we explain why bargaining games could be useful for exploring deterrence not only in micro-meso interactions but also for high stakes macro level interactions.

1.1.1 2.3.1. Bargaining Games and Information Security

Theory of Games or Bargaining Games are special insofar as they mix conflict with mutual dependence. Mutual dependence refers to tacit collaboration or mutual accommodation between players through messaging (or signaling) in the context of conflict so as to avoid significant mutual discomfort and achieve deterrence (Schelling, 1970). This makes signaling (e.g., threats) crucial for avoiding conflict, which in turn means they must be credible to bargaining actors. Schelling helped advance deterrence by exploring the overlap between pure conflict and pure collaboration to more appropriately capture real life situations, such as nuclear standoffs (Schelling, 1956). We regard these characteristics as essential, especially when exploring deterrence in high stakes information security interactions involving heavyweights. Below, we use bargaining games to explore deterrence in low-stakes and high-stakes scenarios.

3. Exploring Deterrence Using Bargaining Games

3.1 Low Stakes Bargaining Game in Information Security Disclosure Platforms (ISDPs)

Following Schelling’s bargaining game setup under risk of failing at deterrence (Schelling, 1970) we depict a low-stakes scenario between an ISR and a firm in Figure 1 below. Admittedly, there are at least two complications when exploring low stakes deterrence using bargaining games: players are not likely to sustain significant losses owing to the shallow nature of the vulnerabilities involved. Because of this, players are not likely to lend credence to each other’s signals (e.g., ISR exploit deployment threats). However, bargaining games bring to bear additional considerations that may add value to the characterization of low stakes information security interactions.

		Firm	
		Do not purchase shallow vulnerability (with probability q)	Purchase shallow vulnerability (with probability 1-q)
ISR	Disclose on irregular ISDP with mixed intent (with probability p)	$p_i, 0$	$0, v_i$
	Disclose on official ISDP with intent to sell (with probability 1-p)	$0, (v_e = 0)$	p_s, v_e

Figure 1: One Shot Bargaining Game Involving Firm and Information Security Researcher (ISR) in an Information Security Disclosure Platform (ISDP)

In the above setup, the ISR threatens the firm with disclosing a recently discovered shallow vulnerability (v_e) on an irregular ISDP (where a BH might decide to buy it from the ISR at market price p_i with the intent of deploying against the firm) if firm doesn’t to pay sales price p_s for it. Firm has first move and two strategies “to purchase” or “NOT to accept/purchase” the shallow vulnerability. Due to signaling issues related to low stakes ISR threats, firms have the prerogative of deciding whether or not to accept/pay for vulnerabilities submitted by ISRs to official ISDPs. However, the ISR’s payoff might still be realized at the bug’s market value (p_i) since this same shallow vulnerability may be offered and sold in a different ISDPs (due to ISRs’ multihoming ability), and the firm’s payoff would be zero. The strategy of disclosing the shallow vulnerability in a different, or perhaps even irregular, ISDP may lead to no payoff for the ISR as other ISRs may also discover this same shallow vulnerability and disclose it before the ISR in this game does. Thus, the firm can end up obtaining this shallow vulnerability from the marketplace (v_i) at zero payoff for the ISR. In essence, after the threat, the firm may choose not to trade with the ISR and procure the shallow vulnerability (v_i) from a different ISDP (as firms may also run BBPs in different ISDPs). Again, if ISR discloses v_e on the official ISDP, firms may still decide not to accept it. Especially since firms may have their own coders identify and patch the shallow vulnerability in question such that upcoming software upgrades can invalidate it. When there is no trade, the payoff for both ISR and firm are zero (as v_e becomes 0 when the firm

rejects the disclosed vulnerability). Finally, when trade occurs ISR gets payoff (p_s) and firm gets (v_e). Attacks and conflict are avoided, and deterrence is advanced insofar as ISRs refrain from disclosing (v_e) on an irregular ISDP. ISR and the firm are rational actors, so utilities are calculated as follows:

$$U_{\text{ISR}} = p \cdot q \cdot (p_i) + (1-p) \cdot (1-q) \cdot (p_s) \quad (1)$$

$$U_{\text{FIRM}} = (1-q)[p \cdot (v_i) + (1-p) \cdot (v_e)] \quad (2)$$

A Nash equilibrium is attained when both U_1 and U_2 are maximized with respect to each actor's probability (i.e., p and q). We obtain the following optimal probabilities:

$$q^* = (p_s) / (p_i - p_s) \quad (3)$$

$$p^* = (v_e) / (v_e - v_i) \quad (4)$$

Our first proposition follows from equations (3) and (4).

Proposition 1: *A low stakes bargaining game involving ISDPs reaches equilibrium (facilitating trade and advancing deterrence) when $p_s < p_i$ and $v_e > v_i$.*

Signaling and compensation distortions give firms the upper hand since trade only occurs when ISR produces a differentiated product ($v_e > v_i$) and sales it at a price below commoditized value ($p_s < p_i$). From this proposition, we derive 2 lemmas relating to payoffs for ISR and firm.

Lemma 1.1: *Deterrence through trade is impossible if ISR does not produce a differentiated product ($v_i > v_e$) or if it discloses a product that is already on offer in the market ($v_i = v_e$).*

Lemma 1.2: *Deterrence through trade is impossible if ISR's sales price is greater than market/commodity price ($p_s > p_i$) or if they are equal ($p_i = p_s$).*

Next, we discuss how these results apply to practice.

1.1.2 3.1.1 Implications of the Results of Low Stakes Bargaining Game

Supporting illustrations for the results of our models are observed in practice as shown by prior research. Subramanian and Malladi (2020) use vulnerability disclosure data on more than 700 vulnerabilities sourced by 54 firms using ISDPs. While their research illustrates the possibility of creating new marketplaces for responsible disclosure through ISDPs and the formation of supply-demand equilibria, the authors argue about possibilities of noise (signal issues) on ISDPs resulting from reporting of low-quality vulnerabilities by ISRs and even at times duplicates (refer Lemma 1.1).

Similarly, Malladi and Subramanian (2020) examine existing vulnerability disclosure practices from organization run ISDPs such as Microsoft, Google and Facebook to advocate that firms participating in ISDPs can compete with grey and black marketplaces only by creating fair and competitive incentives (refer Lemma 1.2). In sum, prior low stakes research corroborates that signaling and compensation distortions (through ISDP facilitated interactions) make avoiding cyber-conflict and advancing deterrence difficult. High stakes scenario is described next.

3.2 High Stakes Bargaining Game with Heavyweights

Consider a heavyweight actor (an attacker), such as nation state, with a deep exploit that could be used to damage another state’s infrastructure, such as a power grid. Stakes are now much higher now and prior threats are credible (i.e., signaling applies). Because of this, heavyweight actors can face robust opposition and counterattacks, which can lead to escalation into pure conflict along with significant mutual discomfort. High stakes cyber-attacks occur frequently between heavyweight actors (e.g., information stealing, destruction or corruption of critical hardware and software layers, etc.) as discussed by Michael McDonnell and Terry Sayers in Schilling (2002). Again, adopting Schelling’s bargaining game under risk of failing at deterrence, we now explore a high stakes deterrence, or standoff equilibrium conditions, between two heavyweight actors capable of deploying ZDV-associated-exploits to cause extreme damage to each other. Also, both players have attribution certainty (i.e., are able to establish each other’s identity with precision). Note extant research has examined the lack of attribution certainty and its effect on timing of cyber-attacks (Axelrod & Iliev, 2014). Actor 1 makes a credible threat to Actor 2 that if it attacks, pure conflict will ensue, and both actors will sustain significant damage. Actor 2 has first move. Both actors are rational and are aware of each other’s capabilities. Our game setup is presented in Figure 2 below:

		Heavyweight actor 2	
		q	(1- q)
Heavyweight actor 1	p	G1, 0	0, G2
	(1-p)	0, 0	(x.g1-L2) (y.g2-L1)

Figure 2: One Shot Bargaining Game Involving Two Heavyweight Actors

Actor 2 may decide to attack in pursuit of unilateral gains G_2 and assume that there will be no retaliation from actor 1. Without a prior credible threat from actor 1, actor 2 would pursue unilateral gain G_2 , knowing that actor 1 would also attack in pursuit of G_1 . However, actor 1 will retaliate if actor 2 attacks. Under these conditions, both actors instead of attacking in pursuit of unilateral gains opt for stand-off. We use conditional probability of gain attainment p for Actor 1 and q for Actor 2 (p

and q are conditional on the other actor's capabilities to launch cyber-attacks and patch ZDVs). If the other actor has higher capabilities, then gain attainment probability for the actor in question would be lower. Unilateral gains $G1$ are pursued by Actor 1, and $G2$ by Actor 2, under no opposition from the other actor. However, if conflict ensues, smaller gains $g1$ (for Actor 1) and $g2$ (for Actor 2) may be attained during conflict in light of opposition from the other actor. These smaller gains to be attained during conflict have associated probabilities x and y , for actors 1 and 2, respectively. Because of counterattacks, there are losses each party must bear. These losses could be considered as the cost to attack (or the price that Actors must pay in order to attack). $L2$ is the loss to Actor 1 for having decided to attack Actor 2, and $L1$ is the loss to Actor 2 for having decided to attack actor 1. Both p and q , as well as x and y , are identically and independently distributed to create well-formed utility functions. We calculate payoffs for both actors as follows:

$$U1 = p.q.(G1) + (1-p).(1-q).(x.g1 - L2) \quad (5)$$

$$U2 = (1-q)[p.(G2) + (1-p).(y.g2 - L1)] \quad (6)$$

An equilibrium is attained when $U1$ and $U2$ are maximized with respect to each actor's probability of gain attainment (i.e., p and q). We obtain the following optimal probabilities:

$$q^* = (x.g1 - L2) / (G1 + x.g1 - L2) \quad (7)$$

$$p^* = (L1 - y.g2) / (G2 + L1 - y.g2) \quad (8)$$

To simplify equations 7 and 8, we use gain differential for actor 1 ($gd1$) defined as $gd1 = x.g1 - L2$ and the gain differential for actor 2 ($gd2$) defined as $gd2 = L1 - y.g2$. Thus, we re-write optimal probability equations 7 and 8 in terms of gain differentials for each actor, as follows

$$q^* = 1 / [(G1 + 1) / gd1] \quad (9)$$

$$p^* = 1 / [(G2 + 1) / gd2] \quad (10)$$

We now use equations 9 and 10 to characterize deterrence and pure conflict conditions through Proposition 2.

Proposition 2: *A high stakes bargaining game involving heavyweight actors reaches Nash equilibrium when respective utilities are maximized to obtain $q^* = 1 / [(G1 + 1) / gd1]$ and $p^* = 1 / [(G2 + 1) / gd2]$*

Two lemmas relating to deterrence and pure conflict conditions are detailed below:

Lemma 2.1: *Deterrence (or standoff) occurs when dominant equilibrium leads to: $p^* = 0$, which arises*

when $gd2 = 0$ or $L1 = y.g2$ and to $q^* = 1$, which arises when $G1 = 0$.

Deterrence is achieved and standoff prevails when the threatening party (actor 1) has no reason to attack (since $G1 = 0$). This happens when actor 2 does not attack having deemed prior threat from actor 1 as credible. However, actor 2's estimated losses for deciding to attack are equal to its gains under opposition from actor 1, irrespective of its unilateral gains $G2$ (which actually makes pure conflict a feasible outcome for actor 2). Thus, deterrence occurs when actor 1 has no unilateral gains to pursue. This is clearly a very fickle equilibrium condition, especially since there can always be something to be gained by actor 1 as demonstrated by the U.S. deciding to hack other world leaders' mobile phones (i.e., $G1$ will always be greater than 0 and positive). Particularly, in light of the fact that for actor 2 pure conflict is feasible (as $L1 = y.g2$), and thus any unilateral gains ($G2$) derived from deciding to attack first (in effect, ignoring actor 1's priori threat) could be worth pursuing (and may exceed initial gain expectations).

Lemma 2.2: *Pure conflict ensues when dominant equilibrium leads to $p^* = q^* = 0$ resulting in $gd1 = gd2 = 0$ and thus $L2 = x.g1$ and $L1 = y.g2$*

Pure conflict is feasible for both actors when their estimated counter-attack losses are equal to their gains under opposition from each other, irrespective of any unilateral gains (which could now exceed expectations for both actors). In essence, when gains under opposition compensate for counter-attack losses, what could tip the scale into pure conflict is that there are any initial unilateral gain expectations (from deciding to attack first).

Figures 3a and 3b below depict solution spaces (of expected payoffs) for each actor, for various values of $G1$, $G2$, $g1$, $g2$, $L1$ and $L2$. In particular, Figures 3a and 3b illustrate a credible prior threat from actor 1, who has higher stakes than actor 2 (and actor 2's unilateral gains are equal to its losses for deciding to attack first) by means of the following conditions: $G1 > G2$, $g1 > g2$ and $L1 > L2$ with $G2 = L1$. This scenario is simulated by using the following values: $G1 = 1000$, $g1 = 200$, and $L2 = 300$ for actor 1. And $G2 = 500$, $g2 = 100$, $L1 = 500$ for actor 2. We then let p and q , as well as x and y , vary between $[0,1]$.

In order to depict simulated equilibrium conditions pertaining to proposition 2, we look at planar projections of the intersections between solution spaces for actor 1 (presented in Figure 3a) and actor 2 (presented in Figure 3b). These planar projections allow us to explore the range of values for p and q , as well as of x and y , under which conflict might ensue. In particular, we will now discuss three scenarios with different high stakes conditions (gains, losses and gains under opposition) for two heavyweight actors involved in our bargaining game setup. For each case we provide real-world illustrations that exemplify the propositions in our modeling.

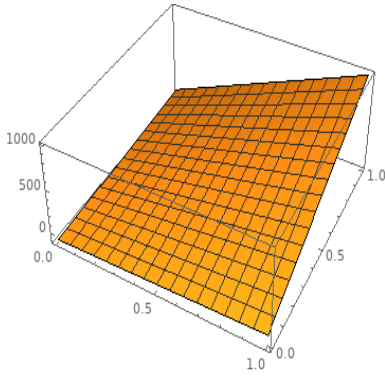


Figure 3a: Plot of Actor 1's Expected Payoffs (Z-axis) by Varying p (X-axis) and q (Y-axis) $G1 = 1000$, $g1 = 200$, and $L2 = 300$ for actor 1.

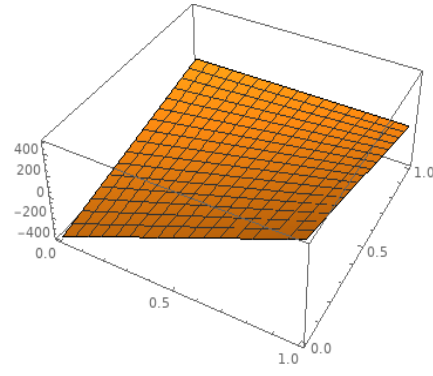


Figure 3b: Plot of Actor 2's Expected Payoffs (Z-axis) by Varying p (X-axis) and q (Y-axis) $G2 = 500$, $g2 = 100$, $L1 = 500$ for actor 2.

1.1.3 3.2.1 Case 1: Equivalent Stakes (With Stakes Twice as Large for Actor 1), and Unilateral Gains Equal to Losses for Each Actor

Conditions in this scenario are set to $G1=2G2$, $g1=2g2$, and $L2= 2L1$ with $G1=L2$ and $G2=L1$. This scenario is simulated by using the following values $G1 = 1000$, $g1 = 200$, and $L2 = 1000$ for actor 1, $G2 = 500$, $g2 = 100$, and $L1 = 500$ for actor 2.

Figures 4a and 4b show there are more circumstances (curve crossings into bands encompassing valid values for p $[0,1]$ and x $[0,1]$) under which actor 1 could decide to attack first in pursuit of $G1$ and gains under opposition $g1$, than for actor 2 (who has fewer curve crossings into band encompassing valid values of y $[0,1]$ to obtain $g2$, but not into the band for q $[0,1]$, see Figure 8). Thus, actor 1 could decide to attack under many values of p and x , while actor 2 would find pure conflict a feasible outcome only for a few values of y . Thus, when stakes are equivalent (with stakes twice as high for threatening actor 1) and unilateral gains are equal to losses for each actor, conflict will ensue as actor 1 decides to pursue unilateral gains ($G1$) as well as gains under opposition ($g1$).

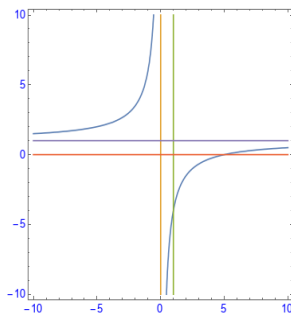


Figure 4a: Solution-Space for Actor 1 (p on X-axis, x on the Y-axis)
 $G1 = 1000$, $g1 = 200$, and $L2 = 1000$

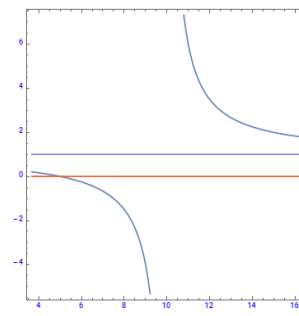


Figure 4b: Solution-Space for Actor 2 (q on X-axis, y on the Y-axis)
 $G2 = 500$, $g2 = 100$, and $L1 = 500$

1.1.4 3.2.2 Case1: Illustrations from Practice

A practical observation of this case may correspond to the Stuxnet attack on Iran’s nuclear facilities. When the Stuxnet worm was employed to delay Iran’s nuclear ambitions, it was subsequently discovered and remedied by Iran. Thereafter, Iran launched retaliatory attacks on Saudi Aramco’s infrastructure to manipulate data and destabilize the oil pipelines (Axelrod & Iliev, 2014). While the attack was detected and cleaned up within four days, Iran’s actions may be construed as displaying the ability to launch aggressive and quick counterattacks and prove a point, despite knowing that more attacks can be launched on its own infrastructure as well as the chance for increased economic sanctions. In this case, Iran had a credible warning from other nation states such as the US and Israel about retaliatory actions, but Iran’s actions can be seen as having viewed pure conflict as a feasible outcome. The ability to launch quick counterattacks on attackers’ infrastructure would relate to the gains during conflict for actor 2.

1.1.5 3.2.3 Case 2: Identical High Stakes with High Losses for Both Actors

Conditions are set to $G1=G2$, $g1=g2$, and $L2= L1$ using the following values $G1 = 1000$, $g1 = 100$, and $L2 = 3000$ for actor 1, and $G2 = 1000$, $g2 = 100$, and $L1 = 3000$ for actor 2.

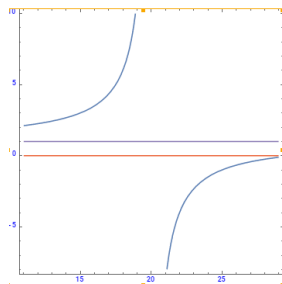


Figure 5a: Solution-Space for Actor 1 (p on X-axis, x on the Y-axis)
 $G1 = 1000$, $g1 = 100$, and $L2 = 3000$

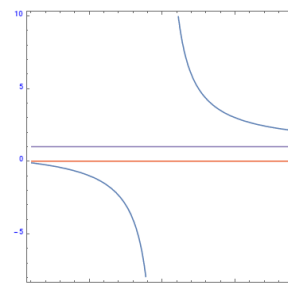


Figure 5b: Solution-Space for Actor 2 (q on X-axis, y on the Y-axis)
 $G2 = 1000$, $g2 = 100$, and $L1 = 3000$

Figures 5a and 5b show there are no circumstances (or curve crossings, or touchpoints into bands encompassing values of x or y) under which actor 1 or actor 2 would decide to attack, in light of identical stakes scenario. This is corroborated by the fact that there are no crossings or touchpoints into bands encompassing values of p or q, in light of high and identical losses for both actors, namely: “to avoid any initial conflict, it has to be evident to the players that the preferences are identical” (Schelling, 1970, p. 85). Because of this, stand-off is preferred when stakes are identical and losses are equally high for both actors.

1.1.6 3.2.4 Case 2: Illustrations from Practice

This traditional scenario is noted in the deterrence achieved by nuclear states, which are at

loggerheads over extended periods of time. Such standoffs have happened between the US and the erstwhile USSR during the cold war era, as well as the US and Russia currently, the logjam between India and Pakistan, etc.

1.1.7 3.2.5 Case 3: Equivalent Stakes (With Stakes 50% Larger for Actor 1), Unilateral Gains Represent Half the Losses for Each Actor

Conditions in this scenario are set to $G1=1.5G2$, $g1=1.5g2$, and $L2=1.5L1$ with $G1=0.5L2$ and $G2=0.5L1$. This scenario is simulated by using the following values $G1 = 1500$, $g1 = 150$, $L2 = 3000$ for actor 1; $G2 = 1000$, $g2 = 100$ and $L1 = 2000$ for actor 2.

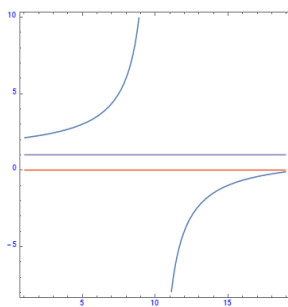


Figure 6a: Solution-Space for Actor 1 (p on X-axis, x on the Y-axis)
 $G1 = 1500$, $g1 = 150$, $L2 = 3000$

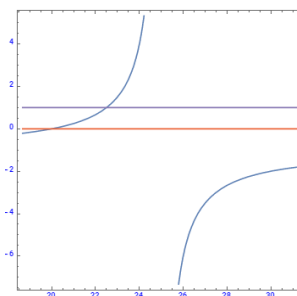


Figure 6b: Solution-Space for Actor 2 (q on X-axis, y on the Y-axis)
 $G2 = 1000$, $g2 = 100$ and $L1 = 2000$

Figures 6a and 6b show there are many more circumstances (curve crossings or touchpoints into bands encompassing valid values of y but not of q, see Figure 12), under which actor 2 could decide to endure pure conflict, than actor 1 (due to fewer curve crossings or touchpoints into bands encompassing valid values of p or x, see Figure 11). Actor 2 sees pure conflict as feasible under all y values. Thus, when stakes are equivalent but unilateral gains represent only half the possible losses for both actors, and stakes are higher for threatening actor 1: conflict ensues despite actor 1's prior credible threat, because actor 2 sees pure conflict as bearable. This game depicts the fickleness of deterrence discussed in Lemma 2.1 brought about by the fact that the bargaining game now turns into a who has more to lose game.

1.1.8 3.2.6 Case 3: Illustrations from Practice

A prominent example of this instance could relate to Russia's alleged actions in meddling with the democratic processes of democratic nations such as the U.S. (Shuya, 2018). Similar to the Iranian case explained in 3.2.2 where there can be consequential counterattacks in the form of economic sanctions, etc. Russia may have decided to launch a cyberattack, despite any prior threats, considering that the ensuing turmoil, animosity and divisiveness generated could exceed any initial unilateral gain expectations (also alluding to the situation depicted in Lemma 2.2). Russia's intent

may have been not just to demonstrate its ability to influence the mandates and opinions of people in established democracies, as well as its ability to discount and brave any subsequent counterattacks. But also, crucially, it may have calculated that pure conflict would actually leave Russia better off than its adversaries, especially in light of the institutional fragility that underpins real democracies (which Russia lacks and may actually see as a vulnerability in others). In essence, Russia (as actor 2) may have realized that despite $G1 > G2$ and $g1 > g2$, what matters most is that $L2 > L1$ and thus pure conflict is justified. Per Browder (2015, p. 116) through the proverb below, actor 2 (to portray strength and superiority) sacrifices its own wellbeing (accepting $L1$) simply because the damages it can inflict on actor 1 ($L2$) are greater:

“One day, a poor villager happens upon a magic talking fish that is ready to grant him a single wish. Overjoyed, the villager weighs his options: ‘Maybe a castle? Or even better – a thousand bars of gold? Why not a ship to sail the world?’ As the villager is about to make his decision, the fish interrupts him to say that there is one important caveat: whatever the villager gets, his neighbor will receive two of the same. Without skipping a beat, the villager says, ‘in that case, please poke one of my eyes out.’”

We now turn to discuss gain-loss ratios and attack strategies based on equations (7) and (8).

3.3 Gain-Loss Ratios, Attack Strategies and Black Market Brokers

Let Actor 1’s gain-loss ratio be $R1 = (x.g1 - L2) / (G1 + xg1 - L2)$, and Actor 2’s gain-loss ratio be $R2 = (L1 - y.g2) / (G2 + L1 - y.g2)$. In a trivial scenario, Actor 1 attacks pursuing gain $G1$ ($p=1$), expecting no opposition from actor 2 ($q = 1$), when it estimates actor 2’s capacity to launch cyber-attacks and patch ZDVs (or actor 2’s conditional probability of attainment, q) to be greater than its own gain-loss ratio ($R1$).

$$q > R1 = (x.g1 - L2) / (G1 + xg1 - L2) \quad (11)$$

When Actor 2’s capacity to launch cyber-attacks and patch ZDVs is low, actor 1 has a high likelihood of realizing $G1$, because its conditional probability of attaining $G1$ without opposition from 2 would be high ($q \approx 1$). Now, since q is almost 1, then many values of $R1$ would satisfy $q > R1$. All that would be needed to satisfy this condition is for $G1 > x.g1 - L2$ such that $R1 < 1$, and again since $q \approx 1$, then $q > R1$ would be easily satisfied. However, please note that this would imply that actor 2 is not really another heavyweight actor.

A relevant example is that of a state actor (North Korea) launching an attack on Sony (non-state actor) when Sony made the movie ‘The Interview’ about North Korea’s leader and planned its release despite credible threat from actor 1 (North Korea) to stop its theatrical release (Sharp, 2017). North Korea allegedly could get access to the personal information of Sony’s employees and dependents and the business affairs of Sony Pictures. In this case, Sony had limited wherewithal to deter the attack which allowed unilateral gains to actor 1. Now, when Actor 2 is indeed another heavyweight and has the ability to launch damaging cyber-attacks and patch ZDVs in a timely manner, then actor 1 has a low likelihood of attaining $G1$ without opposition from 2 and thus $q \approx 0$. To satisfy $q > R1$, when $q \approx 0$, would require $R1$ to be as small as possible such that $G1 \gg x.g1 - L2$. This means that actor 1 should go for $G1$, if actor 2’s capacity to launch cyber-attacks and patch ZDVs is

estimated to be very high, only if its gains without opposition from actor 2 (G_1) are much greater than its gains during conflict ($x.g_1$) after subtracting L_2 (or the price actor 2 would make actor 1 pay for having attacked!). It becomes imperative that actor 1 can estimate G_1 appropriately and does everything necessary to ensure that G_1 is much larger than any gains during conflict ($x.g_1 - L_2$). This, we believe, helps to partially elucidate how BMBs and/or shadow brokers operate.

1.1.9 3.3.1 Black Market Brokers (BMBs)

BMBs add value in high-stakes information security interactions between heavyweight actors, not merely as re-sellers of ZDVs (as intuition would dictate), but as providers of customizable exploits (Gonzalez, 2015; Greenburg, 2017). At the very least, BMBs should help heavyweight clients estimate the following parameters: a) potential unilateral gains (G_1) to be pursued and damages to be inflicted (L_1); b) attribution, retaliation ($y.g_2$) and pure conflict risks (along with mitigation strategies); c) the price other heavyweight actors could make BMB clients pay (L_2); d) potential gains to be pursued and damages to be endured during pure conflict ($x.g_1 - L_2$). All these must be used for customizing exploits and tailoring them to comply with estimated parameters – leading to calibration. The success of an overarching attack strategy can help guarantee achieving (or even exceeding) the estimated parameters (G_1 , L_1 , $x.g_1 - L_2$, etc.). Moreover, overarching attack strategies leverage tailored exploit design and deployment for the sake of broader-context aims (such as gaining or retaining political power, or a competitive advantage in an industry, etc.), which cannot be meaningfully discussed and/or be arranged neither in C-BBPs nor in I-BBPs. When stakes are high and heavyweights are involved, ISDPs are not an ideal channel for conducting high stakes information security interactions. Though firms have recently begun to explore new strategies for using ISDPs and ISRs for discovering ZDVs before they fall into wrong hands. However, up to now and for the most part, tailored ZDV exploits and related customization interactions (as well as associated transactions) essential to devising a successful overarching attack strategy, are facilitated mainly by BMBs outside of ISDPs. This helps explain why BMBs prefer not to join the ranks of any heavyweight actor, since their value add (as consultants) comes from a wide range and scope of experiences devising successful overarching attack strategies.

4. Conclusion

Our results evidence how difficult it is to avoid cyber-conflict and advance deterrence between actors engaged in interactions that involve information security products. For low stakes scenarios involving shallow vulnerabilities, conflict may be avoided through trade (in ISDPs). However, signal and compensation distortions require ISRs to produce differentiated bug discoveries while firms compensate them below market value. For high stakes scenarios (involving ZDVs), avoiding conflict and advancing deterrence is even harder to achieve since *standoff is a very fickle equilibrium condition*. This is the case because there can always be something to be gained by actor 1 (as per case 1), or actor 2 may deem pure conflict to be bearable or even feasible (as case 3). Distinctively, our high stakes exploration helps justify the existence of BMBs and shed light into their business value proposition (as consultants to heavyweights). Finally, our study has limitations which can be avenues for future research. Other variables (such as timing) may be considered to gauge their influence on payoffs. Our study may be replicated incorporating classifications such as white, grey and black marketplaces to characterize alternative game setups with different stakes and

implications. Also, researchers may simulate other real-life cyberconflicts (between heavyweights), or explore the characteristics of possible future ones, which we believe are bound to become more frequent given how difficult it is to avoid cyber-conflict.

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P08: CYBERHATE: PROFILING OF POTENTIAL TARGETS

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Abstract

Cyberhate is defined as hatred expressed in online environments directed at groups and individuals based on their race, religious belief, ethnic origin, sexual orientation, or gender. Cyberhate is a growing phenomenon, as it coincides with increased access to the Internet. This paper explores cyberhate awareness, observations, and experiences to present a profile of cyberhate victims using the Routine Activities Theory. Providing such a profile can raise awareness of at-risk targets and provide opportunities for intervention. A survey of 183 students at a large university provided insight into online user experiences. The research revealed links between awareness, observations, and experiences of cyberhate on various online platforms. While awareness of cyberhate was associated with frequent Internet and social media access, reported experiences of cyberhate were lower than anticipated. Males experienced higher levels of cyberhate in online games and news sites. Likewise, older students experienced higher levels of cyberhate on news sites, as did respondents with higher education levels who also experienced a higher level of cyberhate on chat sites. Daily users of social media experienced higher levels of cyberhate on such platforms. An interesting finding was a correlation between frequent online gaming and lower levels of empathy for victims. The findings show the complexity of defining a profile for cyberhate targets.

Keywords: Cyberhate, Cyberbullying, Victims, Targets, Profiling, Routine Activities Theory.

1. Introduction

The rapid development of accessible technologies provides new opportunities for traditional extremist activities (Vandenbosch & Van Cleemput, 2009). One opportunity provided by the Internet is the dissemination of hate speech and the spread of cyberhate related activities with few controls (Cassim, 2015). Cyberhate is the promotion of bias against a person or persons through information and communications technology (ICT). Biases leading to hate can be based on race, religion, ethnicity, sexual orientation or gender identity (Southern Poverty Law Center, 2017). While bias and associated hate are not limited to online or Internet virtual communities (Quandt, & Festl, 2017), hate promoted online can have global influence (Perry, & Olsson, 2009). Extreme forms of bias, such

as cyberhate that impacts other people - referred to as targets - proliferate rapidly online (Perry, & Olsson, 2009). However, bias is not a criminal act, and even the FBI (2016), which has a broad definition of hate, can only act on the perpetration of criminal activity based on such bias.

This research set out to explore cyberhate victimization and to propose a profile of potential cyberhate targets. Providing such a profile can raise awareness of targets and provide an opportunity for educating targets and for potential technical interventions. In executing the research, data was collected from a group of South African online users. As a developing country, South Africa has many users with a limited online presence. Nevertheless, South African legislation recognizes the problem of hate speech and discrimination, making this a critical socio-technical issue.

The paper proceeds as follows; the ensuing section provides a background to cyberhate and the aim of the research. The third section describes the research approach, followed by data analysis and findings in the fourth section. Section five discusses the findings and provides a conclusion with further research recommendations.

2. Background to Cyberhate

Blaya (2019) regards cyberhate as attempts against human rights based on false rhetoric. Cyberhate targets a community, thereby threatening social cohesion and democracy. Similar to cyberhate, cyberbullying targets individuals and has manifested in online communication in various contexts since the Internet became popular in the mid-1990s (Jaishankar, 2008).

2.1 Cyberhate

Cyberhate, which thrives through limited physical contact between perpetrator and victim, is committed using ICTs, such as e-mail, cell phones, and instant messaging. Social networking sites, in particular, have provided platforms for making hateful material increasingly visible to millions of young social network sites users (Oksanen, Hawdon, Holkeri, Näsi, & Räsänen, 2014.).

In contrast to traditional bullying, which involves the threat of physical force to abuse or to intimidate others, cyberhate involves limited direct contact (Namane, 2017). The low risk of being assaulted by the target and the anonymity provided by the Internet empowers people who would not otherwise be as outspoken (Brown, 2018). Online hate can extend into everyday routines and impact how victims interact with others (Pacheco & Melhuish, 2018), which may reinforce discrimination against vulnerable groups (Oksanen et al., 2014) and result in the victims' restriction of online activities (Pacheco & Melhuish, 2018) or even their recruitment into the perpetrator's group (Quandt & Festl, 2017). Young people are especially vulnerable as targets and may become potential recruits attracted through feelings of personal commitment, social utility or a sense of belonging provided by cyberhate perpetrators. Consequently, they may become involved as witnesses, victims or perpetrators (Blaya, 2019).

Legislatively South Africa lags America and Europe and must rely on criminal law (Cassim, 2015). However, criminal acts may be difficult to prove (FBI, 2016). The South African Promotion of Equality and Prevention of Unfair Discrimination Act 4 of 2000 includes hate speech, the prohibition of unfair discrimination on the ground of race, gender, disability, harassment and the dissemination and publication of unfair discriminatory information that unfairly discriminates. This has led to several cases perpetrated on social media going to trial.

Cyberhate involves both indirect and direct harm (Oksanen et al., 2014). Direct exposure to cyberhate can result in high levels of depression, anger, anxiety, and post-traumatic stress disorder symptoms and even to the suicide of victims. Hate speech often impacts people who share the same sentiment or identity as the victims (Fearn, 2017). Thus, cyberhate communicates societal power and may increase the marginalization of particular groups (Perry, 2002). Studies have suggested that people who share the same group characteristics as the victim may experience vicarious trauma such as a loss of self-esteem and self-worth. Fearn (2017) reveals that hate-related bias is based on either a preference for people of their own group (in-group favouritism) or negative sentiment towards people not of the same sentiment or identity as themselves (out-group bias). These biases can make groups more socially valued with out-group cyberhate provoking more fear and anger than in-group hate speech (Fearn, 2017).

While females are the predominant targets of hate speech and abusive online behaviour (Pacheco & Melhuish, 2018; Vandenbosch & Van Cleemput, 2009), cyberbullying research findings have shown that male Internet users experienced more online hate speech (Celik, 2018). There are no precise age correlations to cyberbullying with paradoxical studies showing that cyberbullying both increases with age and lessens amongst older youth (Vandenbosch & Van Cleemput, 2009).

Cyberhate requires research with rigorous evaluation protocols to counter cyberhate and evaluate strategies to overcome it (Blaya, 2019). However, cyberhate is complex and contextual and relies on multiple interpretations rendering a profile of cyberhate profile targets challenging to define.

2.2 Theoretical Basis of the Study

Theoretical frameworks on victimisation, for the most part, emphasize the role of race, religious belief, ethnic origin, sexual orientation, or gender (Wick, Nagoshi, Basham, Jordan, Kim, Nguyen, & Lehmann, 2017). Routine Activities Theory, which was developed by Cohen and Felson in 1979, shifts the emphasis to experiences in daily life where regular contact with crime relates to a higher occurrence of victimization (Wick et al., 2017). Routine Activities Theory suggests that victimization occurs at the nexus of the presence of a suitable target, a motivated perpetrator, and a lack of capable guardianship (MacKenzie, 2005; Wick et al., 2017). Routine Activities Theory has been used in several studies (e.g. Wick et al., 2017), including cyberbullying (Navarro & Jasinski, 2012). Suitability of targets, according to the Routine Activities Theory, is the degree of vulnerability posed by the potential victim. In cyberbullying, this has been linked to the types of online activities one engages in (Navarro & Jasinski, 2012). The absence of capable guardianship is attributed to the openness and disorganised structure of the Internet. Therefore, it is essential to identify at-risk individuals by clarifying the relationship between theory and victimisation (Navarro & Jansinki, 2012).

2.3 The Current Study

Underpinned by the Routine Activities Theory, the current research sought to identify the cyberhate experiences of online users and provide a preliminary profile of a potential target, given that motivated perpetrators pre-exist and that there is limited guardianship on the Internet. The study aimed to contribute to the existing cyberhate literature from the perspective of digitally literate higher education students in South Africa. To this end, the study posed the question: What online cyberhate experiences could identify potential cyberhate targets?

3. Research Method

To answer the research question, a quantitative research approach was undertaken using a structured survey instrument developed for a similar study undertaken in Turkey and the USA by Celik (2018). The instrument included nine demographic questions including frequency of Internet access, one question on cyberhate awareness and three questions regarding observations of cyberhate. The second part of the instrument elicits responses from 42 questions about cyberhate experience using a Likert scale from one to five (never, rarely, occasionally, often and always). The original instrument was successfully applied by Celik (2018) with both Cronbach alpha and Kaiser-Meyer-Olkin ($p=0.000$) tests having values greater than 0.9.

The cross-sectional purposive sampling study took place in June 2019. Data analysis was performed using the SPSS statistical analysis package so that the level of human error was minimized. The research was governed by the guidelines of the Ethics Committee of the university in respect of the right to dignity, consent, privacy and confidentiality of the participants. Participation in this research project was voluntary, and participants could withdraw at any stage of the research process and allowed not to answer some of the questions.

Construct validity tests were done on the collected data to test whether variables for the same construct are drawn from the same pool and that the construct and concepts being studied have been correctly identified (Creswell, 2003; Cronbach & Meehl, 1955). Reliability testing to ensure consistent measurements of the data (Creswell, 2003) provided confidence that the results can be generalized, and similar results obtained if the research is conducted again. For internal consistency, the questionnaire took care not to provide leading questions. External reliability was measured using Cronbach's alpha (Creswell, 2003) which is commonly used in Information Systems studies.

4. Analysis and Findings

The survey was undertaken by 183 respondents and analyzed using SPSS version 19. Demographic measurements included gender, ethnicity, age and degree for which the respondents were registered. Female respondents ($n=110$, 60.1%) comprised the majority with males comprising 37.7% ($n=69$) and 2.2% ($n=4$) respondents who preferred not to provide their gender. The majority of the respondents were African students ($n=63$, 34.4%) closely followed by White/Caucasian students ($n=60$, 32.8%). This was followed by Coloured ($n=31$, 16.9%), Indian ($n=19$, 10.4%) and Asian ($n=3$,

1.6%) students. Most students were below the age of 26 with 18-21 (n=83 45.4%) being dominant followed by 22-25 (n=45, 24.6%). Older respondents were aged 26-29 (n=20, 10.9%) and 30+ (n=35, 19.1%). Most of the respondents were registered for Bachelor’s degrees (n=106, 57.9%) followed by Masters (n=31, 16.9%), Honours (n=23, 12.6%) and Doctoral degrees (n=17, 9.3%). Six students (3.3%) were registered for other courses.

4.1 Normality – Nonparametric Data

Normality Shapiro-Wilks tests confirmed by a Kolmogorov-Smirnov test (with Lilliefors Significance Correction) failed to reveal normality in any of the constructs. Hence, non-parametric tests were applied to the data. Correlations between variables were analysed using Bivariate Kendall’s Tau-b tests, and significance tests were performed using Kruskal-Wallis H (K-Independent Samples) tests. Post-hoc Mann-Whitney U tests were performed on the significant Kruskal-Wallis H observations for within-group and between-subject tests.

4.2 Descriptive Statistics

Four aspects of online usage were analysed to identify a profile of respondents – General Internet Usage, Awareness of Possible Hate Speech, Observations of Hate Speech and Experience of Hate Speech. As shown in Table 1, 88.0% of the 183 respondents (n=161) revealed that they had experienced cyberhate on social media sites. A lower percentage (83.6%, n=153) reported having empathy for targets of cyberhate. For cyberhate awareness, ethnicity was dominant (n=149, 81.4%), followed by politics (n=141, 77.0%), religion (n=139, 76.0%) and sexuality (n=135, 73.8%). One respondent (0.5%) noted awareness of disability hate speech, and another respondent noted awareness of cyberhate based on physical appearance.

Descriptive Statistics				
	Count	%	Mean	Std. Deviation
General				
Social Media Cyberhate Experience	161	88.0%	.88	.326
Empathy towards Victims	153	83.6%	.84	.371
Awareness				
Ethnicity	149	81.4%	.81	.390
Politics	141	77.0%	.77	.422
Religion	139	76.0%	.76	.429
Sexuality	135	73.8%	.74	.441

Table 1. Descriptive Statistics – General Usage and Awareness.

Analysis of the online platforms on which hate speech was identified and on which hate speech was experienced revealed commonalities between observed and experienced hate speech as shown in Table 2. Video sites were the most observed platform for hate speech (n=114, 62.3%) and experiences of hate speech (n=94, 51.4%), followed by forums (n=90, 49.2%; n=76, 41.5%), blogs (n=66, 36.1%; n=43, 23.5%), news sites (n=47, 25.7 %; n=42, 23.0%), games (n=30, 16.4%; n=18, 9.8 %) and chat sites (n=20, 10.9%; n=17, 9.3%).

Site Platform	N	Observed		Experienced		Delta %
		Count	%	Count	%	
Video Sites	183	114	62.3%	94	51.4%	10.9%
Forums	183	90	49.2%	76	41.5%	7.7%
Blogs	183	66	36.1%	43	23.5%	12.6%
News Sites	183	47	25.7%	42	23.0%	2.7%
Games	183	30	16.4%	18	9.8%	6.6%
Chat Sites	183	20	10.9%	17	9.3%	1.6%

Table 2. Comparison of Observed Hate Speech Compared to Experienced Hate Speech.

Bivariate Kendall's Tau-b tests, shown in Table 3, were used to test the correlation between observed and experienced hate speech per online platform.

Observed	Experienced Cyberhate					
	Video	Forums	News	Blogs	Games	Chat
Video	.619** (0.00)		.183* (0.01)	.192** (0.01)	.181* (0.01)	
Forums	.170* (0.02)	.657** (0.00)	.191* (0.01)	.409** (0.00)		.212** (0.00)
News	.147* (0.05)	.165* (0.03)	.571** (0.00)	.205** (0.01)	.268** (0.00)	
Blogs	.184* (0.01)	.337** (0.00)	.267** (0.00)	.523** (0.00)	.210** (0.01)	.308** (0.00)
Games	.224** (0.00)	.196** (0.01)	.320** (0.00)	.207** (0.01)	.696** (0.00)	.214** (0.00)
Chat		.238** (0.00)		.302** (0.00)	.237** (0.00)	.672** (0.00)
Awareness	.272** (0.00)	.298** (0.00)	.287** (0.00)	.224** (0.00)	.212** (0.00)	.175* (0.01)

Table 3. Correlation between Observed and Experienced Hate Speech showing τ_b (p-value).

The Kendall's Tau-b tests showed positive correlations between observations of hate speech and experiences of hate speech for each platform, which were all statistically significant ($\tau_b > 0.500$, $p=0.000$). Chat platforms ($\tau_b > 0.672$, $p=0.000$) showed the strongest correlation which agreed with the observation of the smallest difference (1.6%). Observations of online hate on one platform in most cases correlated to experience in other platforms. This was confirmed in the frequency of observations of hate speech in general (Awareness) which showed moderate positive correlations to hate speech experienced across all measured forms of online sites. Thus entanglements exist of cyberhate observed and experienced across platforms. This was especially true for games and blogs which showed significance across all platforms.

4.3 Profile of a Cyberhate Target

The demographic data were analyzed to provide a preliminary profile of potential cyberhate targets. Three areas of cyberhate activity (Online Hate Speech Awareness, Observations of Cyberhate and Experience of Cyberhate) were analyzed using Kendall's Tau-b correlation for each demographic measure. The findings are shown in this section.

1.1.1 4.3.1 General

Analysis of the general demographics showed that online activity on social media strongly correlated with reading news sites ($\tau_b=0.345$, $p=0.000$) and posting to news sites ($\tau_b=0.137$, $p < 0.050$). Justifiably, levels of online activity correlated to levels of social media use ($\tau_b=0.238$, $p=0.000$) and similarly to reading news outside of social media ($\tau_b=0.171$, $p < 0.050$). Posting to news sites outside of social media strongly correlated with reading news sites ($\tau_b=0.354$, $p=0.000$). However, posting to news sites had a strong positive correlation to age ($\tau_b=0.196$, $p=0.003$) and a weak correlation to ethnicity ($\tau_b=-0.135$, $p=0.036$). This reveals that older respondents and White/Caucasian respondents were more likely to post to news sites than younger respondents and non-Caucasians. Empathy for victims of cyberhate correlated positively to social media use ($\tau_b=0.166$, $p=0.021$) as well as to gender ($\tau_b=0.220$, $p=0.003$). This finding shows that frequent users of social media and females were observed to exhibit more empathy than less frequent users and males. However, empathy correlated negatively to age ($\tau_b=-0.159$, $p=0.020$) and reading news outside of social media ($\tau_b=-0.137$, $p=0.045$). Consequently, older respondents were less sympathetic to victims as were respondents who read more online news.

1.1.2 4.3.2 Experience of Cyberhate

There was a negative correlation between the experience of cyberhate online games and empathy for targets of cyberhate ($\tau_b=-0.151$, $p=0.041$). A further negative correlation between games and gender ($\tau_b=-0.186$, $p=0.011$) showed that male gamers experienced more cyberhate than females. A positive correlation was observed between cyberhate experienced on social media, and sympathy for victims of cyberhate ($\tau_b=0.199$, $p=0.007$). Experience of cyberhate on news sites correlated positively to age ($\tau_b=0.153$, $p=0.026$) but negatively to gender ($\tau_b=-0.186$, $p=0.011$). Thus, cyberhate was experienced on news sites by older and male respondents. There was a positive correlation between online chat cyberhate experiences and age ($\tau_b=0.154$, $p=0.025$) as was a correlation to education ($\tau_b=0.235$, $p=0.001$). Cyberhate on chat sites was experienced by older and more educated people with higher education, showing a stronger correlation than age. Although

correlations between ethnicity and observations of cyberhate were identified, no correlations to experiences of cyberhate were observed.

Kendall's Tau-b analyses provided aggregated evidence of awareness, observation and experience of online cyberhate. In the next sections, in-depth analyses using Kruskal-Wallis H and Mann-Whitney U to test statistical variations between the group are reported.

1.1.3 4.3.3 Gender

Kruskal-Wallis H tests showed that there were statistically significant gender differences for cyberhate empathy, observed and experienced cyberhate in online games and cyberhate experiences on news sites. Kruskal-Wallis H tests showed a statistically significant difference in empathy for online cyberhate targets ($\chi^2(2) = 6.847, p=0.009$) with females having a higher average mean (95.05) than males (81.95). The Kruskal-Wallis H tests showed statistically significant higher observations of cyberhate by males in online games ($\chi^2(2) = 8.037, p=0.005$) as well as for the experience of cyberhate in online games ($\chi^2(2) = 5.396, p=0.020$). Similarly, Kruskal-Wallis H tests showed a statistically significant difference in cyberhate experienced in online news sites ($\chi^2(2) = 6.876, p=0.009$).

1.1.4 4.3.4 Ethnicity

Kruskal-Wallis H tests showed that there were statistically significant ethnicity differences for cyberhate empathy ($\chi^2(2) = 10.578, p=0.032$), awareness of political intolerance ($\chi^2(2) = 11.622, p=0.020$) and cyberhate observed in blogging sites ($\chi^2(2) = 15.712, p=0.003$).

Mann-Whitney U tests were performed to determine the statistically significant differences between ethnic groups for the differences identified by the Kruskal-Wallis H tests. Empathy amongst the Coloured ethnic group was higher than the African ($U=837.000, p=0.028$), Indian ($U=232.500, p=0.008$) and White ($U=697.500, p=0.002$) ethnic groups. The Coloured ethnic group were also higher in political awareness than the Indian ($U=205.000, p=0.007$) and White ($U=726.500, p=0.015$) ethnic groups. Observation of cyberhate in blogging sites was higher for the Coloured ethnic group than African ($U=674.000, p=0.002$) and Indian ($U=204.500, p=0.034$) ethnic groups. A similar finding of the observation of cyberhate in blogging sites was higher for the White ethnic group than African ($U=1398.000, p=0.002$) and Indian ($U=424.000, p=0.049$) ethnic groups.

1.1.5 4.3.5 Age

Kruskal-Wallis H tests showed that there were statistically significant age differences for cyberhate in reading news sites ($\chi^2(2) = 9.062, p=0.028$), posting to news sites ($\chi^2(2) = 15.831, p=0.001$) and experiencing cyberhate on news sites ($\chi^2(2) = 8.217, p=0.042$).

Post-hoc Mann-Whitney U tests were performed to determine the statistically significant differences between age groups for the differences identified by the Kruskal-Wallis H tests. Respondents 30 years old and older were observed to read more news sites, post more to news sites and experience more cyberhate than younger respondents. Respondents 30+ read more news sites than 26-29-year-olds ($U=218.500, p=0.015$) and posted more to news sites than 22-25-year-old respondents ($U=475.000, p=0.001$). The 30+-year-old group read more than the 18-21-year-old group ($U=1017.000, p=0.007$), posted more than them ($U=887.500, p=0.000$) and experienced more cyberhate on news groups than the 18-21-year-old group ($U=1116.500, p=0.007$).

1.1.6 4.3.6 Education

Kruskal-Wallis H tests showed that there were statistically significant differences by level of education frequency of general observation of cyberhate ($\chi^2(2) = 10.601$, $p=0.014$) which was associated with being online ($\chi^2(2) = 12.056$, $p=0.007$) and posting to news sites ($\chi^2(2) = 12.107$, $p=0.007$). Statistically significant differences by education level was found for cyberhate observation on video sites ($\chi^2(2) = 8.001$, $p=0.046$) and cyberhate experiences on news sites ($\chi^2(2) = 8.109$, $p=0.044$) and chat sites ($\chi^2(2) = 17.641$, $p=0.001$).

Mann-Whitney U tests were performed to determine the statistically significant differences between education levels for the awareness and experienced differences identified by the Kruskal-Wallis H tests. PhD students spent more time online than the Bachelor group ($U=536.500$, $p=0.006$), the Honours group ($U=88.500$, $p=0.003$) and the Masters' group ($U=139.000$, $p=0.005$). Higher levels of cyberhate were observed on video sites by the Bachelor degree registered students than Honours students ($U=898.000$, $p=0.028$). The Master degree group had a higher frequency of observing cyberhate than the Bachelor degree students ($U=1232.500$, $p=0.026$) and the Honours students ($U=187.500$, $p=0.002$). While the Master's student group posted more on news sites than the Bachelor degree group ($U=1078.000$, $p=0.001$) and than the Honours students ($U=227.500$, $p=0.015$). They also experienced more cyberhate on chat sites than the Bachelor student group ($U=1228.000$, $p=0.000$). The PhD student group experienced more cyberhate on news groups than the Bachelor group ($U=647.000$, $p=0.010$).

1.1.7 4.3.7 Social Media Frequency of Use

Kruskal-Wallis H tests showed that there were statistically significant differences associated with time spent on social media platforms and empathy ($\chi^2(2) = 9.647$, $p=0.008$), reading news sites ($\chi^2(2) = 18.127$, $p=0.000$), cyberhate observed in forums ($\chi^2(2)=7.316$, $p=0.026$), cyberhate experienced on social media platforms ($\chi^2(2)=9.549$, $p=0.008$) and frequency of being online ($\chi^2(2)=8.092$, $p=0.017$).

Mann-Whitney U tests were performed to determine the statistically significant differences between time spent on social media groups for the differences identified by the Kruskal-Wallis H tests. Empathy was higher amongst daily users of social media sites compared to monthly users ($U=435.000$, $p=0.002$). However, daily users of social media also experienced higher levels of cyberhate on social media sites ($U=474.000$, $p=0.002$). The daily users of social media read more online news sites than monthly social media users ($U=321.000$, $p=0.003$). Daily social media users read more online news sites than weekly social media users ($U=1292.500$, $p=0.001$) and observed more cyberhate in forums than weekly social media users ($U=1566.000$, $p=0.016$). While respondents who go online frequently were more likely to use social media daily than weekly ($U=1539.000$, $p=0.020$), no significance was found for monthly use of social media.

1.1.8 4.3.8 Online Frequency

Kruskal-Wallis H tests showed that there were statistically significant ethnicity differences for the frequency of social media use ($\chi^2(2) = 25.829$, $p=0.000$), reading of news sites ($\chi^2(2) = 19.823$, $p=0.001$), observed cyberhate in online forums ($\chi^2(2) = 12.147$, $p=0.016$), and cyberhate experienced in blogging sites ($\chi^2(2) = 11.892$, $p=0.018$).

Mann-Whitney U tests were performed to determine the statistically significant differences between online frequency groups for the differences identified by the Kruskal-Wallis H tests. The increasing frequency of being online was statistically significantly associated with higher use of social media and using online news sites. Weekly online frequency of 1 to 4 hours per week showed lower use of social media than 4 to 8 hours per week ($U=151.500$, $p=0.001$), 8 to 16 hours ($U=168.500$, $p=0.000$), 16 to 24 hours per week ($U=135.500$, $p=0.000$) and more than 24 hours per week online ($U=187.500$, $p=0.000$). A similar pattern was observed for using online news sites where the weekly online frequency of 1 to 4 hours per week showed lower use of online news sites than 4 to 8 hours per week ($U=119.000$, $p=0.000$), 8 to 16 hours ($U=138.500$, $p=0.000$), 16 to 24 hours per week ($U=125.500$, $p=0.000$) and more than 24 hours per week online ($U=159.500$, $p=0.000$). Observations of cyberhate on online forums were lower for respondents who were online for between 1 and 4 hours per week compared to the groups who went online between 8 and 16 hours per week ($U=266.500$, $p=0.044$) or more than 24 hours per week ($U=253.000$, $p=0.004$). Users with an online frequency above 24 hours per week were more likely to observe cyberhate on online forums than frequencies of 4 to 8 hours per week.

Cyberhate experiences in online blogs were statistically significantly higher for an online frequency of 1 to 4 hours per week compared to 16 to 24 hours. However online frequencies of more than 24 hours per week showed statistically significantly higher observations of cyberhate on online blogs than the online frequency of 4 to 8 hours per week ($U=692.500$, $p=0.039$), 8 to 16 hours per week ($U=882.000$, $p=0.035$) and 16 to 24 hours per week ($U=673.500$, $p=0.005$).

5. Discussion and Conclusion

This paper set out to explore a profile of cyberhate victims. Providing such a profile could raise awareness of targets who may be at risk. This is important given the limited recourse to cyberhate until a punishable crime is identified. A survey completed by 183 participants provided insight into cyberhate experiences from which a preliminary profile can be built. The research revealed links between awareness and observations of cyberhate in various online platforms – social networking, video sites, forums, news sites, blogs, games and chat sites – and experiences of cyberhate. Observations per platform correlated strongly to experience on the same platforms and moderately on other platforms. Thus awareness, observations and experiences of cyberhate were not restricted to any one type of social media.

5.1 Summary of Findings

The findings resonate with Wick et al. (2017), in the view that most cyberhate research focuses on the roles of the victim's attributes, such as age and gender. The findings showed that awareness of cyberhate permeated the online environment. As can be expected, people who were frequently online often frequented social media sites. Frequent use of social media sites correlated to a statistically significant reading of news sites. Interestingly, chat sites revealed higher correlations of cyberhate experiences for older and more educated respondents. Males experienced higher levels of cyberhate on news sites where higher levels of use correlated to lower levels of empathy for victims of cyberhate. On the other hand, higher use of social media correlated to higher levels of empathy. Thus, a potential paradox exists in the effect of social media and news sites on empathy. Empathy

was lower for increased age, although it correlated most strongly to females. In contrast, online games correlated strongly to lower empathy for cyberhate victims. However, this may be due to a stronger correlation between online games and males. Analysis of ethnicity showed that Coloured students showed more empathy than other groups, while no significant empathy differences between African and White students were observed. Although observation of cyberhate in blogs was significantly higher for White students, there were no statistically significant differences between ethnic groups for the experience of cyberhate. Older students were observed to read and post more to news sites and experience more cyberhate on the news sites. Senior students experienced higher levels of cyberhate on newsgroups while Masters students experienced more cyberhate on chat sites. Analysis of social media use showed more empathy amongst daily users of social media compared to monthly users. Daily Internet users experienced higher levels of cyberhate on social media and higher frequency of going online correlated to a higher experience of cyberhate on blogs.

5.2 Towards a Cyberhate Target Profile Based on the Experiences of Cyberhate

Following the Routine Activities Theory, cyber-victimisation can be identified through the experiences of users of technology (Wick et al., 2017). Consequently, this study analysed the cyberhate experiences of respondents to develop a preliminary target profile. Frequent Internet and social media access showed more awareness, observation and experience of cyberhate. Although awareness of cyberhate was statistically significant and observations of cyberhate were frequent, there was lower than anticipated findings of cyberhate experiences. No statistically significant evidence was observed for the experience of cyberhate by ethnic groups. Males experienced higher levels of cyberhate in online games and news sites. Older students also experienced more cyberhate on news sites, as did respondents with higher education levels. Higher education levels experienced higher levels of cyberhate on chat sites. Daily users of social media experienced higher levels of cyberhate on social media sites while high online frequency correlated to a high level of experience of cyberhate on blogs. Paradoxically, low online frequency correlated to higher cyberhate experiences on blogs than medium online frequency.

	Video	Social Media	Forums	News	Blogs	Games	Chat
Daily online					×		
Social Media Frequency		×					
Ethnicity							
Males				×		×	
Older				×			
Higher Education				×			×

Table 5. Profile of a Cyberhate Target.

The preliminary profile of a cyberhate target, as shown in Table 5, revealed that cyberhate experienced in blogs correlated closely to being online daily. Plausibly, higher social media use is associated with higher levels of cyberhate experienced on social media. However, there were no significant findings of cyberhate experienced on social media and frequent general online activities. There were also no significant correlations between ethnicity and cyberhate. Males were found to experience more cyberhate in online gaming and news sites. Likewise, older students and higher education level students experienced cyberhate in news sites. Higher educated also experienced cyberhate in chat rooms.

The preliminary profile and research findings show the complexity of defining a profile for cyberhate targets. This profile provides a starting point to identify at-risk individuals. For example, an older, higher educated male is most likely to experience cyberhate on news sites but is statistically less likely to experience cyberhate in forums.

5.3 Conclusion

The findings are broadly in line with the reviewed literature and the findings of authors such as Blaya (2019) who suggest more research is required for cyberhate target profiling. An underexplored area observed in the current research was the impact of cyberhate on the online gaming community. The current study showed statistically significant observations of cyberhate in online gaming with an associated lowering of empathy for cyberhate victims, which indicates an interesting area for future research. Across platforms observations of cyberhate exceeded experienced cyberhate. The difference between experienced and observed hate speech per platform appeared to increase with increasing distance between the perpetrator and the target. Distance related to combinations of time and space. For example, chat sites (delta = 1.6%), and news sites (delta = 2.7%) typically are associated with closer proximity in time, whereas blogs (delta = 12.6%) are accessed frequently over extended periods. Supposedly more static media, such as video sites (delta = 10.9%), was similar to blogs, presumably due to recommendation algorithms. Further research may provide insight into these findings.

Limitations for the research derives from the use of low sample size and a single case study at a prominent South African University with high levels of digital literacy skills. A larger sample and other contextual settings may result in variations on these findings.

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P09: DESIGNING SOCIAL NETWORKING MOBILE APP FOR DIABETES MANAGEMENT

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Abstract

The knowledge required for diabetes prevention and management among the rural people in developing countries vastly remains in the state of non-existence. To address this, a diabetic knowledge sharing platform, as an effective means for diabetes prevention, control, and treatment, can play role in increasing diabetes awareness and literacy. Currently researchers have emphasized the scope of peer-led learning by knowledge sharing on social media platforms in healthcare context. Therefore, by identifying this scope, we have prototyped a mobile app integrated with social media features to enable diabetic patients for cost-effective peer-led learning, knowledge sharing, and awareness building. In this process, we resorted to follow the cycles and guidelines as proposed in the Information System Research (ISR) framework for identifying users' needs and preferences as well as building the theoretical foundation for the design of an app. This study demonstrates that the users had positive response and well acceptance to this prototype app as a medium for peer-led for diabetes management. Based on the findings, the researchers are optimistic about the potentiality of the app for a wider scale adoption by diabetic patients as a cost-effective peer-led learning platform.

Keywords: Social Platform, Diabetes Management, Knowledge Sharing, mHealth, Mobile Apps.

1. Introduction

In Bangladesh, about 8 million people have diabetes, which brings about 6.4 percent of all death incidents in the country (Palma, 2018). As of 2017, the International Diabetes Federation (IDF) has reported that 6.9% of the total population in Bangladesh has diabetes (IDF, 2018). An epidemiological study by Islam, Khan, Basak, Khanam, and Masum (2016) also reported about the disproportionate increase of diabetic patients in Bangladesh, a developing country, which is higher

than earlier. They ascribed this worsening issue to the rapid urbanization and change in lifestyle. About 33% of the population who are above the age of 35 are pre-diabetic in Bangladesh (Aowsaf, 2018). Unfortunately, most of the time, diabetes among Bangladeshi patients is not diagnosed until complications appear, which often leads to adverse health conditions, which can be prevented most of the time. As a result, nationwide diabetes awareness and screening are suggested by experts, especially in low-income settings in rural areas (Hasan et al., 2019).

The common complications found in diabetic patients in Bangladesh are stroke, nerve damage, kidney disease, leg ulcers, and blindness (Haque et al., 2017). These complications exacerbate even more when poor diabetes management is attended by reduced blood-lipid profiles, hypertension and obesity. The treatment for diabetes is more expensive than other chronic diseases, which, in general, costs 6.1 folds more for diabetic patients than non-diabetic patients (Palma, 2018). Hence, a scoping review by Biswas, Islam, Rawal, and Islam (2016) on the diabetic patients in Bangladesh recommended for developing preventive and management strategies for diabetes with the assistance of government and stakeholders. The implementation of such a strategy can spread awareness and knowledge about diabetes, its risks, and mitigation.

The daily expenditure by diabetic patients has a negative economic impact on nations. For Bangladesh context, the prevention and well management of diabetes can significantly minimize the financial burden (Islam et al., 2017). Study shows that the required knowledge for diabetes prevention and management among the rural people in Bangladesh vastly remains in the state of non-existence, which is a threatening condition that necessitates large-scale awareness initiatives as soon as possible (Fottrell et al., 2018). With that regard, to increase diabetes awareness and literacy, the initiatives have to primarily involve knowledge sharing facility as a way for diabetes prevention, control and treatment, and for making awareness on the consequences of the risks associated with diabetes.

Diabetes has become a national health concern in Bangladesh; yet, its effective management rate is significantly low (Rahman et al., 2015). It is estimated that by 2030, Bangladesh will be the 6th country in the IDF SEA region in the world in terms of the population living with diabetes, which will challenge its health system to meet its population's demands (IDF, 2017). It is therefore expected that the increasing incidence of diabetes will have overwhelming social and economic impacts on the country's overburdened healthcare systems. Heisler (2007) reported that peer to peer support model is useful for improving diabetes management and achieving a clinical outcome. In such a situation, peer-led education by knowledge sharing on diabetes management is recommended by Khan, Saleh, and Pathan (2018) in Bangladesh context along with learning from the health professionals, which is too costly to provide to the individual patients. The peer-led learning is a form of community learning through social support programs which is both cost-effective and flexible and preferred by the healthcare scientists, today. As social networking platforms nowadays have become an effective and ubiquitous platform for easy and quick exchange of information, the scope of peer-led learning through sharing and disseminating knowledge based on personal experience has increased exponentially (Alanzi et al., 2016).

From e-learning to peer to peer-based social learning in the healthcare context has increased not only the access to learning but also online social support (Hajli et al., 2013). Healthcare-focused social networking platforms such as PatientsLikeMe, MedHelp, TrackMyStack, and CureTogether

facilitate the empowerment of patients, where the patients can share health knowledge and medical information, and as well as can participate in peer-led learning by continuing discourse on health education, health management and medical conditions (Wicks et al., 2010). Such peer-led learning eventually helps the peers by emotional support and to learn from each other about effective self-tackling, peer-tracking, peer-benchmarking, diagnosing disease symptoms, and personalization, modification, and altering of medications for better health management. People can be educated, and their awareness levels can be increased through information sharing and discussions via mobile social networking applications, which are very convenient and easy to use. This can rapidly decrease healthcare expenditures in managing such chronic diseases and help people to self-manage their condition effectively (Alanzi et al., 2018).

Mobile application (app) is now increasingly used for preventing and controlling diabetes through lifestyle management. Innovative approaches using information technology and mobile health (mHealth) might be an option where traditional methods have failed to deliver sustainable health attention to individuals with diabetes (Islam et al., 2016). The development and implementation of mHealth apps can play an alternative and imperative role in overcoming these limitations in low resource settings of Bangladesh (Vatsalan et al., 2010). Many private and public sectors have invested millions of dollars in this domain. In addition, a total of 180 mHealth apps available in Bangladesh under seven clusters that are primarily designed to fit more or less all the major mobile devices (Karim et al., 2016). Several controlled trials of mHealth intervention by sending a regular voice message along with community-led workshops in the rural areas in Bangladesh has shown cost-effective and positive outcome in awareness building and control of diabetes and its complications (Fottrell et al., 2018; Haghparast-Bidgoli et al., 2018). Kaium and Alam (2019) suggested using mHealth based follow-up and SMS for diabetic patients. However, none of these mHealth interventions for diabetes control worked specifically at peer to peer level that enables peer-led learning and sharing of more personal experience and motivation.

However, in Bangladesh context, little or no studies have examined the scope of designing and developing a mobile app based on the social networking concept that facilitates diabetic knowledge sharing for preventing and controlling diabetes. Most today's social networks are focused more towards teenagers and young adults as a virtual discussion area. However, there is a lack in one crucial area of social networking development, and that is the medical/healthcare industry. Such knowledge sharing by a mobile app is vital for cost-effective learning and awareness building by diabetic patients with various needs.

Diabetes mellitus demands continuous medical care, patient education, self-management, and regular access to support systems. Considering the complications associated with diabetes as well as factors like increasing mobile penetration in Bangladesh, the primary aim of this study is to design the social networking mobile application for increasing knowledge, self-efficacy, and awareness about diabetes management among the patients in Bangladesh context. In this process, this paper presents the methods of designing and developing a mobile app based on a social networking platform for diabetic knowledge sharing by diabetic patients in Bangladesh.

2. Literature Review

There are two main approaches to perform data transfers in today's IP-based networks. One is based on FTP and several variations to that protocol, and the second, and much newer, approach is based on peer-to-peer networking configurations. Started with the use of Web 2.0 tools in the healthcare context that enable social networking functions such as knowledge sharing, social learning, and social interaction (Lau, 2011). Social media is now widely used for medical education (Popoiu et al., 2012). The researchers have emphasized understanding social interactions among online communities in the healthcare context (Tsouri et al., 2016). When studying the user preference for mobile app development for diabetic patients, Conway, Campbell, Forbes, Cunningham, and Wake (2016) reported that there is a demand for social media features integration in mobile apps for diabetes in their studies. A study of a diabetes-specific mobile app, which enables social networking for health knowledge sharing by the patients, reported well acceptability by users in Saudi Arabia (Alanzi et al., 2016). Also, Alanzi (2018) studied the role of social media in diabetes management and found positive influence of social media on the self-management of diabetes in the Middle Eastern region.

The diabetes-focused mobile apps have shown evidence as a knowledge translation medium and in diabetes self-management and personalizing lifestyle behaviors (Goyal, 2017). A longitudinal study shows that the use of mobile health applications has been found convenient, beneficial, and promising to educate, motivate for self-management, and render social support for low-income Latino diabetic patients (Burner et al., 2018). Because of the wide-spread availability of mobile phones that enables easy access to health information and experience sharing, the design and application of mobile app as a platform with social networking functions is gaining popularity. For example, a mobile app called Bhalo Achi was designed based on social networking concepts to facilitate peer-led health information dissemination in the rural areas in Bangladesh (Miah et al., 2017). Based on the theory of Social Exchange, that app was found useful as a healthcare decision support medium and for reducing the digital divide among rural communities. Similarly, it was found that the application of the social exchange theory can explain three leading underpinning causes of knowledge sharing in the context of online health communities. The reasons are users' senses of self-worth, perceived social support, and achieving reputation that influence the users for health knowledge sharing on an online platform.

The ways and mediums for diabetes care and management in this digital age are remarkably transformed by the improvements of information and communications technology (ICT) (Fatehi et al., 2018). With that regard, Gavrilă, Garrity, Hirschfeld, Edwards, and Lee (2019) identified that online peer support in diabetes social media communities could empower the diabetic patients through knowledge sharing, and emotional and technical supports. On the other hand, Oliveira, Souza, de Lima, da Silveira, and de Souza (2014) found that their peer-to-peer Mobile Exchange of Knowledge (MEK) software can facilitate active participation of the people with similar health interests and needs. Furthermore, in Sub-Saharan Africa, instant messaging mobile apps are used as a cost-effective means of knowledge creation and sharing that is now significantly considered as a new knowledge tool in global health context (Lee & Mwaikambo, 2018).

Kim and Seo (2014) propose an SNS-based mobile application for diabetes self-management. The system offers tailored information that can induce changes in patient behavior through relevant and

helpful messages, exchanges, and news. Also, the usage of social networking applications like Facebook, Skype, and WhatsApp on mobile devices is increasing rapidly (Alanzi et al., 2018). Social networking platforms such as Facebook and Twitter have support groups in which people can share information and participate in discussions. On the other hand, apps like “MobiMood” allows seeking emotional support by sharing self-tracking records or achievements of mood on social networks (Caldeira et al., 2018). Another app also allows seeking social support and communication, which is designed explicitly for asthma patients (Roberts et al., 2016). However, none of these apps have been developed by following a Design science (DS) framework and theory together that can explain the underlying motivation of the users in peer-led learning and sharing their knowledge on diabetes spontaneously.

Numerous reviews have attempted to assess the quality and characteristics of current mobile applications, a challenge in the ever-changing world of app development (Hood et al., 2016). There is inadequate systematic assistance via social support to solve the problem of emotional support for people with diabetes, who need to receive lifelong treatment. To induce regular and comprehensive care for diabetes, rigorous self-management is essential during the diabetic's life; this is possible through a collaborative patient-physician healthcare model.

This study is significant as unlike other apps; the authors have used the theory of Social Exchange as a theoretical foundation of the designed app to justify the addition of social features in the app, and also followed Information System Research (ISR) framework (Hevner, 2007) to involve the users in the app design and evaluation phase. The social exchange theory can explain three leading underpinning causes of knowledge sharing in the context of online health communities. The reasons are users' senses of self-worth, perceived social support, and achieving a reputation that influences the users for health knowledge sharing on the online platform.

3. Design Methodology

To design a useful mobile app based on the social networking platform, we resorted to following the cycles and guidelines as proposed in Information System Research (ISR) framework (Hevner, 2007). ISR framework helps in the identification of users' needs and preferences regarding mobile app development and use (Schnall et al., 2016). It consists of three cycles, namely Relevance Cycle, Design Cycle, and the Rigor Cycle (Figure 1). The Relevance Cycle lets us understand the users' requirements concerning any problem by surveying them, and the Design Cycle lets develop the artifact (the mobile app) through constructing and evaluating the evolving artifact. And the Rigor cycle entails consideration of theories contributed to design the artifact. It is vital to follow the ISR framework for specifying a design-based solution artifact, applying the solution, assessing the design artifact, and presenting study details and results.

3.1 The Relevance Cycle

Since the overarching goal of this study is to design and develop a mobile app based on the social networking platform for knowledge sharing and peer learning by the diabetic patients, we started with Relevance Cycle where we have identified the problem relevance which is to develop a cost-

effective way of knowledge sharing that is relevant and vital to the target population (i.e., diabetic patients). In this cycle, we also have conducted two focus group discussion (FGD) sessions consist of eight participants (five males and three females). The participants were aged 25–65 years. All the participants were diabetic patients from rural areas to address their needs, and they were recruited based on purposive sampling because of the convenience of the authors. Each FGD session spanned slightly more than 50 minutes, involving proving the participants with multiple series of questions to understand their needs and motivation. The FGDs were essential to identify the functional requirements for cost-effective peer-led learning by knowledge sharing.

After focus group discussion, the thematic analysis shows that for peer-led learning, they are interested in knowledge sharing, and peer-performance sharing as functional requirements to manage diabetes. The interview of the health experts also guided to keep the app functions as per the medical guidelines. It also identified whether the participants indicated positivity in adopting such a mobile app as a tool for peer-led learning by knowledge sharing and diabetes management by peer-performance sharing. The intention of the adoption of such a social platform-based mobile app was found to be high among the younger participants aging between 35 to 45 years old who prefer a mobile app for better diabetes management.

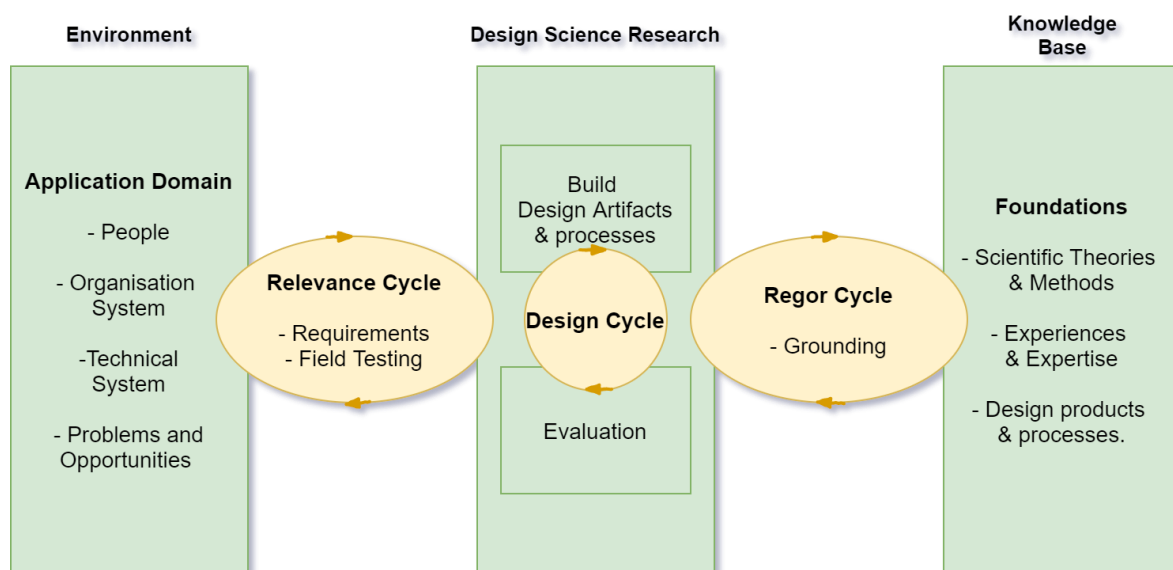


Figure 1: Information System Research (ISR) framework

(Source: Hevner, 2007)

3.2 The Design Cycle

After identifying the functional requirements, we also have conducted two more FGDs (consist of 6 participants) design sessions to identify the most desired features for peer-led learning for app design. The six participants (three males and three females) were recruited from the eight participants of the relevance cycle in a similar way. The respondents were encouraged to answer the probing questions that seek information on what users need from a mobile app used for peer-led learning, and how the functional requirements can be fulfilled by incorporating different features.

During probing questions, the respondents revealed the preference for the usability features (Table 1, the rightmost column named 'How') of how the functional requirements can be fulfilled. The respondents recommended the inclusion of features such as answering other users' questions for knowledge sharing and diabetes tracking for peer-performance sharing.

Topics	What (Contents)	How (Features)
Knowledge sharing	An interactive social media platform	<ul style="list-style-type: none"> • Chat and communication • Online discussion • Share Diabetic educational contents • Answering to other users' questions
Peer-performance sharing	Tracking performance in diabetic management	<ul style="list-style-type: none"> • Diabetes (Glucose level) tracking • Blood Pressure (BP) tracking • Weight tracking • Activity (daily walk steps) tracking

Table 1: Results from focus group sessions on app design

A group of three participants from the last two focus group design sessions was present to give their opinion during the mobile app interface design for prototyping. They were shown the draft interface in Android Studio software. Also, in the design cycle involved the evaluation of the users' experience regarding user interface and app usability of the prototype. This process was iterative and formatively evaluated from the perspective of consistency with the previously identified functional requirements and users' needs.

3.3 The Rigor Cycle

The objective of this cycle is to improve the users' acceptance. In this cycle, the researchers studied the theories that explain the users' motivation for knowledge sharing for peer-led learning on a social media platform. After reviewing the literature, it was found that the application of 'Social Exchange Theory' can explain the underpinning factors influencing the 'exchange of resource' (e.g., knowledge sharing) (Hall, 2003). This theory conceptualizes why a person values something that belongs to another person and prefers to exchange based on cost-benefit analysis (Cook et al., 2013). The benefits could be of various types of rewards, such as economic, social, and personal rewards (Hall, 2003) (Figure 2).

As social exchange drives knowledge sharing, this theory explains why users would exchange information in an online environment. This theory can aptly interpret the reasons for the co-construction of knowledge on the online social networking platforms by the users by understating

the worth of entering into an exchange (i.e., knowledge sharing). Therefore, based on figure 3 below, this study postulates five hypotheses based on which the researchers have incorporated features of peer-led learning by knowledge sharing in the artifact. Based on the FGDs in the previous cycles and 'Social Exchange Theory,' these hypotheses assume that the diabetic patients share experience on the social platform because of social rewards, economic rewards, personal rewards, health rewards, and for attaining reputation. Hence social media-based mobile app for peer-led learning by knowledge sharing is useful for diabetes management. These five hypotheses are:

- Peer-led learning opportunity encourages knowledge sharing on social platform.
- Low-cost access to information supports knowledge sharing on a social platform.
- Personal satisfaction encourages knowledge sharing on social platforms.
- Personalized healthcare opportunity helps knowledge sharing on a social platform.
- Reputation gaining opportunity encourages knowledge sharing on social platforms.

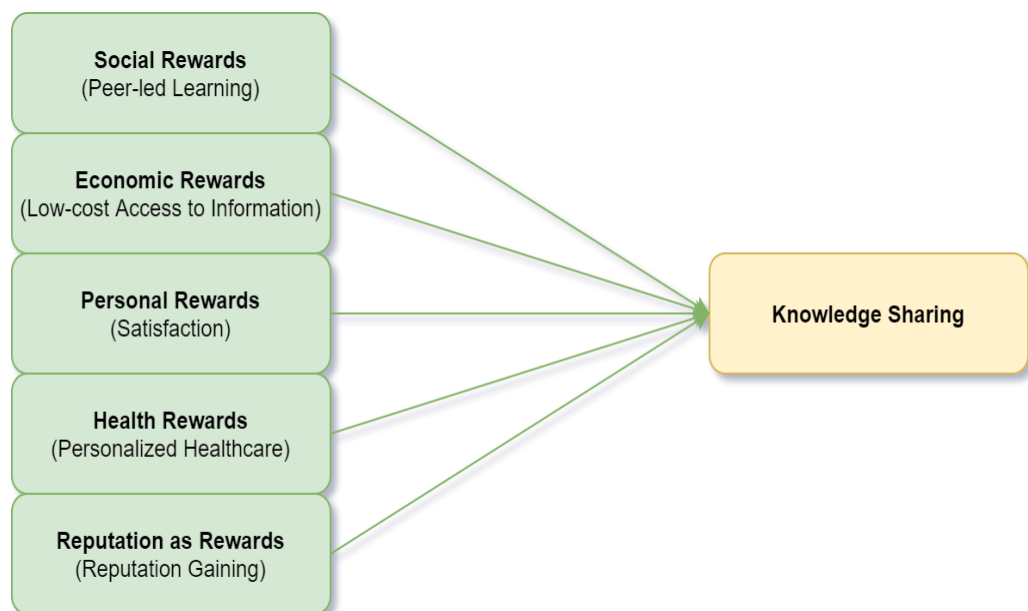


Figure 2: Users' interest influences knowledge sharing for social, economic, personal, health rewards, and for attaining reputation

4. Functional structure and features

The diagram of the overall system architecture of the mobile app is shown in figure 3 below. The system has two parts, 1) the user end, and 2) the back end. From the user end, the users can use two functional modules, which are: 1) knowledge sharing and 2) peer-performance sharing. And from the back end, the functions of admin panel module are maintained. For data security and scalability, cloud storage is used with maintaining user privacy. The prototype of the app runs only in the android mobiles. Figure 4 below shows the screenshots of the functionalities, as described below.

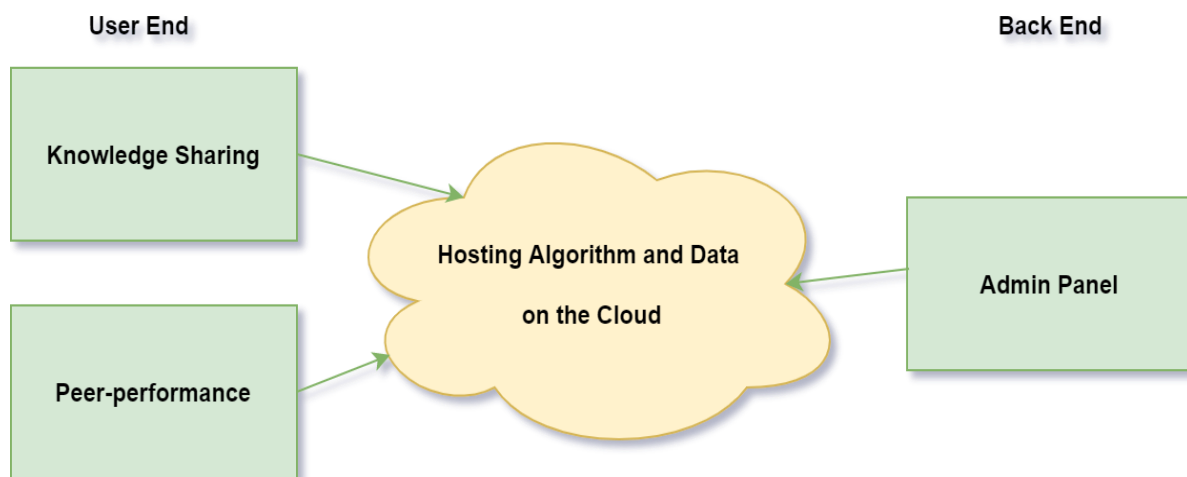


Figure 3: User end and back end with their respective function modules

4.1 Knowledge Sharing Module

This module has the features that allow the users for knowledge sharing by answering different questions on diabetes or by starting a discussion on any diabetic topic. Such activities lead to peer-led learning where the users continue discussion asynchronously. Other peers or users can like the posts during the discussions, and most users with the maximum number of like's area ranked in the dashboard. A similar function helps a user to increase their reputation and interest in knowledge sharing. Under this module, screenshot 1 (figure 4) shows that the app has the features of Chat and communication, Online discussion, Share Diabetic educational contents, and Answering to other users' questions.

4.2 Peer-performance Sharing

The screenshot 2 (figure 4) shows that using this module, the users from the peer group can keep records of their Diabetes (Glucose), Blood Pressure (BP), weight tracking, and activity (daily walk steps) performance with other peers. This function shows the graphical representation of their performance on various diabetes management criteria. It works like content sharing on the social networking sites that allows comparing one member's performance against the other peers in the groups. The most successful achiever(s) from the peer group encourages others by sharing his/her positive experiences and allows them to share their record with other peers in their peer groups.

4.3 Admin Panel Module

Screenshot 4 shows the necessary functions that the admin needs to maintain the system that includes scalability, user registration tracking, and preventing the users from spamming.

5. Findings and Discussion

Once the prototype is developed by following the iterative process of the ISR framework, the usability study shows the result of the usability aspects of the prototype app. For usability study, a total number of 40 diabetic patients (25 males and 15 females) were asked to install the app in their Android mobile. The average age of the participants was 41.4. The participants were shown how to use the two modules of the app (knowledge sharing and peer-performance sharing) and asked them to apply for three months. Then it was found that a total number of 67 chat sessions were recorded as details presented in Table 2. In the peer chat sessions, the peer mainly liked to get motivation for life-style and diet management for diabetes management. Also, 31 times the peers (users) have answered the questions of other peers, and nine times the peers shared diabetic educational contents with other peers. Moreover, it was found that 38 and 19 participants tracked their blood glucose level and activity (daily walk steps) respectively. Likewise, it was found that only 8 participants out of 40 participants shared their diabetes tracking information with their peers. In contrast, 10 participants out of 40 participants shared their activity (daily walk steps) tracking performance.

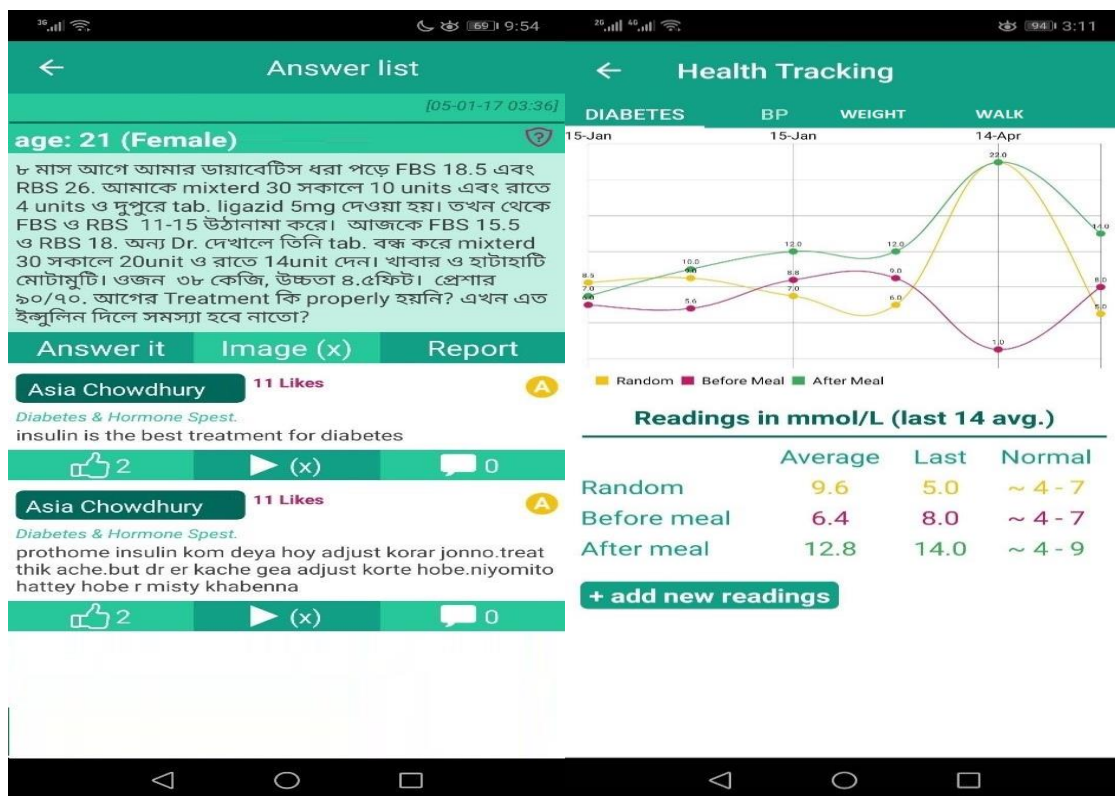


Figure 4: The screenshots of the app

About 58% participants asked questions about where and what treatment to seek for diabetes-related complexities and 22% participants asked question about what diet tips to follow for diabetes control. Two doctors monitored and moderated the contents and answered when needed to avoid the dissemination of wrong information. It was also found that most of the time, the users followed the guidelines appropriately for content sharing, questioning, and answering on the app. At the

same time, the participants' feedback has provided a strong foundation for the development of this prototype version to a potentially usable and widely adopted app. The feedback for the participants shows that although peer-led learning is informal, this app allows constructivism-oriented learning where the individuals (learners) actively interact with other individuals and experts for learning by knowledge sharing.

Features used	Use frequency
Chat and communication	67
Online discussion	15
Share Diabetic educational contents	9
Answering to other users' questions	31
Features used	Use frequency
Diabetes (Glucose level) tracking	38
Blood Pressure (BP) tracking	15
Weight tracking	7
Activity tracking	19
Features Shared	Share frequency
Diabetes (Glucose level) tracking	8
Blood Pressure (BP) tracking	2
Weight tracking	5
Activity (walk steps) tracking	10

Table 2: Frequency of the features used and performance shared by the participants in two months

Lastly, the participants were given a questionnaire (Table 3) to rate their overall perception of the app. The initial result indicates high general acceptance by participants in using the app. The user's overall satisfaction was also positive. Furthermore, 81 % of the participants were strongly agreed when asked about the app as a source for knowledge sharing. Hence, the integration of social media features has brought a new change of health-seeking behavior in diabetes management. The overall reaction of the participants regarding the use of this app was good. Hence, depending on the awareness creation of this app, the researchers are optimistic about the wide-scale adoption of the app as a means of cost-effective peer-led learning platform.

. Conclusion, limitation, and Future Work

This study started with conceptualization of designing a mobile app as a social media platform to facilitate cost-effective peer-led learning for diabetes management, then followed by the information System Research (ISR) framework, and ended with the development of a prototype. Our study has especially focused on following design science guidelines (i.e., ISR framework) on the development of a mobile app based on a social networking platform for diabetic knowledge sharing. In the ISR framework, we iteratively refined the app by vetting the recommendations and feedback given by the participants and experts to fulfill the needs of the users as well as the objective of the app. Following the ISR framework, the 'Social Exchange Theory' was used as the theoretical foundation to design the artifact.

Items	Item Mean (SD)
1. Not useful/Useful	4.71 (1.23)
2. Difficult/easy	4.69 (1.30)
3. Frustrating/satisfying	4.01 (1.31)
4. Inadequate empowerment/adequate empowerment	4.43 (1.22)
5. Dull/Interesting	4.29 (1.12)
6. Low educative/High educative	4.07 (0.94)
7. Lowly interactive/Highly interactive	4.81 (0.13)
8. Low social integration/High social integration	4.59 (0.97)
Overall Mean =	4.45

Table 3: Overall reaction of participants to the eight items

This study demonstrated some interesting insights about the users' preferred features (Table 1) for knowledge sharing and peer-performance sharing. The findings show that the users have demonstrated positive response and acceptance to this app (Table 3), which has positive practical and theoretical implications for researchers, health professionals, diabetic patients, and stakeholders. Such a positive response from the participants at the prototype stage of this app has motivated the researchers to explore the scope for developing beyond a prototype version and implementing full-scale adoption by creating awareness.

The major limitation is that the app has not been formally tested yet in accordance with any comprehensive assessment checklist such as the mERA checklist developed by World Health Organization (WHO). Therefore, a future study can be conducted for evidence reporting, based on mERA checklist, on the effectiveness of peer-led learning for diabetes management through mobile app intervention. Moreover, the hypotheses proposed based on 'Social Exchange' theory in the Rigor Cycle of the ISR framework are yet to be tested and proved. Another significant limitation of this study is that we have not collected any information regarding the diabetic health literacy of the participants to understand how that affects the peer-led learning using this app. With that regard, another future study can be carried out to analyze the quality of the posts and contents shared by the users on peer-led learning using the app. A cost-benefit analysis of peer-led learning on this app is yet to be conducted. Finally, the evaluation of this app needs further study as the preliminary assessment was conducted using non-generalizable sample participants.

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P10: DIGITAL ENTREPRENEURSHIP AND INSTITUTIONAL CHANGES: FINTECHS IN THE BRAZILIAN MOBILE PAYMENT SYSTEM

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Abstract

In mature and highly regulated markets, digital entrepreneurship may demand institutional changes to flourish. This paper aims to analyze institutional changes associated with the entry of new digital entrepreneurs (fintechs) into a national payment system. To achieve this goal, we conducted a case study in the Brazilian mobile payment system, with data collected from multiple sources, such as interviews with fintech entrepreneurs, document analysis, a survey with 580 users and non-users of mobile payments, and participant observations during a fintech summit. The Institutional Theory supported the understanding of institutional changes regarding the regulatory, normative, and cultural/cognitive pillars of the mobile payment system needed to support the new entrants (fintechs). The institutional work performed to carry on these changes is also analyzed.

Keywords: Digital Entrepreneurship, Institutional changes, Fintechs, Mobile payments, Institutional Theory.

1. Introduction

Mobile payments encompass the payments of goods, services, or bills through a mobile device using wireless communication networks (Dahlberg, Gou & Ondrus, 2015; Wang et al., 2019). Innovations in mobile payment technologies bring opportunities for digital entrepreneurship, or the pursuit of entrepreneurship opportunities based on the use of digital technologies (Davidson & Vaast, 2010). This technology also allows firms to create new products, services, and business models (Nambisan, 2017; Hinings, Gegenhuber & Greenwood, 2018). The information technology, which until recently was considered a barrier for organizations to enter the payment sector, is now seen as an opportunity, especially with the spread of mobile technologies and digital platforms. In this context, new entrants have the potential to offer innovative solutions for a population currently excluded from the payment system (Gomber, Kauffman, Parker & Weber, 2018).

This context, therefore, is favorable to digital entrepreneurship, resulting in the development of new

technology-based organizations, such as fintechs, which aim to solve problems with a set of innovative and often disruptive services. Nevertheless, institutional conflicts may arise when new digital solutions may be incompatible with formal and informal laws and regulations in established industries (Geissinger, Laurell, Sandström, Eriksson, & Nykvist, 2019).

Several researchers have argued for the need to investigate digital entrepreneurship in light of new theoretical approaches. They suggest that an institutional perspective helps to analyze how critical actors socially legitimate new businesses and how they interact with the existing institutional arrangements (Hinings, Gegenhuber & Greenwood, 2018). This is particularly important when new digital ventures operate in mature markets with stable and routine interactions between participants (Scott, 2014).

In this sense, our research studies the case of fintechs entering the payment sector. Fintechs refers to "a new financial industry that applies technology to improve financial activities" (Schueffel, 2016:32). These companies have been developing new technologies and designing new services, typically addressing the consumers' needs in very direct, valuable, and innovative ways, with new business models (Gomber et al., 2018). Fintechs may break the paradigms of the traditional financial system, which often inefficiently use the available technological resources (Gomber et al., 2018; Du, 2018). Given this context, we aimed to answer the following questions: *(a) What are the institutional changes associated with the entry and development of fintechs in the mobile payment sector? (b) What type(s) of institutional work has been conducted in this sector to promote digital entrepreneurship of fintechs?*

We considered the institutional theory (DiMaggio & Powell, 1983; North, 1990; Bruton, Ahlstron & Li, 2010), as a theoretical lens to understand the institutional changes. Institutions are the "rules of the game," established to reduce the uncertainty in relationships and transactions and to guide the behavior of individuals and organizations (North, 1990). Institutional changes, in turn, are understood as changes that occur in the relationship between institutions and organizations (North, 1994; Kanazawa, 1999).

This article contributes theoretically by analyzing, in the light of Institutional Theory, the relation between digital entrepreneurship and institutional changes in mature and regulated business environments. Therefore, the article contributes to the knowledge generation on the role of digital technologies in entrepreneurial pursuits (Nambisan, 2017) and the understanding of institutional factors that act upon it. From a managerial point of view, this study is useful for digital entrepreneurs wishing to understand better the institutional issues regarding the entry and development of new organizations based on digital innovations. Concerning governments, the study analyzes the relationship between norms and regulations in the payment sector and digital entrepreneurship, which is often encouraged to promote local development.

2. Institutional changes and institutional work

We study the institutional change in the light of institutional theory, which addresses how organizations protect and improve their positions and legitimacy, under the established rules and norms in the institutional environment (Meyer & Rowan, 1991). In this context, the term "institution" refers to the formal sets of rules and agreements that organizations and individuals must follow (North, 1990; Bruton, Ahlstron & Li, 2010). Those derive from regulatory structures, government agencies, laws, professions, and other social and cultural practices that generate compliance pressures

on them (DiMaggio & Powell, 1983).

The institutional theory emphasizes that organizations are not purely rational systems of production of goods and services; they are social and cultural entities embedded in an institutional order (Hinings, Gegenhuber & Greenwood, 2018). This institutional perspective analyzes how new arrangements are socially legitimated by critical actors, exploring how actors interact with the existing institutional arrangements. Scott (2014) identified regulatory, normative, and cultural/cognitive systems that are vital for institutions (Table 1). From an institutional perspective, the legitimacy of new organizations is not a commodity to be owned or exchanged. Still, it is related to rules and laws, normative support, and alignment with cultural/cognitive structures (Scott, 2014).

Dimensions	Regulatory	Normative	Cultural/Cognitive
Indicators	Rules, laws, sanctions	Certification, accreditation	Common Beliefs, Shared Logics of action
Basis of compliance	Expedient	Social Obligation	<i>Taken for grantedness</i> Shared understandings
Basis of order	Regulative Rules	Normative Expectations	Constitutive schema
Mechanisms	Coercive	Normative	Mimetic
Logic	Instrumentality	Appropriateness	Orthodoxy
Affect	Fear guilt/innocence	Shame/Honor	Certainty/confusion
Basis of Legitimacy	Legally sanctioned	Morally governed	Elements understandable, recognizable, culturally supported

Table 1: Three pillars of institutions (Scott, 2014: 60).

The role of the actors when creating new institutions has been examined based on the concept of institutional entrepreneurship. Institutional entrepreneurs are organized actors who envision new institutions as a means of promoting interests and are highly valued and suppressed by the existing logic (DiMaggio, 1988). The concept of institutional entrepreneurship is important because it focuses on how the actors work to influence their institutional context through particular strategies, such as market and technical leadership, lobbying for regulatory change, and discursive action (Lawrence & Suddaby, 2006). Research on institutional entrepreneurship should explain how actors can envision and impose alternative futures (Hinings, Gegenhuber & Greenwood, 2018). This is related to the concept of institutional work.

The perspective of institutional work is primarily focused on understanding how action influences social and institutional structures. That is, it aims to understand the work developed by individuals, groups, and organizations to promote the creation, maintenance, or disruption of institutions (Lawrence, Suddaby & Leca, 2009). Creating new institutions requires institutional work done by a set of actors with different resources and skills (Lobley et al., 1991). Table 2 presents the possible forms of institutional work related to the creation of institutions and their definitions, as proposed

by Lawrence and Suddaby (2006).

<i>Forms of institutional work</i>	Definition
<i>Advocacy</i>	The mobilization of political and regulatory support through direct and deliberate techniques of social suasion
<i>Defining</i>	The construction of rule systems that confer status or identities, define boundaries of membership or create status hierarchies within a field
<i>Vesting</i>	The creation of rule structures that confer property rights
<i>Constructing identities</i>	Defining the relationship between an actor and the field in which that actor operates
<i>Changing normative associations</i>	Re-making the connections between sets of practices and the moral and cultural foundations for those practices
<i>Constructing normative networks</i>	Constructing inter-organizational relationships through which practices become normatively sanctioned via peer group concerning compliance, monitoring, and evaluation
<i>Mimicry</i>	Associating new practices with existing sets of taken-for-granted practices, technologies, and rules to ease adoption
<i>Theorizing</i>	The development and specification of abstract categories and the elaboration of chains of cause and effect
<i>Educating</i>	Educating actors in the skills and knowledge necessary to support the new institution

Table 2: Institutional work for the creation of institutions
(Source: Lawrence & Suddaby, 2006:221)

The forms of institutional work can be divided into three groups. The first group, including the work of advocacy, defining and vesting, reflects the political work by which actors reconstruct the rules, property rights, and boundaries that define the access to material resources. The second group, consisting of constructing identities, changing normative associations, and constructing normative networks, emphasizes the actions in which actors' belief systems are reconfigured. The final group (mimicry, theorizing, and educating) involves activities intended to change abstract categorizations in which the boundaries of meaning systems are changed (Lawrence & Suddaby, 2006).

3. Method

We conducted a case study, considering as the unit of analysis the entry and development of mobile payment fintechs in the Brazilian payment sector. Following Eisenhardt (1989), we collected data from different sources and in different ways, via document analysis, interview, questionnaire, and participant observation. We collected the data in five steps:

Step 1: Mapping the Brazilian mobile payment fintechs: To identify the mobile payment fintechs in Brazil, we performed an advanced Google search for the term “mobile payments,” only in Brazilian and Portuguese-language websites, on November 30, 2017. We considered the first 30 pages of results, corresponding to 300 websites. These were accessed and had their content evaluated. In this search, we identified 34 companies offering mobile payment solutions. All of them were contacted, and 9 agreed to participate in our study.

Step 2: Conducting interviews with fintech managers: we used a script with 19 questions, with nine of them being specific to the company interviewed, and ten about the Brazilian payment sector. The interviews lasted 50 minutes on average. They were recorded, later transcribed and saved in a single database created in NVivo software. The profile of the participating companies is shown in Table 3.

	Solution Offered	Foundation	# of Employees	Area of operation
I1	Bank transfers via app	2016	5	Brazil
I2	Payment and money recharge smartphone app	2015	20	Brazil
I3	Mobile food voucher	2013	6	Brazilian inland
I4	Prepaid Card	2013	160	Latin America
I5	Prepaid Card	2012	150	Brazil
I6	Payments and receipts via smartphone	2015	9	Brazil
I7	Validation of payments using face recognition	2015	15	International
I8	Payment and transfer via app	2013	20	Brazil
I9	Digital card	2017	-	Brazil

Table 3: Profile of the fintechs studied

Step 3: Survey with users and non-users of mobile payments: we conducted a survey on the use of mobile payments in Brazil with both users and non-users of this type of payment. The questionnaire was previously reviewed and tested by a group of 17 academics (masters and Ph.D. students). The link to the online survey was shared within the researchers' social networks, with snowballing, from July to October 2018, and 580 people answered it.

Step 4: Participation in the event Fintouch 2018: the first author participated in the Fintouch 2018, considered the largest fintech event in Latin America. The event featured 35 lectures and workshops, 3 of which were selected for recording, as they addressed topics directly related to this research. The lecturers were recorded and transcribed, and their content was imported into the NVivo database.

Step 5: Mapping the activities of ABFintechs (Brazilian Association of Fintechs): we collected the content of the ABFintech Facebook page from the date the page was created, on October 26, 2016,

until October 5, 2018. We saved 222 articles and images and imported them into NVivo. We categorized and analyzed the content about the activities of this association.

Initially, we coded all the data sources in "case nodes," and each interview received a code (01 to 09) followed by the name of the company, for example: 01_fintech1. The Fintouch lectures were classified according to the player represented in each speech, for example: Central Bank (CB) of Brazil (in Portuguese, Banco Central do Brasil), Brazilian Stock Exchange (CVM), ABFintechs, etc. After coding the case nodes, assigning each document to a given player, we coded the content using the open coding technique. Open coding divides qualitative data into discrete parts while closely examining and comparing them for similarities and differences, leaving them open to all possible theoretical directions (Saldaña, 2009). Thus, initially, we established the categories based on the data collected, without linking them to a theoretical approach. The open categories that emerged from the field were then linked to theoretical categories of analysis in the light of institutional theory (Table 4).

Categories	Definition	Source
<i>Institution</i>	"Rules of the game," established to reduce the uncertainty in relationships and transactions and to provide the structure guiding the individual and organizational behavior.	DiMaggio & Powell, (1983); North (1990); Bruton, Ahlstron & Li (2010)
<i>Organizations</i>	Players who aim to combine their skills, strategies, and abilities to "win the game," following the rules (institutions) established, working in the process of institutional change.	North (1990); North (1994)
<i>Legitimacy</i>	It consists of the social approval of specific actions and forms of organization.	Meyer & Rowan (1977); Hofer & Green Jr. (2016)
<i>Institutional Changes</i>	Changes in the relationships between institutions and organizations.	North (1994); Kanazawa (1999)
<i>Institutional Pillars</i>	The institutional pillars (regulatory, normative, and cultural/cognitive pillars) reflect aspects of institutions in various perspectives based on obedience, legitimation, and order, mechanisms, logic, indicators, and emotion.	Scott (2014)
<i>Institutional Work</i>	Work developed by individuals, groups, and organizations to promote the creation, maintenance, or disruption of institutions (see types in Table 2).	Lawrence & Suddaby (2006); Lawrence, Suddaby & Leca (2009)

Table 1: Theoretical categories considered in the data analysis

We attempted to follow criteria to check the research reliability and validity (Gibbert & Ruigrok, 2010) such as (i) a protocol was created with the entire case study planning; (ii) multiple sources of evidence were used (interviews, documents, participant observation and survey); (iii) the data were triangulated during the analyses; (iv) a brief survey report was sent to the participants; (v) the data

collected were stored and organized in a single NVivo database.

4. Results

First, the regulation and development of mobile payment fintechs in Brazil are overviewed, following the institutional changes that already occurred and those that still need to happen in this context (according to the research participants) for the entry and development of fintechs.

4.1 Regulation and diffusion of mobile payment fintechs in Brazil

According to the Central Bank of Brazil (CB), the Brazilian Payment System comprises the entities, systems, and procedures related to the processing and settlement of fund transfer operations, transactions with foreign currencies, or with financial assets and securities. The payment arrangements are defined as a "set of rules and procedures regulating the provision of particular payment service to the public, accepted by more than one payee, through direct access by end-users, payers and payees" (BC, 2017). The payment system involves a set of norms, standards, and instruments that control money transfers between several economic agents, including organizations, individuals, banks, government, among others (Brito, 2002; BC, 2017). Table 5 presents a description of the role of each player in the system.

Over time, the sub-acquirer (Table 5) emerged as a new player in the payment system to intermediate companies/users and other players, thus facilitating operations. Interviewee 6 explains: *"Since about 2008, 2009, a new player has entered this umbrella of the arrangement, which are the sub-acquirers, which is where we [fintechs] fit in. So, most of our contracts are brokered by our acquirer, it does all the contracts with the credit card companies, and with the banks"*.

Fintechs that participated in this research are classified as acquirers or sub-acquirers. They aim to provide a more focused and target-oriented service, improving the relationship between consumers and companies and acting as intermediates with the players of the sector. The website of the CB (Banco Central do Brasil, 2019) defines fintechs as *"companies that introduce innovations in the financial markets through the intensive use of technology, with the potential to create new business models. They work through online platforms and offer innovative digital services related to the sector."*

Player	Role
Acquirer	It is the company that accredits a business to accept an electronic means of payment, being responsible for capturing, processing, and settling the transaction.
Credit Card Brand	It is the payment arrangement settlor, responsible for the organization, structure, supervision, and the operational and safety rules necessary for the system to work.
Issuing bank	It is responsible for issuing payment instruments/cards and for offering credit to the holder. It is the primary institution that is in contact with the holder.
Cardholder	It is the holder of the payment instrument (credit, debit, or prepaid card). In the case of a credit card, the holder has a credit limit pre-approved by the card issuer (a bank or other card issuing institution).

Business Owner	It is the business that accepts payment instruments/cards as a means of payment for products and services and may be a physical or an online store.
Sub-Acquirer or Facilitator	Any entity that enables receiving users to accept various payment instruments and participates in the settlement process as a business owner's debtor, who may also be an individual, celebrating a contract with receiving users.

Table 5: Players and Roles in the Brazilian Payment System

(Source: Research data and Cartilha de Meios de Pagamento ABECS, 2019).

This page indicates that fintechs are regulated by resolutions 4,656 and 4,657, from April 2018, issued by the National Monetary Council. However, these resolutions do not present the term "fintech", and focus on two types of organizations only: Direct Credit Societies and Personal Loan Companies, which may operate on electronic platforms and issue electronic money. The resolutions allow these organizations to work without the intermediation of banks, but with monetary values restricted to specific values to ensure the security of the financial operations. This legislation does not directly address mobile payment fintechs; they fall under the current legislation on payment institutions and arrangements (Law no. 12,865 from 2013).

Mobile payments have been diffused in Brazil, but still, face some barriers. Our survey results with 580 respondents indicated that 85% of them have already made some type of mobile payment; almost half (49%) make mobile payments weekly and 42% monthly. However, it is not yet part of the everyday life of Brazilians, since only 9% state that they use mobile payments daily. The smartphone is the most used means to make mobile payments, either via app or web (67%), and payments by Near Field Communication is used by 16% of respondents only. The respondents that use mobile payments pointed to the benefits of practicality and convenience in transactions (98.79%), speed (94.14%), and mobility (91.31%). The main barriers indicated in the survey are the lack of perceived security of mobile payment systems (61%), the risk of loss or theft of mobile devices (54%), and the lack of knowledge about this form of payment (52%). Other barriers that deserve attention are the lack of internet access or slow internet access (32%) and bureaucracy to activate mobile payment systems (28%).

4.2 Institutional changes related to the entry and development of fintechs in Brazil

The interviewees indicated advances in the legislation as one of the main institutional changes related to the entry and development of fintechs in Brazil. The main change is the Law #12,865/2013 about payment arrangements and institutions and the subsequent government regulations. Due to this law, new means of payment began to emerge and spread in Brazil. I6 reports that the Central Bank was a key actor in the approval of this law and has worked day by day to improve and innovate the payment sector in Brazil: *"mainly the Central Bank has been a very favorable and very active agent for change"*. According to the respondents, the impacts of this legislation are positive, such as increased market security, ease of fundraising by fintechs, knowledge of the "rules of the game", and blocking of the entry and development of adventurous companies.

A second change refers to the openness of the Central Bank to the fintechs. Companies report that some time ago, the rules were simply enforced, and everyone should abide by them; today, the

reality is different. The respondents mention that there are frequent meetings between the financial companies and the Central Bank to discuss norms, as well as working groups to discuss changes in the legislation and rules.

The third main change was the creation of ABFintechs. Its emergence as a representative association of fintechs in Brazil gave voice to this group of companies, and the association influences the regulatory agencies. I1 works on the board of ABFintechs, and reaffirms this commitment: *"we fight for the smaller ones to become one voice and to be heard so that things stop being easy only for the larger companies."* The association also plays a vital role in organizing events and diffusing information about the Brazilian market of fintechs, promoting the competitiveness of these companies.

Finally, a fourth change reported by the respondents is the opening of large players to the fintechs. There is a number of innovation and entrepreneurship programs offered by major banks and credit card companies. As highlighted by I6: *"Banks themselves, they... all of them, without exception, have innovation programs in which they approach fintechs, but I still see that they haven't found the right way to get that approach."*

In this sense, several institutional changes are still needed to overcome barriers to the entry and development of mobile payments fintechs in Brazil. The first change indicated by the interviewees refers to get easier access to venture capital and public funding programs. The fintechs report great difficulty in proving themselves profitable for investors and federal funds. I6 makes this point very clear when comparing the fintechs with banks: *"For example, for a bank to raise capital from scratch, [...] it comes with their own capital, obviously, with its own funding, but for a bank to raise capital with agencies ... federal institutions, it is much easier than, for example, for a fintech"*.

Another issue highlighted as a necessary change refers to the abandonment of the *hardware*, as there is still a heavy reliance on and use of payment machines. According to the respondents, it could be replaced by applications: *"it is necessary to abandon this hardware attachment, the installed hardware base of card reading machines [...] I think the point would be to change the view of the hardware installed base and replace that base with smartphones."*

Changes in legal, fiscal and regulatory elements are also necessary, especially regarding the acquirers and sub-acquirers in the Brazilian payment system, as highlighted by I7: *"I think there needs to be created a layer of legislation for sub-acquirers, for smaller companies, so they can be regulated"*. The interviewees pointed to the need to establish differentiated rules for mobile payment fintechs that are different of traditional and large financial institutions. I7 commented on the establishment of different levels of regulation, according to the stage and the volume of money traded by the fintech: *"that limits the risks to volume, as it is, for example, in England, in which there are API and SPI: API is authorized payment institution; SPI is small payment institution. And for you to move from one phase to another, it's a matter of volume. So, this is something that you would solve intelligently, but for political reasons [...] there is resistance to that, but the Central Bank is starting to be open to this."*
(17)

The respondents pointed out that larger players have a stronger voice in Brazilian regulatory agencies while influencing the market rules, defending their interests, and ensuring their benefits

because of their power and size. For example, withdrawal operations are centralized in the hands of large players, which ends up making the cost too high for fintechs: *“today the cost of withdrawal is very high because we can't get inside a bank network with a reasonable cost; today the cost is too high... and that's a barrier”*. (I5)

They also mentioned their struggle to understand and complying with the current regulations, as explained by I3: *“The challenge is the regulation. When you are about to start, it is complex to meet all this regulation ... until you can map everything, you have to understand that the legislation available is not easy to understand. I am a trained lawyer and I've spent a lot of time studying it. I said that non-lawyers cannot understand this. They [fintechs] will have to hire lawyers, and it will be very expensive”*. Therefore, simplifying legislation is a necessity.

The lack of communication between the regulatory agencies in Brazil and the high level of bureaucracy was also pointed as a barrier. In an attempt to regulate a food voucher solution, for example, I3 highlighted a number of mismatches faced along the way, as the Ministry of Labor and the Central Bank were not aligned on the related rules. The lack of public policies to increase Internet access by the Brazilian population also appears as a barrier to the development of fintechs, especially regarding the people excluded from the traditional payment system. Evidence about it also emerged in the survey with users and non-users of mobile payments that emphasized the lack of Internet access in all locations (even in large Brazilian urban centers) as a barrier to the use of these services.

5. Discussion

Some digital innovations challenge the existing institutional arrangements as they involve legitimacy and regulatory issues (Hinings, Gegenhuber & Greenwood, 2018). The research data show that the technology drove a set of institutional changes in the Brazilian payment system when new players – the mobile payment fintechs – entered this context. This result confirms that the emergence of new technologies can create a form of “exogenous shock”, imposing a need for change within an established field (Geissinger et al., 2019). The main institutional changes identified were classified into the three institutional pillars (Table 6).

Hinings, Gegenhuber & Greenwood (2018) emphasize that, despite the faster development of technology, the diffusion process is variable, and new technologies do not necessarily become legitimized faster. In this context, the institutional theory suggests that institutional changes extend over time; there is a time-lapse between the emergence of new institutional frameworks searching for legitimacy and the existing arrangements (Brownsword & Yeung, 2008). The creation of new institutions also requires institutional work done by a set of actors with the resources and skills to act as entrepreneurs or to support or facilitate an entrepreneurial behavior (Loblebici et al., 1991). In this sense, we identified four main types of institutional work (see theoretical definitions in Table 2) in the case study, summarized in Table 7.

INSTITUTIONAL CHANGES IDENTIFIED						
INSTITUTIONAL CHANGES ALREADY MADE	REGULATORY PILLAR	- Publication of Law no. 12,865/2013 on payment arrangements and institutions	NORMATIVE PILLAR	- Openness of the Central Bank to the fintechs - Emergence of ABFintechs - Openness of the large players to the fintechs	CULTURAL/COGNITIVE PILLAR	- Acceptance and use of a new means of (mobile) payment
FUTURE INSTITUTIONAL CHANGES	REGULATORY PILLAR	- Specific regulation on <i>mobile payment</i> fintechs - Better public policies to promote internet access	NORMATIVE PILLAR	- Improved relationship between fintechs and large players - Legislation simplification - Debureaucratization and better communication between public agencies	CULTURAL/COGNITIVE PILLAR	- A better understanding of mobile payments - Abandonment of the <i>hardware attachment</i> - Knowledge of the current legislation

Table 6: Institutional Changes Identified

Advocacy consists of an essential institutional work in which organizations of interest are formally established to make demands and represent a group of actors (Lawrence & Suddaby, 2006). In the analyzed case, ABFintechs has this role and is responsible for the mobilization and representation of the fintechs with the Central Bank and other agencies. Lawrence & Suddaby (2006) emphasize that advocacy involves lobbying for resources, promoting agendas and proposing new laws, or attacking current legislation, which ABFintechs has done through the promotion of events (such as Fintouch) and the discussion of regulations. The second form of institutional work identified was **defining** (Lawrence & Suddaby, 2006), strongly performed by the Central Bank when establishing rules, standards and roles, regulating companies, and defining what organizations can and cannot do within the payment system. Related to this, **constructing identities** is also a critical form of institutional work to the creation of institutions since identities describe the relationship between an actor and the field of work. In the context analyzed, the construction of identities was observed through the development of the new organizational form (fintech) through the use of information technology by the entrepreneurs. Finally, the **construction of normative networks** (Lawrence & Suddaby, 2006) emerged through the interorganizational connections between the fintechs and their representative agency (ABFintechs) with other players and with the Central Bank and regulatory agencies. Based on these connections and related interactions, practices may become normatively sanctioned.

Some forms of institutional work were not identified in the case analyzed here. The main one was **education** – which involves educating actors by developing their skills and knowledge necessary to support the new institutions (Lawrence & Suddaby, 2006). For example, there is a need to further educate citizens about mobile payments. According to the survey data, there is still some resistance and a certain fear for making these payments, especially regarding the security in transactions.

Educating could also be used to stimulate a change in the "hardware attachment" identified.

Form	Empirical Example
Advocacy	Role played mainly by ABFintechs, an association that aims to mobilize actors and defend their interests with higher agencies through political action.
Defining	Role played mainly by the Central Bank, by proposing laws, rules, and standards to establish roles, regulate companies, and set the limits of what each member can do within the payment system.
Constructing Identities	Construction of a new organizational form (fintech) based on information technology, recognized in the financial sector.
Constructing Normative Networks	Construction of inter-organizational connections (fintechs with other players of the sector, ABFintechs, Central Banks, and other regulatory agencies), through which practices become normatively sanctioned.

Table 7: Main types of institutional work identified

6. Final Remarks

This article explored the institutional changes associated with the entry and development of fintechs in the mobile payment sector and the institutional work performed to promote digital entrepreneurship in this context. The institutional theory provided support for understanding the institutional changes already made and those that still need to be made in the regulatory, normative, and cultural/cognitive pillars (Scott, 2014) of the payment system and the related institutional work. Therefore, the article contributes to the knowledge about the development of fintechs and the mobile payment sector, which is linked to the role of digital technologies in entrepreneurial pursuits (Nambisan, 2017), and the understanding of institutional factors that act upon it. This research also contributes to the practice of entrepreneurs or future entrepreneurs wishing to enter the payment sector, as well as provides subsidies for regulatory agencies and the creation of public policies for promoting the entrepreneurship and development of fintechs, which can help to increase the financial inclusion of the population.

Our study focused on analyzing the creation of new institutions. We suggest that future studies analyze how institutional work can be performed to maintain and/or disrupt institutions (with the use of information technology) in the financial sector. Future research can also analyze conflicts of interest and the possible influence of large players on the creation of norms and rules established for the financial system that may affect digital entrepreneurship of fintechs. The institutional conditions for the creation and development of fintechs that aim to include low-income users in mobile payment services are also indicated.

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P11. DIGITAL-BY-DEFAULT: EXCLUSION THROUGH DIGITAL PUBLIC SERVICE CHANNELS

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Abstract

The use of digital channels has been promoted by governments as a way of improving services and reducing costs. This article aims to discuss how new forms of exclusion can be created by policies based on a digital-by-default orientation. To this end, more than 1.2 million service records are analyzed, as well as being considered socioeconomic indicators and spatial factors of the city of São Paulo. Results show that there is a statistically significant correlation between income and digital channels usage, as well as between digital channels usage and the requested service attendance time. It is also verified that the districts of the central region of the city tend to have high income, high rates of human development and high digital channels usage, while the periphery's districts tend to have low income, lower rates of human development and high traditional channels usage. It is concluded that, by prioritizing digital service channels, new forms of social exclusion are being created and that a portion of the population may be "forgotten" by the government.

Keywords: E-Government, Service Channels, Digital-by-default, Digital Divide, Brazil.

1. Introduction

The interaction between governments and citizens have changed over time and, in part, this change has been leveraged by the governmental use of information and communication technologies (ICT), known as e-government, aiming to improve government performance and processes (Chun, Shulman, Sandoval, & Hovy, 2010). Also, the use of ICT contributes to improving transparency, accountability, and changes the role of citizens, allowing them to be more than consumers of public services (Bonsón, Torres, Royo, & Flores, 2012).

Although e-government literature is vast (Cunha & Miranda, 2013), there is a tendency to underestimate the use of ICT and the digitization as if they were limited to technical discussions, minimizing its political aspects and consequences (Löfgren & Sørensen, 2011; Hall, 2008), ignoring contexts of social exclusion, with only a few researchers addressing e-service provision and digital exclusion (Schou & Pors, 2018). The service provision solely through electronic channels as a self-service – or the digital-by-default orientation – is based on the pre-requisite that citizens have access to technologies, have digital skills to use them, and have the socioeconomic conditions to benefit from it (Schou & Pors, 2018).

Aiming at analyzing the usage of service channels, captured by the different service channels available in a mega city in the global south, this paper discusses the possibility of to strengthen social exclusion through in the case of digital-by-default orientation, arguing the importance of maintaining the existence of traditional channels, with the same quality in the provision of services. Thus, in an effort to understand how citizens from São Paulo city (Brazil) interact with the municipal government to register requests for public services, this article presents a quantitative data analysis of the SP156, the service multichannel of São Paulo City (PMSP, 2018). The analysis is based on the requests registered in the SP156 service channels, which can be on-site, online (website and app) or via call center. The aim is to answer the research question: Is there a relation among spatial factors, socio-demographic characteristics and the service channels used by citizens?

Based on the use of large volumes of data (big data) to analyze public services requests, as it analyzes more than 1.2 million attendance records, the contributions of this paper are: (i) the use of spatial information to analyze the digital divide, which was not found in other publications, should be considered to advancement of theoretical frameworks; and (ii) the analysis of the digital divide in a global south context, which is virtually unexplored by current literature. The discussion of digital-by-default orientation and the digital divide based on the city of São Paulo data may inspire public managers to reflect on service channels offer to the citizen and on the need to provide mechanisms other than digital ones, especially in the large cities of the global south. The data processing of requests showing territory is also a contribution to the administrators of big cities, so that they can design services considering the territorial and social differences, such as the income of a specific territory.

2. Digital-by-Default and Digital Divide

The ways governments and citizens interact have changed over time, in part influenced by the governmental use of ICT. More and more governments are required to offer electronic services – e-services, understood as the use of ICT tools as a channel for providing public services to citizens (Cunha & Miranda, 2013) –, delivering services that empower citizens and meet their needs (Lopes, Macadar, & Luciano, 2018; Cunha & Miranda, 2013). The use of ICT in the provision of services aims to improve public management, as well as increase the provision, quality and effectiveness of the services provided (Araujo, Reinhard, & Cunha, 2018), efforts that only make sense when they create value for citizens (Meijer, Koops, Pieterse, & Overman, 2012).

The new forms of interaction, leveraged by ICT, influence the growing use of multi-channel for interaction, especially electronic channels (Ebbers, Jansen, & van Deursen, 2016; Giritli Nygren, Axelsson, & Melin, 2014). However, to make these new forms of interaction possible, it is necessary to consider the existing digital gaps which in order to do not reinforce current socio-economic and territorial inequalities. Schou and Pors (2018) emphasize that citizens have increasingly been understood as being “digital-by-default” by decision makers, placing those who do not use digital technologies as non-standard. The criticism regarding the digital-by-default orientation is that, by including self-service solutions, citizens are understood as being responsible for seeking services themselves, impacting people who do not use digital technologies who will thus face new forms of exclusion (Schou & Pors, 2018).

These new forms of exclusion are known as digital divide and can be distinguished by three groupings or levels (Ebbers, Jansen, & van Deursen, 2016; van Deursen & Helsper, 2015; Reddick, Abdelsalam, & Elkadi, 2012): the first level of digital divide is related to the access to technology; the second level encompasses digital skills, considering that people might have skills to use technology; the third level of digital divide presumes that, even among people who have access to and skills to use the technology, not all of them would be able to transform the access and use into real outcomes. The lack of skills impacts the use of online government services (Van Deursen, 2007) and this must be considered as governments are increasingly offering online services and presuming that citizens are able to fully use all those online services (Van Deursen & Van Dijk, 2009). Figure 1 shows the theoretical framework that considers three levels of digital exclusion.

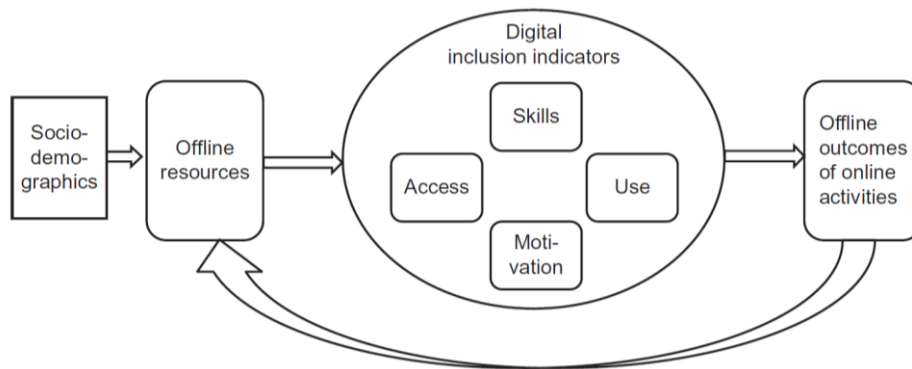


Figure 1: Theoretical Framework of Digital Exclusion

(Source: van Deursen & Helsper, 2015)

The implementation of public policies that presume the use of digital devices (such as computers or mobile phones) for interaction might also consider the possible biases among the requests resulting from that interaction (O’Leary, 2013). Those policies should consider that, in order to interact through digital solutions to register request, citizens should have access to the device and app, and the context (O’Leary, 2013, p. 184); if there is no other form of interaction and citizens do not have access to any of these three conditions, they cannot, for example, engage in interactions with governments, then generating forms of digital exclusion. O’Leary (2013) cites the case of Street Bump, a mobile app implemented in the city of Boston (USA) to capture the holes in the streets of the city; to use it, citizens had to have the app installed, an iPhone and a car, conditions tied to socioeconomic issues that could result in the improvement of some areas of the city and not others. Therefore, it is important to consider the territory – and all the socioeconomic issues inherent to it; as noted by Reddick, Abdelsalamb and Elkadic (2012), “access to public services is not just a technological issue, social and economic forces come into play as well”.

Aiming at analyzing the usage of service channels, this paper explores how socioeconomic characteristics and spatial factors are related to how citizens from São Paulo city register service

requests to the municipal government. Considering spatial and socioeconomic issues of the territory is especially relevant, mainly in a country with the dimensions and inequalities of Brazil and, specifically, of São Paulo. The population of São Paulo city is estimated to be more than 12 million inhabitants (IBGE, 2019), ranking it among the world's largest cities, and it has a high Municipal Human Development Index (MHDI)¹ for the Brazilian standard (0.805) (IBGE, 2017), but also has high inequality among its population, with a Gini index² of 0.6453 (DATASUS, 2019). In Brazil 70% of the population had used the Internet in the last three months (NIC.br, 2019) – 75% in the Southeast region of the country, where the city of São Paulo is located. Specifically, 90% of higher social class users are Internet users by mobile phone, contrasting with 55% of lower class, numbers that approximate the proportion of individuals who have used e-government in the 12 months prior to the date of the survey: 75% from higher and 37% from lower classes (NIC.br, 2019).

Guided by the research question 'is there a relation among spatial factors, socio-demographic characteristics and the service channels used by citizens?' the requests registered in the SP156 service channels were analyzed. In December 2016, São Paulo City Hall improved the availability of online citizen service channels: The Service Portal SP156 – reformulating the former Citizen Assistance Service (SAC) with regard to the presentation of services and the most simple and user-friendly language – and SP156 App, a new service channel. Aiming at simplifying and modernize the citizens' access to public services, by using these new platforms, they can register their requests to the municipal government through the website or app, as well as telephone and in person at the on-site service centers. However, it is important to note that not all services are available to be requested online and the expansion of online services is one of the lines of action of the current management of the City of São Paulo (PMSP, 2017).

3. Methodology

In order to answer the research question, an exploratory-descriptive study was carried out, with a quantitative approach, through secondary data analysis. Data referring to the services recorded by the service multichannel SP156 were extracted from Open Data on the São Paulo City website (PMSP, 2013) on 11/15/2019 and, for this research, the service request data from January 2017 to December 2018 was considered. Initially, a total of 1,479,988 occurrences were obtained. However, due to the focus of this paper was to analyze how socioeconomic characteristics and spatial factors are related to the usage of SP156 service channels, the following records were disregarded: records without district, 67,128 occurrences; service channel type "Integration"³, 58,321 occurrences; services without requests on the four channel types, 150,274 occurrences⁴; records with start date after end date, 664 occurrences. In this way, the final sample was 1,203,601 service requests. For the purpose of comparison, São Paulo City's population is over 12 million people, that is, the number

¹ The MHDI uses the same dimensions of HDI (health, education and income) and adjusts it to the municipal reality.

² The Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution (OECD, 2006).

³ The "Integration" service channel contains requests registered through the Integrated Systems SP156 - Military Police and Traffic Engineering Company (CET) - and it were discontinued in December 2017 for Military Police and in June 2018.

⁴ 97 service types were requested by the 4 channels out of a total of 356 available services.

of service requests is equivalent to approximately 10% of the population.

Data referring to São Paulo districts' income were obtained through download from IBGE's website (IBGE, 2010) and the most recent available data corresponded to the 2010 Census. As IBGE data is detailed by Census enumeration area, it was necessary to group such data by city district, in order to allow the information to be cross-checked with the SP156 service center records. Thus, the weighted average values of the household's monthly income were calculated being grouped by district. Data regarding the MHDl was downloaded from Open Data website of the Municipality of São Paulo (PMSP, 2015) on 11/15/2019, corresponding to 2010 MHDl's data for this research.

It is important to note that it was not possible to carry out individual analyses, since the available data is related to the service request, and not to the person who requested it. This would be an interesting analyses, since the results from previous researches show differences in the use of e-government by men and women (69% and 59% respectively), by education level, ranging from 26% for illiterate people to 85% for university graduates, by age group and social class (O'Leary, 2013).

The cross-checked information from Central SP156 records and IBGE's socio-demographic data was carried out using the software Excel version 365, considering the "Distrito" column in the records of Central 156 and column "Nome_do_distrito" in the IBGE database. Minitab version 19 was used as supporting software for statistical analyses, considering confidence intervals of 95% for the mean, and the individual standard deviations were used to calculate the intervals. The spatial data were obtained from GeoSampa website on 11/15/2019, where the shapefiles from districts, on "Administrative Boundaries" section were downloaded. The software QGIS version 3.10 was used for spatial analysis. Maps illustrated in this research consider the data grouped by quartiles of the information they represent.

For data presentation and representation purposes, service channels will be referenced in figures as follows: Application SP156 will be treated only by Application; Central SP156 will be denominated Telephone; Portal of Service SP156 will be treated as Web Portal; and for Service Centers the nomenclature is maintained. Data shown on all the maps are split into 4 quartiles, having each quartile exactly 24 districts, totaling the 96 districts of São Paulo's city.

Besides, Attendance Time is the elapsed time between citizen register a request and the update of the status request and it is calculated through the subtraction of date from "Data do parecer" column minus the date from "Data de abertura" column.

4. Data Analysis and Discussion

Most of the requests registered in the SP156 between 2017 and 2018 were through the Telephone (61.09%), followed by the Web Portal (24.23%), the Application (7.64%) and the on-site Service Centers (7.04%).

Table 1 presents descriptive statistics of income, MHDl, Digital Channels usage and Traditional Channels usage, where it appears that there is a wide range of data for all variables. The districts'

average income was R\$ 3,966.74, but the lowest income identified was R\$ 1,221.64 and the highest was R\$ 12,655.17, a variation of almost 10 times. When talking about MHDH, it appears that the lowest human development was 0.64700, this HDI is like that of countries with medium human development and the highest HDI was 0.94467, like countries with better HDI. However, when analyzing digital channels usage, the district that least uses digital channels presented 10.97% made through these channels (Application or Web Portal), and on the other hand, the one that used the most presented 73.57% of the requests registered through digital channels. The variability of traditional channels (Telephone and Service Centers) is also no different, where 26.43% of requests were registered by traditional channels in the district that least used these types of channels, and 89.03% of requests were made through digital channels in the district that most used it.

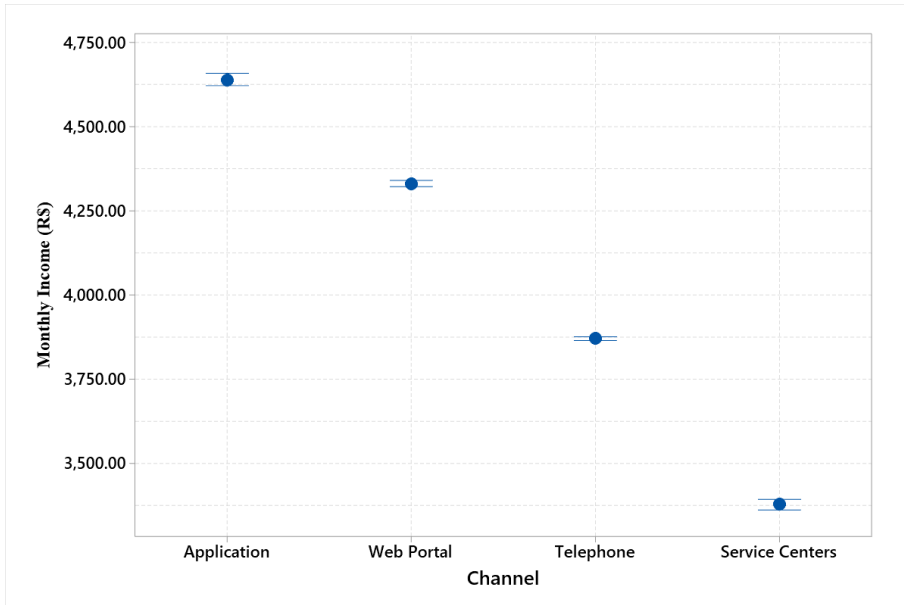
Variable	Mean	Standard Deviation	Minimum	Quartile 1	Median	Quartile 3	Maximum
Income	R\$ 3,966.74	R\$ 2,708.12	R\$ 1,221.64	R\$ 2,255.11	R\$ 3,027.94	R\$ 5,326.48	R\$ 12,655.17
MHDH	0.7896	0.0659	0.64700	0.74191	0.78497	0.82569	0.94467
Digital Channel	30.84%	9.53%	10.97%	23.98%	30.42%	36.12%	73.57%
Traditional Channel	69.16%	9.53%	26.43%	63.88%	69.58%	76.02%	89.03%

Table 1: Descriptive Statistics of Variables Used in Research

Figure 2 shows an interval plot of districts average income according to the service channel usage. It is noticed that digital channels (Application and Web Portal) are mainly used by districts with higher income (R\$ 4,639.66 and R\$ 4,330.33, or US\$ 1,091.68⁵ and US\$

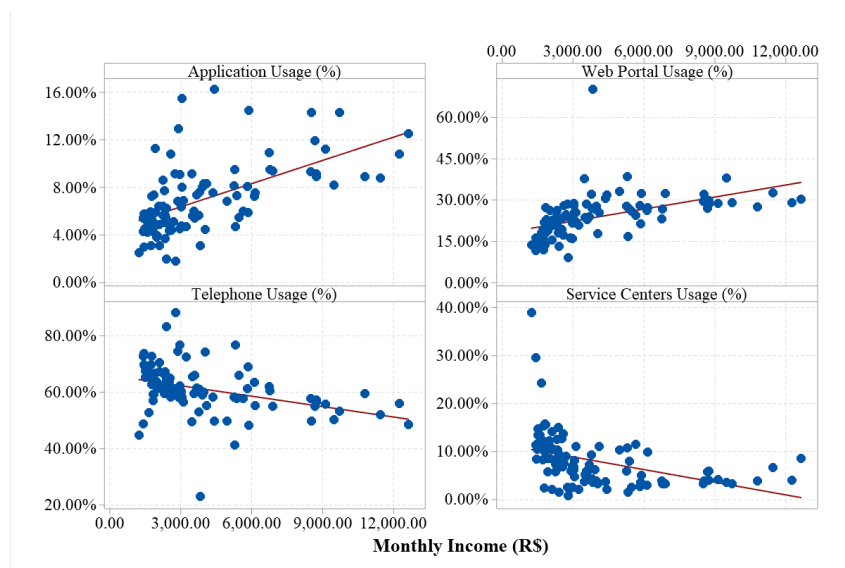
The preference for the use of digital channels in highest income districts is confirmed by correlation analysis between the channel usage percentage and district income, as shown in Figure 3. The correlations are statistically significant for all analyzed channels ($p < 0.001$) with Pearson's correlation coefficient (r) of: 0.58 for Application; 0.50 for Web Portal; -0.38 for Telephone; and -0.41 for Service Centers. That is, the positive Pearson's correlation coefficient found for Application and Web Portal Usage indicates that when income increases the digital channels usage also tends to increase, and as income decreases less it tends to be the digital channels usage. On the other hand, the negative Pearson's correlation coefficient found for Telephone and Service Centers indicates an inverse behavior, that is, when income increases the traditional service channels usage tends to decrease and when the income decreases the traditional service channels usage tends to increase.

⁵ US\$ 1.00 = R\$ 4.25 according to 1/30/2020 exchange rate.



Notes: n = 91,903 for Application; n = 291,618 for Web Portal; n = 735,336 for Telephone; n = 84,744 for Service Centers. Individual standard deviations were used to calculate the intervals. 95% confidence interval for the mean.

Figure 2: Monthly Income Grouped by Channel Type



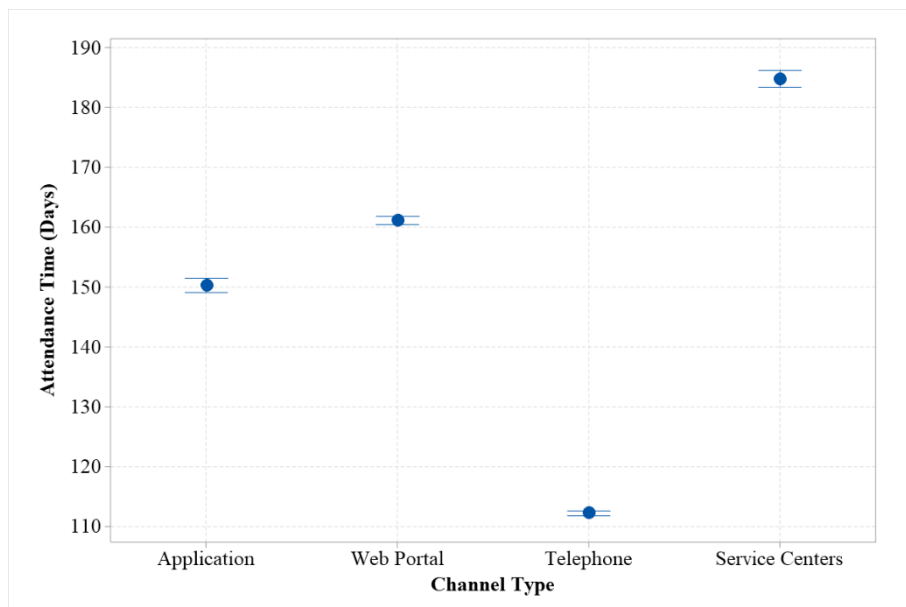
Note: n = 1,203,601.

Figure 3: Correlation between Monthly Income and Channel Usage Percentage

These findings corroborate with others that point to income as one of the determining variables for ICT use and for digital channels usage (van Deursen & Helsper, 2015; van Deursen, van Dijk, & Helsper, 2014; van Dijk, 2006). A low income makes it difficult for the population to access computers, laptops, smartphones or even a data access plan, which characterizes the first level of digital divide (van Deursen & Helsper, 2015).

When analyzing the average attendance service time, it is noticed that Service Centers attendance time (184 days) is superior to all other service channels (Application: 150 days; Web Portal: 161 days; and Telephone: 122 days), as shown in Figure 4. The differences between the average attendance service times are statistically significant ($p < 0.001$) according to the ANOVA test performed, for a 95% confidence interval. This result is also found when analyzing the average attendance time services type individually. Here it is worth remembering that service centers tend to be the preferred channel for people living in low-income districts.

Still, if we compare the attendance time of requests registered through Service Centers (which tend to be the channel of choice for the lower income population), they tend to be, on average, 23 days slower than that registered through Web Portal and on average 34 days slower than Application. In other words, people who use digital channels tend to have their requests answered in a faster time than those who use Services Centers, being able to enjoy the outcomes of their request in advance when compared to Service Centers.



Note: $n = 88,086$ for Application; $n = 278,784$ for Web Portal; $n = 714,610$ for Telephone; $n = 79,817$ for Service Centers. Individual standard deviations were used to calculate the intervals. 95% confidence interval for the mean.

Figure 4: Attendance Time Grouped by Channel Type

Having the request answered sooner does not mean only to have the grass in a square cut or a hole in the street repaired in advance (which is also important), but could mean a place that has diseases vectors clean or an unclogged manhole, which can prevent flooding. These findings contribute to the discussion on the third level of digital divide, which seeks to obtain real outcomes from digital channels usage (van Deursen & Helsper, 2015; Helsper, 2012); here the discussion does not only considers the achievement of real outcomes from citizens who are able to use digital channels to request public services, but goes further by exploring how citizens who use digital channels have access to the real outcomes faster than those using traditional channels

Considering a spatial analysis, it is noted that the city of São Paulo is also very unequal. Figure 5 shows two maps São Paulo's districts, with a comparison between the average monthly districts' income (map on the left side) and the districts' MHD (map on the right side). It is noticed that there is concentration of high-income districts in the central region and that this income concentration is accompanied by a high human development. The MHD of the central region districts is comparable to countries with high human development (HDI ≥ 0.8), while the MHD of the districts on the periphery is comparable to countries with medium human development (HDI ≤ 0.699). For comparison, Brazil's HDI is 0.761.

The digital channels usage spatial behavior, illustrated by Figure 6, is very similar to that verified by the income and MHD. The map on the left side represents the digital channels usage percentage quartiles (Application and Web Portal) in the districts and the map on the right side represents of traditional channels usage percentage quartiles (Telephone and Service Centers) in the districts. It is noticed that the digital channels usage is concentrated in central region districts (the same region that tends to have high income and very high human development) and the traditional channels usage is concentrated in the periphery districts (which tend to have low income and lower human development).

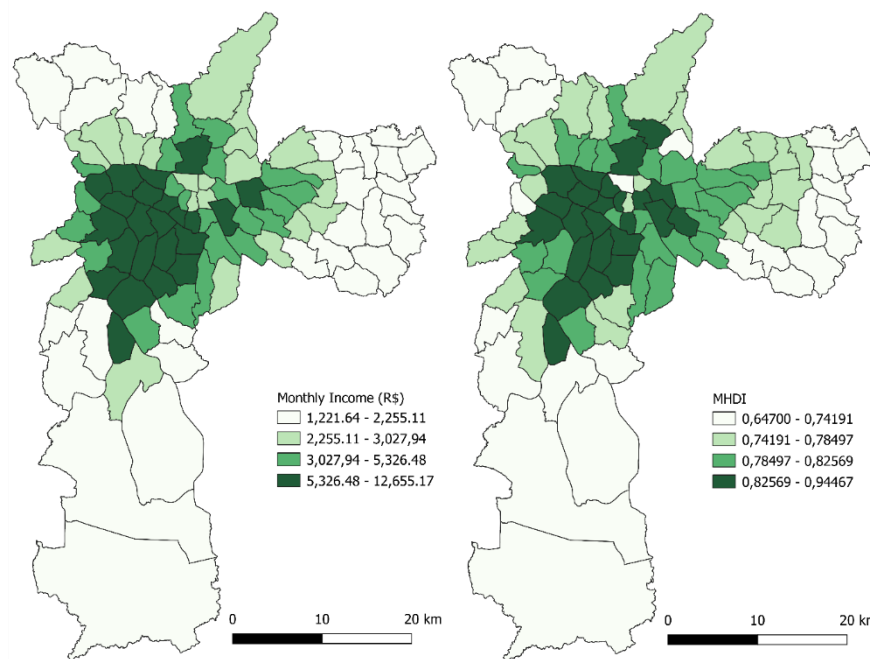


Figure 5: Comparative maps between average monthly income and MHD

The spatial analysis between income, MHD, use of digital channels and use of traditional channels (as illustrated by figures 5 and 6), together with the statistical analyzes previously exposed, shows that there is a trend in high-income districts (concentrated in the region) use digital channels, which tend to have a shorter service time compared to Service Centers.

The outcomes that can be obtained by the lower attendance time (as shown in Figure 3) can further reinforce the existing social inequalities (as shown in Figure 5, map on the right) of the city, as the districts that tend to use digital channels also tend to have higher HDI.

5. Conclusion

The purpose of this paper was to analyze how new forms of exclusion can be created by policies based on a digital-by-default orientation. To do so, databases of the public service requests, spatial data from São Paulo, and sociodemographic data of the districts of the city were used.

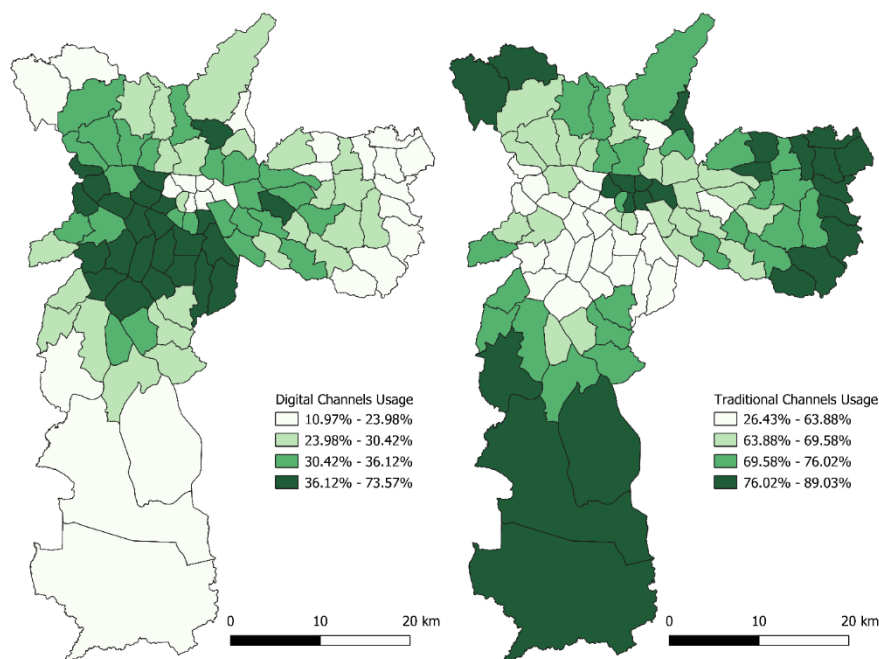


Figure 6: Comparative Maps between Digital and Traditional Channel Usage

The analyses allowed us to identify that there is a statistically significant difference in how districts' citizens with different income levels make their service requests. People with higher incomes tend to use digital channels (Application and Web Portal) for their service requests, whereas people with lower incomes tend to use more traditional service channels (Telephone and Service Centers), with Service Centers being the channel that tends to be used by the lower income population. At the same time, Service Centers are the channel type that tends to have the highest attendance time. Thus, population of peripheral districts, usually composed of people in a situation of vulnerability, ends up being neglected about the attendance time of their requests.

It was also verified, through spatial analysis, that there is a concentration of districts with higher income in the city's central region, and that these districts also tend to present a higher digital channels usage. The periphery districts tend to have low income, lower human development and

higher traditional channels usage.

In this way, it is not enough for the government to create new digital service channels, based on the idea of digital-by-default, and expect that citizens will use those and take the advantages and real outcomes that their use could result in. Together with the digital channels, the government should be concerned with creating policies to equalize the service provided for all the channels, improving the use of ICT for the service of the Service Centers, as well as through inclusion policies, be they through the provision of access points, access, digital literacy, as well as awareness of e-citizenship. If this is not done, there is a risk that digital divide creates new forms of social exclusion, as well as accentuating existing social differences.

The findings of this research collaborate with the existing digital divide discussions, mainly with regard to the first and third level of exclusion (van Deursen & Helsper, 2015; Helsper, 2012; van Dijk, 2006), as well as it shows the importance of considering the territory in decision making (O'Leary, 2013), and of offering different means to register requests, without presuming the digital by default characteristic (Schou & Pors, 2018). Future studies could further analyze the data on the usage profile of individuals by district of the city considering devices used, Internet use, use of e-government, for example. This information could help local decision-makers to better understand what it takes, for example, what makes the citizen use one channel and not the other.

A limitation of the analysis is the inference of people's average income who requested services as being equivalent to the district's average income. Additionally, it is important to acknowledge that the requests sample, despite being large enough, is non-parametric. In addition, it has been inferred. Finally, it is recommended that, for public policy and future research purposes, the databases be made available with other sociodemographic breaks, such as the gender and age of the requesting person, respecting and following the privacy and data protection policies, ensuring data anonymity. Also, it would be valuable to analyze the data from other cities and citizens, in order to understand how this phenomenon occurs in other contexts.

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P12: ELEMENTOS QUE AFETAM O DESENVOLVIMENTO DE *FINTECHS* DE PAGAMENTOS MÓVEIS: UM ESTUDO DE CASO NO CONTEXTO BRASILEIRO

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Resumo

As fintechs têm criado uma nova realidade financeira global, provendo acesso a serviços que antes se concentravam nos bancos. Este artigo visa identificar facilitadores e barreiras enfrentadas pelas fintechs de pagamentos móveis para operarem em um país em desenvolvimento (Brasil). O método de pesquisa foi um estudo de caso único, cuja unidade de análise foi o segmento de fintechs de pagamentos móveis no contexto brasileiro, envolvendo nove empresas desse setor. Como resultados, identificou-se que diversos fatores atuam como facilitadores ao ingresso e desenvolvimento das fintechs, tais como: conveniência e foco da solução oferecida, inovação no uso da tecnologia e colaboração e parcerias entre fintechs. Porém, diversas barreiras são enfrentadas no surgimento e desenvolvimento dessas empresas, tais como: questões regulatórias, necessidades de investimentos, dificuldades de encontrar parceiros e conflitos de interesse com grandes players do mercado financeiro.

Palavras-chave: *Fintechs*, Empreendedorismo, Pagamentos móveis, Facilitadores, Barreiras.

1. Introdução

Os pagamentos móveis envolvem pagamentos por meio de um dispositivo móvel, utilizando redes de comunicação sem fio (Lee, Ryu & Lee, 2019) e sua utilização é uma das inovações mais promissoras para a inclusão financeira devido à difusão dos smartphones e à facilidade do uso de tecnologias móveis (Iman, 2018). Esta forma de pagamento tem sido um dos principais impulsionadores do desenvolvimento socioeconômico nos mercados emergentes e cada vez mais vem substituindo meios de pagamentos tradicionais (Moon, 2017).

Entretanto, tecnologias emergentes não necessariamente criam valor econômico; elas precisam ser alavancadas e exploradas por empreendedores (Steininger, 2019). Assim, diversas startups têm surgido e oferecido serviços financeiros de maneira inovadora, eficiente e com menores custos, baseadas nas tecnologias digitais, as quais são chamadas de *fintechs* (Prado, 2016; Murshudli & Loguinov, 2019). O termo “*fintech*” representa a junção dos termos “*financial*” e “*technology*” (Prado, 2016), e representa empresas que têm criado uma nova realidade financeira global,

provendo acesso a serviços que antes se concentravam exclusivamente nos bancos tradicionais (Gomber et al., 2018).

As *fintechs* podem romper paradigmas do sistema financeiro tradicional, que muitas vezes utiliza de maneira ineficiente os recursos tecnológicos disponíveis (Prado, 2016; Du, 2018). Assim, a tecnologia, que já foi considerada uma barreira para entrada de empresas no setor de pagamentos, hoje é vista como uma oportunidade de ingresso, especialmente com a propagação de tecnologias móveis. Dessa forma, novos *players*, como as *fintechs*, buscam competir por oportunidades no setor, enquanto instituições tradicionais tentam se manter relevantes nesse novo cenário (Leong et al., 2017; Dallagnol & Verschoore Filho, 2018).

Vários são os desafios a ser enfrentados pelas *fintechs* nos próximos anos, por exemplo: a intenção dos varejistas em adotar novas tecnologias de pagamento (Lee, Ryu & Lee, 2019), as vantagens de adoção de diversas plataformas de pagamento móvel (Shaikh, Hanafizadeh & Karjaluoto, 2017), a relação entre inovação e segurança das informações bancárias (Arner et al., 2019; Murshudli & Loguinov, 2019) e o surgimento de regulamentações governamentais (Fenwick; Kaal; Vermeulen, 2018).

Nesse cenário, torna-se importante analisar o desenvolvimento de *fintechs*, que têm potencial de contribuir para a inclusão financeira e oferta de serviços inovadores de pagamento, colaborando para o desenvolvimento local, especialmente em países em desenvolvimento. Sabe-se que as *startups* são mais suscetíveis a fracassarem devido à sua vulnerabilidade inicial, pois enfrentam mais riscos, possuem menos recursos e têm pouca legitimidade, pois geralmente enfrentam barreiras significativas ao crescimento, incluindo a falta de acesso a conhecimento, recursos humanos e formas eficientes de financiamento (Steininger, 2019).

A literatura de empreendedorismo aponta fatores e infraestruturas de apoio que são necessárias para promover o ingresso e desenvolvimento de novas empresas e *startups* (Reynolds, 1991; Van de Ven, 1993; Gnyawali & Fogel 1994, Shane & Venkataraman, 2000; Bruton et al., 2010). No entanto, há carência de estudos que abordem esses fatores especificamente no que concerne às *fintechs* e, especialmente, aquelas que atuam em países em desenvolvimento. Assim, este artigo tem como objetivo identificar facilitadores e barreiras enfrentadas pelas *fintechs* de pagamentos móveis para operarem em um país em desenvolvimento (Brasil). Os resultados da pesquisa contribuem com a literatura sobre *fintechs* e podem servir de referência para empreendedores e gestores de organizações que atuam no setor de pagamentos, bem como informar regulações e políticas públicas, a fim de facilitar o ingresso e o desenvolvimento dessas empresas no mercado de pagamentos móveis.

2. Revisão da Literatura

2.1. As *fintechs* e seu ecossistema

O termo *fintech* designa *startups* que oferecem produtos e serviços financeiros por meio da tecnologia e afetam instituições financeiras tradicionais, órgãos reguladores, clientes e comerciantes em uma ampla gama de setores, visto que as tecnologias digitais utilizadas desafiam os fundamentos do setor financeiro altamente regulado, originando sistemas de pagamento não tradicionais, novas linhas de crédito e moedas digitais (Leong et al., 2017). Para o melhor entendimento da dinâmica

competitiva das *fintechs*, é fundamental analisar o seu ecossistema, que afeta o crescimento desse tipo de empresa (Lee & Shin, 2018). Esse ecossistema de *fintechs* inclui diversos atores, cujos principais são: as próprias *fintechs*, os empreendedores, os desenvolvedores de tecnologias, os consumidores, as instituições financeiras tradicionais e os órgãos reguladores (Diemers et al., 2015; Lee & Shin, 2018).

Nesse ecossistema, tem-se as *fintechs* no centro, influenciando e sendo influenciadas pelos demais atores. Como exemplo de *fintechs* estão empresas de pagamentos móveis, de serviços financeiros, *crowdfunding*, de soluções para o mercado de capitais e seguros, utilizando tecnologia digital (Leong et al., 2017). Os **empreendedores** contribuem com ideias e assumem o risco de inserir tecnologias inovadoras e muitas vezes disruptivas em soluções para o ecossistema *fintech*. Em troca, se beneficiam de maior acesso a financiamentos e especialização de mercado (Diemers et al., 2015). É fundamental considerar, nesta análise, os **consumidores de produtos financeiros**, indivíduos ou organizações. No caso das *fintechs* de pagamentos móveis, deve-se considerar tanto os consumidores finais como os varejistas e demais clientes empresariais (Lee & Shin, 2018; Lee, Ryu & Lee, 2019).

Por sua vez, os **desenvolvedores de tecnologia** têm como função, no ecossistema, fornecer tecnologias para as *fintechs* de modo a colaborar com o surgimento e crescimento dessas *startups*. Incluem empresas de análise de *big data*, computação em nuvem, criptomoeda e desenvolvedores de mídias sociais (Gozman, Liebenau & Mangan, 2018). As **instituições financeiras tradicionais** compreendem bancos globais e locais, *private equity* (fundo de investimento que levanta capital para adquirir participação em presas já desenvolvidas) e fundos de capital de risco. Muitas dessas instituições financeiras buscam estimular sua própria inovação estabelecendo parcerias com as *fintechs* iniciantes, o que pode fortalecer a sua posição competitiva, por exemplo, encurtando o tempo que levam para criar e entregar produtos e serviços para o mercado (Lee & Shin, 2018). Também é válido incluir os **órgãos reguladores** que devem implementar e fiscalizar o cumprimento de políticas e regulações, assim como potencializar o desenvolvimento do ecossistema, incentivando a atividade empreendedora e a contratação de empresas de serviços de tecnologia (Diemers et al., 2015).

Observa-se que a relação entre esses agentes contribui ou não para a inovação, surgimento e desenvolvimento das *fintechs*. Os agentes desse ecossistema são capazes de estimular a economia, facilitar a colaboração e a concorrência no setor financeiro, e em última análise, beneficiar os consumidores na indústria financeira (Sussan & Acs, 2017).

2.2. Os facilitadores e as barreiras para atuação das *fintechs*

A literatura de gestão e empreendedorismo aponta diversos fatores de apoio à atividade empreendedora que podem atuar como facilitadores ou barreiras (quando ausentes) para a criação e a expansão de novos negócios, detalhados a seguir.

- **Condições sociais:** uma atitude favorável da sociedade em relação ao empreendedorismo e um amplo apoio público às atividades empreendedoras são necessárias para motivar as pessoas a iniciar um novo negócio (Reynolds, 1991; Gnyawali & Fogel 1994, Shane & Venkataraman, 2000; Bruton et al., 2010).
- **Suporte financeiro:** os empreendedores necessitam de assistência financeira para diversificar e dissipar o risco de uma *startup*, acumular capital inicial e financiar o crescimento e expansão do negócio (Reynolds, 1991; Van de Ven, 1993; Gnyawali & Fogel 1994, Shane & Venkataraman, 2000; Lee et al., 2001; Bruton et al., 2010; Steininger, 2019).

- **Suporte não-financeiro:** os empreendedores precisam de serviços de apoio além da assistência financeira, como para realizar estudos de mercado, preparar planos de negócios, estabelecer contatos e redes com outros empreendedores e agências e obter empréstimos (Gnyawali & Fogel, 1994; Bruton et al., 2010; Steininger, 2019).
- **Fatores legais e regulatórios:** impostos, políticas, governo e burocracia se incluem nesta categoria (Reynolds, 1991; Gnyawali & Fogel 1994; Bruton et al., 2010). Os empreendedores podem ser desencorajados a iniciar um negócio se tiverem que seguir muitas regras e requisitos processuais. Governos podem influenciar os mecanismos de mercado e fazê-los funcionar melhor, eliminando condições que criam imperfeições de mercado e rigidez administrativa (Gnyawali & Fogel, 1994).
- **Condições educacionais e de capacitação:** os serviços educacionais e de treinamento são fundamentais para novos negócios, especialmente nas economias de mercado emergentes, porque os empreendedores podem carecer de habilidades básicas de negócios e necessitar de mão de obra especializada (Van de Ven, 1993; Gnyawali & Fogel 1994; Steininger, 2019). Van de Ven (1993) ainda destaca a importância de arranjos institucionais e da infraestrutura para apoiar processos de P&D e redes de inovação para apoiar novos empreendimentos.

Para ingressar e se desenvolver no mercado, as *fintechs* também enfrentam uma série de facilitadores e barreiras que são específicas do seu contexto de atuação, a saber:

- **Mercado consumidor não atendido:** *fintechs* estão proporcionando a inclusão financeira ou o fornecimento de acesso e uso ativo de produtos financeiros a dois bilhões de adultos sem conta bancária no mundo (Gabor & Brooks, 2017). É evidente a existência de uma demanda não atendida por serviços financeiros e também a insatisfação de parte dos consumidores pelos serviços recebidos (Iman, 2018).
- **Novas tecnologias existentes:** as *fintechs*, através do uso de novas tecnologias, logram a redução de custos nas transações, oferecendo serviços de valor agregado aos seus atuais e potenciais clientes (Shaikh, Hanafizadeh & Karjaluoto, 2017). Proteger-se contra fraudes e crimes, cumprir as obrigações de conhecer o cliente e garantir a integridade do mercado são vitais para o negócio. Logo, a tecnologia é utilizada não só para alcançar novos clientes através da eficiência dos serviços, como também para garantir a segurança cibernética das operações (Arner et al., 2019).
- **Recursos humanos especializados em TI e mercado financeiro:** a existência de desenvolvedores que dominem novas tecnologias, tenham conhecimento do setor financeiro e estejam aptos para contribuir com a construção de novas soluções de pagamento é um facilitador para o negócio. Por outro lado, a escassez desses recursos pode ser uma barreira para novas *fintechs* (Gozman, Liebenau & Mangan, 2018).
- **Parcerias entre *fintechs*:** a utilização de tecnologias e serviços complementares para a construção de uma solução focada no cliente é a estratégia utilizada por diversas *startups*. Fomentar uma rede na qual os empreendedores se relacionem e formem parcerias facilita a criação e o desenvolvimento dessas empresas (Diemers et al., 2015).
- **Grandes *players*:** instituições financeiras tradicionais vêm enfrentando novos concorrentes de diversas formas, principalmente com inovações tecnológicas e eliminando processos que não agregam valor (Murshudli & Loguinov, 2019). Bancos tradicionais têm criado programas de aceleração de *startups*, cooperado com *fintechs* e criado fundos de risco para investir em *fintechs* promissoras (Folwarski, 2018). Entender como esses *players* atuam no mercado e utilizar suas estruturas para desenvolver e escalar novas soluções pode transformar uma possível barreira em um facilitador do negócio para as *fintechs* (Lee & Shin, 2018). Por outro

lado, grandes *players* também podem tomar medidas protetivas de reserva de mercado, criando novas barreiras (Romãnova & Kudinska, 2016).

- **Regulamentações:** o setor financeiro desenvolve regulamentações para garantir a segurança das transações e minimizar fraudes. Entender legislações e aplica-las de maneira adequada é um desafio para novos entrantes (Diemers et al., 2015). Entretanto, o desenvolvimento de tecnologias financeiras e o surgimento das *fintechs* tem modificado o mercado e forçado instituições a se adaptarem e, conseqüentemente, gerado lacunas nas legislações existentes. Órgãos reguladores precisam regular o mercado para proteger os consumidores e proporcionar a livre concorrência. A não atuação desses agentes adiciona riscos às operações e insegurança jurídica, mas o excesso de restrições pode restringir o número de novos entrantes (Folwarski, 2018).

3. Método

Esta pesquisa, de abordagem qualitativa, adotou um estudo de caso único (Yin, 2015), cuja unidade de análise foi o segmento de *fintechs* de pagamentos móveis no contexto brasileiro. A escolha pelo método de estudo de caso justifica-se por diversos motivos (Eisenhardt, 1989; Yin, 2015), sendo o principal, a busca por profundidade e entendimento do histórico e contexto do problema identificado. Conforme preconiza o método de estudo de caso (Eisenhardt, 1989), foram coletados dados de diferentes fontes e de diferentes formas: análise de documentos, entrevista e observação participante. A coleta de dados foi realizada em 3 etapas:

Etapa 1: Mapeamento de *fintechs* de pagamentos móveis - Para identificar as *fintechs* de pagamentos móveis atuantes no Brasil procedeu-se uma busca avançada no Google pelo termo “pagamentos móveis”, solicitando apenas o retorno de sites brasileiros e em língua portuguesa. Esta busca foi realizada 30/11/2017, e foram consideradas as 30 primeiras páginas de resultados, o correspondente a 300 *websites*, os quais foram analisados. A partir desta análise, foram identificadas 34 *fintechs*, as quais foram contatadas, sendo que 9 somente aceitaram participar da pesquisa, conforme apresentado na Tabela 1.

	Solução ofertada	Fundação	Propriedade	Nº Funcion.	Atuação geográfica	Duração entrevista
E1	Transferência via aplicativo	2016	2 sócios	5	Brasil	01:03:45
E2	Celular como máquina de pagamentos e recargas	2015	6 sócios	20	Brasil	00:38:04
E3	Vale alimentação móvel	2013	Holding familiar	6	Interior de SP	01:10:15
E4	Cartão pré-pago	2013	7 sócios	160	América Latina	01:00:32
E5	Cartão pré-pago	2012	30 investidores	150	Brasil	00:35:50
E6	Pagamentos e recebimentos via <i>smartphone</i>	2015	3 sócios	9	Brasil	00:44:34
E7	Validação de pagamentos via reconhecimento facial	2015	-	15	Internacional	00:22:52
E8	Pagamento e transferência	2013	2 sócios	20	Brasil	Contato via

	via app					e-mail
E9	Cartão digital	2017	-	-	Brasil	00:19:56
						05:55:48

Tabela 1: Perfil das empresas participantes

Etapa 2: Realização de entrevistas com os gestores das *fintechs* - Para a realização das entrevistas, utilizou-se como guia um roteiro de questões contendo 19 perguntas, sendo 9 específicas sobre a empresa entrevistada e 10 referentes ao sistema de pagamentos brasileiro. O roteiro serviu como um guia de questionamentos para garantir que os tópicos essenciais para responder aos objetivos do estudo fossem questionados junto aos entrevistados. Contudo, ressalta-se que, em todas as entrevistas, questões complementares foram realizadas, além destas 19 iniciais, a fim de detalhar as respostas fornecidas, além de solicitado o contato de outras empresas ofertantes de pagamentos móveis, seguindo a estratégia de bola de neve. As entrevistas foram realizadas via *Skype* ou *Google Hangouts*, gravadas e, posteriormente, transcritas para a análise de seu conteúdo.

Etapa 3: Participação no evento *Fintouch 2018* - o *Fintouch 2018* - maior evento de *Fintechs* da América Latina - ocorreu em agosto de 2018, em São Paulo/SP; 35 palestras foram assistidas nesse evento, e 3 foram selecionadas para gravação (duração total de 1h32min.), pois abordaram temas diretamente relacionados à pesquisa. As entrevistas e as palestras foram gravadas, transcritas e, posteriormente, importadas para o *software* NVivo, que auxiliou na análise dos dados, utilizando-se a técnica de codificação aberta. A codificação aberta divide os dados qualitativos em partes discretas, examinando-as de perto e comparando-as quanto a semelhanças e diferenças, objetivando deixá-los abertos a todas as direções teóricas possíveis apontadas pela literatura (Saldaña, 2009). Posteriormente, essas categorias geradas por codificação aberta foram comparadas com categorias teóricas (facilitadores e barreiras apontados pela literatura), conforme demonstrado a seguir.

4. Apresentação e análise dos resultados

4.1. Entrada das *fintechs* de pagamento móveis no sistema de pagamentos brasileiro

A principal **barreira** enfrentada para o ingresso das *fintechs* pesquisadas no setor de pagamentos refere-se ao atendimento à legislação, seja pela dificuldade em entender e atender à legislação vigente, questões específicas a serem atendidas de acordo com o setor em que a empresa está atuando ou, até mesmo, pela falta de uma legislação específica, dificuldade enfrentada pelas *fintechs* que ingressaram no mercado antes de 2013, quando foi publicada a Lei 12.865/13 (legislação vigente sobre arranjos e instituições de pagamento).

A dificuldade de entender a regulamentação é destacada por E3: “*Eu sou advogado de formação e fiquei um bom tempo estudando*”. Como a Lei 12.865/2013 não regulamenta as *fintechs*, mas sim os arranjos de pagamentos, alguns entrevistados afirmam que operam sem conhecer as “regras do jogo” que serão impostas a partir de uma eventual regulamentação das *fintechs*, conforme relata E9: “*A gente opera muito ainda sem regulação, esperando que a regulação venha ou que ela comece a ser efetivada, a gente já opera mesmo sem esperar*”.

No entanto, embora a legislação seja vista como uma possível barreira à entrada de *fintechs* no

mercado, E7 se posiciona favorável à postura firme do Banco Central (BC) para evitar que qualquer empresa possa ingressar no mercado, inclusive algumas mal-intencionadas. Ele justifica sua opinião: *“Quando você tem um negócio você vai tentar ao máximo, assim, exigir que novos entrantes sigam normas, como acontece, por exemplo, dos taxistas fazendo com o Uber. Se não qualquer um entra ali, e é gente mal-intencionada também...”*.

Um segundo aspecto mencionado como barreira pelos entrevistados refere-se à necessidade de investimento e dificuldade de captação de dinheiro para abertura do negócio. Os entrevistados afirmam que, devido às *fintechs* serem pequenas, desconhecidas e com baixa lucratividade, acabam passando despercebidas pelos investidores, da mesma forma que isso torna o processo de captação de recursos mais difícil, por serem empresas iniciantes e com baixo capital social.

O conflito de interesses com grandes *players* do mercado, como bancos, instituições financeiras e as bandeiras de cartão de crédito também foi destacado como barreira de ingresso no mercado. O relato dos entrevistados remete a questões de abuso de poder, monopólio ou, até mesmo, boicote dos grandes *players*, conforme o relato de E5: *“a gente queria fazer que pessoas pudessem carregar os cartões através de contas bancárias ou por boleto. A gente já teve conta fechada, conta bloqueada pelo banco, banco que cancelou os boletos [...]”*. Alinhado a isso, E7 destaca que os grandes *players* conseguem se organizar e ditar as normas do mercado, como, por exemplo, dificultando o ingresso de novas empresas e as obrigando a estabelecerem parcerias para emissão de cartões, forçando a empresa a se tornar subaquiente de uma adquirente ou emissora de cartões já consolidada.

Os respondentes afirmam que o comportamento dos usuários e a questão cultural de desconfiança com relação a novas formas de pagamentos ainda interfere na aceitação e adoção de pagamentos móveis, sendo uma barreira de entrada. O relato de E6 elucida essa questão: *“O Brasil ainda está engatinhando nessa questão de pagamentos via smartphone [...] só que existe uma questão cultural muito forte. As pessoas estão acostumadas a realizarem uma ação, há anos elas executam da mesma forma. Então essa ques... essa mudança de hábito, essa questão comportamental, a meu ver, é o principal desafio”*.

Por fim, uma última barreira destacada pela única empresa localizada fora do centro do País diz respeito à localização geográfica. O relato de E6 deixa claro que, embora a localização não seja um fator impeditivo para a operacionalização do negócio, há uma certa resistência por parte dos *players* pela empresa estar sediada no Sul do País: *“... fez com que esses players não olhassem com bons olhos pra gente, “po..., por que que três moleques aí, lá do interior de Santa Catarina, querem fazer um negócio que pouca gente conseguiu fazer?”*

Quanto aos **facilitadores** para o ingresso das *fintechs* no mercado, o principal deles é a tecnologia, sendo consenso entre os respondentes que não existe *fintech* sem tecnologia: *“Se existe um porquê qualquer fintech existe é pela base tecnológica [...] não tem como tirar a tecnologia, o papel da tecnologia, ela é o produto, entende? É 100% tecnologia”*. (E1)

Outro aspecto ressaltado como facilitador refere-se à conveniência da solução de pagamento oferecida, trazendo mais facilidade, mais agilidade e menos burocracia que as soluções tradicionais. Como principais fatores atrelados à conveniência, os entrevistados ressaltam a facilidade dos clientes realizarem pagamentos e transferências de valores em apenas um clique ou sem a necessidade de portar um cartão de crédito, utilizando apenas o telefone.

Por fim, outros facilitadores relatados pelos entrevistados foram soluções mais focadas e atendimento diferenciado, que se complementam, pois é característica da *fintech* selecionar um problema específico de mercado e resolvê-lo, por meio de uma solução especializada. Assim, ao oferecer soluções focada no problema, é possível que a empresa se especialize e ofereça um atendimento diferenciado ao usuário. Conforme E6: *“o que a gente se propõe a entregar [...] é agilidade nos pagamentos. Obviamente que existem outros benefícios, mas a gente é muito convicto que se tu quer fazer tudo, no fim tu não faz nada”*.

4.2. Desenvolvimento das *fintechs* de pagamentos móveis no mercado brasileiro

A principal **barreira** destacada pelas empresas refere-se à necessidade de investimentos e dificuldade para captação de recursos financeiros no mercado. A captação de dinheiro junto aos órgãos financiadores tem sido uma dificuldade para as *fintechs* se desenvolverem, assim como o acesso a recursos de investidores. Elas apontam uma questão cultural: investidores brasileiros resistem a investir em negócios de alto risco, como as *fintechs*. Face a isso, os respondentes afirmam que, ao mesmo tempo em que tentam expandir os seus negócios, procuram deixar enxuta a equipe de trabalho, para minimizar seus custos operacionais.

Outra barreira diz respeito à falta de conexão à Internet em diversos pontos do Brasil, o que dificulta e, na maioria das vezes, inviabiliza que o usuário realize pagamentos móveis por *smartphones*. Dessa forma, algumas empresas que iniciaram o negócio focando em soluções voltadas ao usuário tiveram que repensar e propor um novo modelo, focando em pontos de venda onde o acesso à Internet é constante e não depende de rede móvel, como E2 e E3, que desenvolveram um modelo de pagamento por meio de mensagens de texto (SMS).

Da mesma forma que foi mencionado anteriormente, o conflito com os grandes *players* do setor volta a aparecer como barreira para o desenvolvimento das *fintechs* no mercado; E5 afirma que ainda há muita concentração de poder na mão dos bancos. Entretanto, E6 afirma que novos concorrentes têm “desacomodado” os grandes *players*, que precisam buscar novas soluções tecnológicas e prestar um serviço mais qualificado: *“Eu vejo que a concorrência em si ela é baita saudável e quem acaba sendo beneficiado sempre é o cliente”*. Projetos de aceleração oferecidos pelos grandes *players* também foram destacados nas entrevistas, porém segundo os entrevistados, embora sejam interessantes e a *expertise* dos grandes *players* seja útil para o desenvolvimento das *fintechs* muitas vezes há interesses por parte dos grandes que acabam desmotivando a parceria.

Outra barreira é relativa à escassez de profissionais qualificados para auxiliar no desenvolvimento das *fintechs*; E5 afirma que a demanda por bons desenvolvedores tem sido maior do que a oferta de profissionais: *“[...]hoje tem tanta gente querendo entrar que a oferta de mão de obra não supre a demanda, então hoje para desenvolver e etc. é um desafio”*.

A dificuldade de monetização também é uma barreira para o desenvolvimento das *fintechs*. Os entrevistados apontam dificuldades em definir o valor a ser cobrado na prestação de serviços, especialmente porque as pessoas não querem pagar por serviços financeiros. Assim, percebe-se que as *fintechs* precisam ser criativas em sua oferta de solução para se diferenciar e, assim mesmo, trabalhar com margens de lucro pequenas. Por fim, a dificuldade de transformar o dinheiro transferido entre aplicativos pelas pessoas em algo físico, possível de ser sacado, também foi relatado como uma dificuldade enfrentada pelas *fintechs*. Algumas possibilidades de parceria para

esta questão estão centralizadas nas mãos de grandes *players*, o que pode tornar a operação mais cara.

Os principais **facilitadores** identificados para o desenvolvimento das *fintechs* foram: rede de contatos, parceria com empresas, tecnologia, colaboração, união entre *fintechs* e a ABFintechs. O primeiro fator, na percepção de E3, refere-se à rede de contatos. Ele relata que optou, estrategicamente, por iniciar as atividades de seu negócio na sua cidade de origem, por conhecer diversas pessoas e entender que assim teria acesso facilitado e maiores chances de estabelecer parcerias com as empresas. A estratégia inicial adotada pela empresa deu certo; a rede de contatos facilitou a sua expansão.

Um segundo facilitador refere-se à parceria com grandes *players*. Para E3, hoje alguns grandes *players* do setor estão dispostos a fazer alianças e cooperar com empresas inovadoras, conforme destaca: “[...]você consegue evoluir mais rápido hoje, as empresas estão mais dispostas a dar uma coparceria. Então, eu quero começar e vou buscar a Visa para lançar tal modelo de negócio e hoje a Visa vai ser mais aberta a esse tipo de parceria do que ela seria há 4 anos quando a gente começou”. No entanto, os entrevistados ressaltam que esse tipo de parceria nem sempre é positiva, pois algumas empresas impõem regras que dificultam operacionalizar os acordos. Entre essas regras, destacam-se a prioridade de compra futura imposta pela empresa e a não assinatura de contratos de confidencialidade das inovações, o que tem feito muitas *fintechs* seguirem no mercado de forma independente.

Um terceiro facilitador para o desenvolvimento das *fintechs* é a tecnologia; E6 deixa claro o seu papel para o desenvolvimento e capilaridade do negócio: “Então hoje, por exemplo, se a gente... a gente tem 5000, 5600 clientes, se a gente quiser escalar pra 15 mil, a gente só vai conseguir através de tecnologia e a própria tecnologia que nos dá esse poder”. A tecnologia tem papel fundamental, também, na redução dos custos de operação, como emissão de cartões, remessas por correio, entre outros.

Outro facilitador para o desenvolvimento das *fintechs* refere-se à colaboração e união destas empresas que gerou, por exemplo, a Associação Brasileira de *Fintechs*, a ABFintech, que possui papel importante de mobilização e organização dos interesses dessas empresas, servindo como sua entidade representativa junto a órgãos como BC e CVM. É consenso entre os entrevistados a importância e a relevância da associação para o desenvolvimento das empresas. A ABFintechs facilita especialmente a relação com órgãos reguladores; E5 relata que “as associações ‘fazem barulho’ e conseguem, sim, trabalhar com os órgãos, com o mercado, pra expor suas ideias, não tenho dúvida” o que é complementado por E3, ao afirmar que “isso antes da ABFintechs era uma coisa muito segregada, cada um tentava os contatos que tinha”.

5. Discussão

Observou-se convergência entre os facilitadores e barreiras levantados na literatura e os dados empíricos levantados no contexto pesquisado. Quanto às **condições sociais** (Reynolds, 1991; Gnyawali & Fogel 1994, Shane & Venkataraman, 2000; Bruton et al., 2010), os dados da pesquisa indicam que o conhecimento da modalidade de pagamentos móveis pela população, especialmente devido aos serviços ofertados por grandes *players* mundiais, colabora para a aceitação social desse tipo de serviço. Barreiras culturais por parte de investidores brasileiros são um fator social que merece ser considerado.

A questão do **suporte financeiro** (Reynolds, 1991; Van de Ven, 1993; Gnyawali & Fogel 1994, Shane & Venkataraman, 2000; Lee et al., 2001; Bruton et al., 2010; Steininger, 2019) é crucial tanto para a inserção quanto para o desenvolvimento das *fintechs*. Por serem empresas nascentes em um mercado maduro e altamente institucionalizado, há dificuldades em conquistar legitimidade, o que dificulta a obtenção de recursos (Bruton et al., 2010). Com isso, essas empresas enfrentam dificuldades para expandir sua atuação.

Em relação à necessidade de **suporte não financeiro**, embora esse fator não tenha sido apontado diretamente pelos entrevistados, verificou-se que eles enfrentam dificuldades em pensar o modelo de negócio, especialmente a proposta de valor e as formas de monetização de serviços. Existe um amplo mercado disposto a consumir novos serviços financeiros, contudo, conhecer a real necessidade dos potenciais clientes e ter uma proposta de valor clara é fundamental (Lee, Ryu & Lee, 2019). Isso está relacionado a um outro fator que é a **capacitação e mão de obra especializada** (Ozman, Liebenau & Mangan, 2018; Steininger, 2019), pois o desenvolvimento das *fintechs* depende das pessoas que atuam nesse segmento, as quais precisam ter conhecimentos avançados tanto nas áreas de tecnologia como de mercado financeiro, havendo escassez desses recursos qualificados no contexto brasileiro.

Entre o conhecimento necessário para essas equipes especializadas está o da **legislação**, conforme diversos autores apontam (Reynolds, 1991; Gnyawali & Fogel 1994; Bruton et al., 2010; Diemers et al., 2015). O entendimento e a aplicação da legislação, de maneira adequada, são desafios para qualquer entrante, e para as *fintechs* essa a questão impacta diretamente o seu negócio. Ficou evidente que, muito além do atendimento aos aspectos legais preconizados pelos órgãos reguladores brasileiros, é necessário, inicialmente, que as empresas sejam capazes de entender a legislação para, depois, adaptarem-se a ela e cumpri-la. Entretanto, embora a legislação seja vista como uma barreira à entrada de *fintechs* no mercado, algumas delas se posicionam favoráveis à postura firme do Banco Central para evitar que qualquer empresa possa ingressar no mercado, especialmente as mal-intencionadas. Estes resultados vão ao encontro da observação de Folwarski (2018), que afirma que a não atuação de agentes reguladores pode adicionar riscos às operações financeiras e insegurança jurídica. Desse modo, o papel dos órgãos reguladores consiste em entender as alterações que vêm ocorrendo no sistema de pagamentos e regular o mercado de modo a proteger os consumidores e proporcionar a livre concorrência (Folwarski, 2018).

Quanto ao fator **infraestrutura de P&D** (Van de Ven, 1993), este não foi destacado diretamente pelos entrevistados, mas foram evidenciadas atividades de P&D sendo realizadas junto com grandes *players*, por exemplo, em incubadoras ou aceleradoras de grandes bancos. Como facilitador à entrada e desenvolvimento das *fintechs*, ganhou destaque a existência de um **mercado consumidor não atendido** (Soriano, 2017) ou mal atendido e o fornecimento de soluções focadas em satisfazer as necessidades desses clientes, proporcionando a inclusão financeira (Gabor & Brooks, 2017). Iman (2018) afirma que é evidente a demanda por serviços financeiros por parte de consumidores insatisfeitos com os serviços recebidos nas instituições financeiras mais tradicionais; conhecer a real necessidade desses clientes e ter uma proposta de valor clara é fundamental (Lee, Ryu & Lee, 2019).

A **tecnologia** que viabiliza a oferta desses novos serviços é entendida como condição, em primeiro lugar, para a existência das *fintechs*. Através do uso da tecnologia, elas são capazes de obter a redução de custos nas transações, oferecendo serviços de valor agregado (Shaikh, Hanafizadeh & Karjaluoto, 2017). A implementação de tecnologias inovadoras é uma vantagem competitiva frente aos grandes *players*, reduzindo custos e agregando valor aos potenciais clientes (Shaikh, Hanafizadeh & Karjaluoto, 2017). Por outro lado, a infraestrutura de telecomunicação limitada se torna uma barreira tecnológica evidente para o desenvolvimento do ecossistema de *fintechs* (Gozman, Liebenau & Mangan, 2018) no Brasil.

Os relacionamentos com atores do ecossistema de *fintechs* no Brasil foram destacados tanto como facilitadores como barreiras à sua inserção e desenvolvimento. A **parceria entre as *fintechs*** foi citada como um facilitador para o desenvolvimento de soluções conjuntas, onde agregar tecnologias de parceiros é um diferencial. Além disso, a força dessas parcerias, inclusive com a criação de uma associação nacional de *fintechs* (ABFintechs), demonstra a importância da colaboração para esse ecossistema.

Quanto à **relação com grandes *players***, as *fintechs* consideram as instituições financeiras nacionais como barreiras de entrada, mesmo utilizando a estrutura dessas organizações (adquirentes de cartão de crédito) como base para as suas transações. Destacam o conflito de interesses com grandes *players* como bancos, instituições financeiras e as bandeiras de cartão de crédito. No entanto, apontam que alguns grandes *players* internacionais, como fundos de investimentos de risco e fornecedores de tecnologia (como soluções digitais de pagamento internacionais) facilitam sua atuação. Entender melhor como esses *players* agem no mercado e utilizar suas estruturas para desenvolver e escalar novas soluções pode transformar uma possível barreira em um facilitador do negócio (Lee & Shin, 2018).

Por fim, um fator que emergiu dos dados, e que não é tão presente na literatura sobre *fintechs*, refere-se à **localização geográfica**. A única *startup* distante geograficamente do centro do País comentou a barreira de estar fora do “centro” desse ecossistema (Diemers et al., 2015; Lee & Shin, 2018). Os dados sugerem que a distância geográfica dificulta a aceitação e, principalmente, a legitimidade das *fintechs*, o que dificulta, com isso, seu acesso a recursos.

6. Considerações finais

Este artigo teve como objetivo identificar facilitadores e barreiras enfrentadas pelas *fintechs* de pagamentos móveis para operarem em um país em desenvolvimento (Brasil). Observou-se uma convergência entre os facilitadores e barreiras levantados na literatura e os dados empíricos observados no contexto brasileiro. Além disso, foi possível identificar particularidades do ecossistema das *fintechs* no Brasil, segundo a percepção dos empreendedores pesquisados.

Primeiramente, destaca-se a existência de um mercado não atendido ou mal atendido e o fornecimento de soluções focadas em satisfazer as necessidades desses clientes como facilitador para a entrada no mercado, mas adaptar a tecnologia aos anseios do público e monetizar a solução proposta são mencionadas como barreiras. A tecnologia é entendida como condição para a existência das *fintechs*, reduzindo custos e agregando valor aos potenciais clientes (Shaikh et al., 2017). Por outro lado, a escassez de desenvolvedores com conhecimento técnico e uma infraestrutura de comunicação limitada se torna uma barreira para o desenvolvimento do negócio (Gozman, Liebenau & Mangan, 2018).

A parceria entre *fintechs* foi citada como facilitador para desenvolver soluções conjuntas, onde agregar tecnologias de parceiros é um diferencial. Além disso, a força dessas parcerias, com a criação de uma associação de *fintechs*, demonstra a importância da colaboração no ecossistema. A única *startup* distante geograficamente do eixo Rio-SP relata a dificuldade de estar fora do “centro” desse ecossistema (Diemers et al., 2015; Lee & Shin, 2018). Quanto aos grandes *players*, as *fintechs* consideram as instituições financeiras nacionais como barreiras para a entrada no negócio, mesmo utilizando a estrutura destas organizações como base para as suas transações; já os grandes *players* internacionais são facilitadores tanto para conseguir investimentos (fundos de investimentos de risco) como tecnologia (soluções digitais de pagamento internacionais). Entender como esses *players* atuam no mercado e utilizar suas estruturas para desenvolver e escalar novas soluções pode transformar uma possível barreira em um facilitador do negócio (Lee & Shin, 2018).

Os resultados encontrados sobre as barreiras das regulamentações existentes e possíveis lacunas legais corrobora a literatura (Folwarski, 2018); embora a legislação seja vista como uma barreira à entrada de *fintechs* no mercado, a postura firme do BC para evitar que qualquer empresa possa ingressar no mercado, inclusive empresas as mal-intencionadas, é valorizada.

Os resultados da pesquisa contribuem com a literatura sobre *fintechs*, e com empreendedores ou futuros empreendedores que desejam ingressar no mercado financeiro brasileiro, especificamente no de pagamentos, além de fornecer subsídios para a atuação de órgãos reguladores e desenvolvedores de políticas públicas. No entanto, a pesquisa tem limitações pois, embora todas as 34 *fintechs* de pagamentos móveis identificadas pela pesquisa tenham sido contatadas, apenas nove aceitaram participar do estudo; porém se comparou o perfil das *fintechs* pesquisadas no caso com o perfil de *fintechs* brasileiras delineado em pesquisa da ABFintechs (ABFintechs & PwC 2018), verificando-se que são semelhantes, o que aumenta a validade dos resultados do presente estudo.

Sugere-se que pesquisas futuras analisem a influência dos grandes *players* sobre normas e regras estabelecidas para o sistema financeiro. Pesquisar a inserção das *fintechs* em ambientes de P&D públicos ou em ambientes acadêmicos, como incubadoras ou parques tecnológicos, também é relevante para expandir o entendimento de como se pode criar condições de suporte a empresas desse segmento, especialmente em países em desenvolvimento.

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P13: ENTERPRISE SYSTEM IMPLEMENTATION: A MULTIMODAL APPROACH TO SOCIAL NETWORK KNOWLEDGE TRANSFER

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Abstract

Organizations have struggled to provide adequate system-related knowledge support to end users during enterprise system implementation. Prior research has examined the influence of system-related knowledge sourced from end users within workplace social networks on implementation outcomes. Drawing upon the actor-network theory, this study extends the social network to include knowledge sourced from three institutionally mandated entities, the shared inbox, help desk, and service desk. This multimodal approach provides a comprehensive view of knowledge flows across the organization as opposed to a partial view confined to end user interactions. In addition, knowledge sourced from institutionally mandated entities will be of higher quality than that acquired through informal end user interactions, and can have a significant impact on implementation outcomes. This paper conceptualizes the shared inbox, help desk, and service desk as nodes within the network. Preliminary analysis is now being conducted on data collected from end users in the post-implementation phase of an Enterprise Resource Planning (ERP) system. The results of this study could provide additional insights into the impact of knowledge acquired from end users in comparison to knowledge sourced from support structures. Organizations could strategically allocate resources among support structures depending on its relevance to their operational context.

Keywords: Social Networks, Enterprise Resource Planning, Knowledge Transfer, Shared Inbox, Help Desk, Service Desk.

1. Introduction

Enterprise systems enable decision-makers to take a data-driven, cross-organizational, integrated perspective that can help streamline operational processes and lead to improved financial performance (Aremu et al., 2020; Ranjan et al., 2016). The challenges in implementing enterprise systems and obtaining the desired benefits come from various sources including end-user resistance to change, ignorance of system features, a lack of awareness of underlying business processes, and difficulty in motivating the end-users to use the system in the desired way and at the desired level (Aremu et al., 2020; Chadhar & Daneshgar, 2018; Ranjan et al., 2016). Knowledge support in the form of training, end-user involvement throughout the implementation, and the use of experts and technology champions within organizational departments have been used to counter these challenges (Arasanmi, 2019; Bhattacharya et al., 2019; Ma'arif & Satar, 2018; Ranjan et al., 2016). These formal methods of knowledge dissemination provide generalized and basic procedural

information, but do not provide the information inside the business context of every end-user to help them with their work-specific tasks (Sharma & Yetton, 2007). Hence, end users turn to their social networks to obtain real-time, work- and task-specific knowledge (Freeze et al., 2012; Sasidharan et al., 2012; Sasidharan et al., 2017; Sykes et al., 2009; Sykes et al., 2014).

2. Social Networks and Enterprise System Implementation

Social networks refer to informal person-to-person exchanges that occur naturally (Hanneman & Riddle, 2005). It can happen both in the personal and professional/work domains. In the case of the latter, social networks may develop around a mutual need for work guidance, knowledge support for task execution, and even emotional support (Brass 1984, 1985, 2011). Prior research on system-related knowledge acquisition through social networks during enterprise system implementation have found that the real-time, on-the-job knowledge acquired from co-workers serve to improve job and task performance. They also enhance implicit learning and provides end users with greater confidence in their ability to utilize the system in a more effective and efficient manner (Freeze et al., 2012; Sasidharan et al., 2012; Sasidharan et al., 2017; Sykes et al., 2009; Sykes et al., 2014).

Existing research has focused on the structural features of social networks and the positional characteristics of end users within the network in impacting their knowledge acquisition potential. In general, end users who are central to the network have been found to be better positioned to access and disseminate system-related knowledge across the network. Their control over valuable knowledge flows confers on them prestige, power, and authority across the network (Freeze et al., 2012; Sasidharan et al., 2012; Sasidharan et al., 2017; Sykes et al., 2009; Sykes et al., 2014).

3. The Actor-Network Theory

The actor-network theory argues that a social network is not about people alone, but should encompass all actors, including inanimate objects, such as software and hardware (Callon, 1999; Latour, 1987). This heterogeneous approach is rooted in the belief that social order in the network is the product of all actors, and focusing on a subset of these actors alone would give only a partial view of the social order within the network. All actors are equally important to the network as they contribute to the social order in their own ways.

In the context of system-related knowledge dissemination through social networks, prior research has focused on one type of actor alone – the end user. However, in reality, organizations provide formalized knowledge support structures that can serve as sources of authentic system related knowledge. This can include the shared inbox, help desk, and service desk (Andrews et al., 2016; Koch & Mitteregger, 2016; Rahman, 2016). Apart from turning to their co-workers for on-the-job system-related knowledge, end users may acquire knowledge from these institutionally mandated support structures. Excluding them from the purview of social network knowledge research may reflect only a partial “social order” of the actors at play during enterprise system implementation. Hence, we extend this limited perspective of social networks to include the knowledge support structures of shared inbox, help desk, and service desk as knowledge nodes within the network, creating a multimodal social network.

4. A Multimodal Social Network

We now discuss the features and purpose of three institutionally mandated support structures: the shared inbox, the help desk, and the service desk.

4.1 Shared Inbox

A shared inbox is a common mailbox used by multiple users to send and receive emails (Babinchak, 2017; Konrad, 2020). It can be very effective in sharing a common workload amongst multiple individuals (such as for handling user complaints). In the context of an enterprise implementation, a shared inbox allows users to disseminate their system-related experiences and advice to other end users across the organization. They could post systems-related incidents which could then be addressed by others who might have faced similar issues and may be able to suggest effective fixes. Over time, it can develop into a database of end user driven fixes and hands-on problem resolution strategies.

4.2 Help Desk

The helpdesk is a tactical knowledge support entity, with primary focus on fast and efficient resolution of technical issues and incidents faced by the end user (Andrews et al., 2016; Magowan, 2019; Smith, 2019). The goal here is to get end users back to work in as short a time as possible. Typically, a help desk will keep track of problems and incidents faced by end users, ensure that no issues are ignored, and enables a real-time “big picture” view of the technical configuration of the system. Other features of help desks include being a single point of contact for technology support, ticket management, transferring incident ownership to external units in case of escalation, and handling hardware/software configurations (Magowan, 2019; Smith, 2019). The help desk would be a component of the overall service infrastructure of the organization and may feed into some service desk operations.

4.3 Service Desk

As opposed to the tactical orientation of the helpdesk, the service desk is strategic in nature – focusing primarily on the business needs of the organization as a whole, and not on the end user per se (Magowan, 2019; Rahman, 2016; Smith, 2019). The objective here is to design, manage, and support technology-driven business processes both within and across organizational units. It is their responsibility to align technology processes with organizational priorities. They are critical to managing the complex technology infrastructure of more mature organizations, where there may be a need for technology integration with external vendors and other service providers. Their primary functions include service strategy, design, operation, and continual improvement of service activities, and being a single point of contact for all technology units and technology-based processes within the organization (Magowan, 2019; Smith, 2019). They may also be involved in asset, change, and release management, and in maintaining a self-service knowledge portal.

Drawing upon the actor-network theory, we conceptualize end users, the shared inbox, helpdesk, and service desk as being actors within the multimodal social network. This move away from the “end-user only” perspective can provide a more comprehensive view of the knowledge order within the social network. Specific questions that are addressed include (1) the centrality positioning of end users relative to the shared inbox, and (2) the strategic role of the helpdesk and service desk in providing specialized knowledge support within the network (3) the impact of knowledge sourced from institutionally mandated support structures on performance outcomes. Addressing these questions will enable organizations prioritize the relevance of each of these support structures during enterprise system implementation.

5. Research Framework

We now examine the shared inbox, helpdesk, and service desk from a social networking perspective. They are conceptualized as external knowledge support nodes within the multimodal knowledge social network. Prior research has focused on the centrality concept – in general, the extent to which a network member has connections with other members of the network. It is usually measured in terms of the number of ties a member has to other members of the network or the extent to which a network member may be between otherwise unconnected members (Hanneman & Riddle, 2005). Central members have more connections than other members and are better positioned to acquire valued resources and are viewed as powerful within the network (Brass, 1984, 2011; Hanneman & Riddle, 2005). In the context of an enterprise system implementation, multiple end users within the network would have posted their questions and queries to the inbox, and these would conceivably have been addressed by other end users who have had similar experiences in the past. Over time, shared inboxes can mature into a vast database of end user driven discussions on system-related issues and possible resolutions. When extending the social network to include the shared inbox, it is expected to become more central than the most central end user in the network.

P1: The shared inbox will be more central than all other end users within the overall knowledge network.

The amount of effort involved in initiating and sustaining a knowledge tie with the shared inbox is negligible compared to the effort involved in initiating and sustaining interaction ties with other actors of the multimodal network, including the help desk and service desk. Hence it is expected that the shared inbox will be the most central node within the network.

P2: The shared inbox will be the most central node within the overall knowledge network.

The nature of tasks performed by end users would mandate their knowledge needs. Those involved in routine, day-to-day operations would be more inclined to access knowledge regarding “fixes” to immediate operational problems – the stated objective of the help desk. Those at higher managerial levels would be more involved in using the system as a strategic tool to facilitate and streamline cross-organizational business processes – the rationale for the service desk. Hence, if we were to reconceptualize the overall knowledge network into two subnetworks, one including those end users involved in day-to-day operations of the organization, and the other including those involved in

higher-level strategic operations, the former group would be depending primarily on the help desk for knowledge support and the latter group would be depending on the service desk. We refer to the former group as the operational subnetwork and the second group as the strategic subnetwork. When viewed as network nodes, it is likely that the help desk would be central to the operational subnetwork and the service desk would be central to the strategic subnetwork. Hence, we propose that:

P3: The help desk will be the most central node within the operational subnetwork.

P4: The service desk will be the most central node within the strategic subnetwork.

When knowledge support is germane to the task in hand, it can be expected that end user performance outcomes will be maximized. Hence, we propose an interaction effect between the task performed by an end user (whether operational or strategic) and the external support node accessed (help desk or service desk) on performance outcomes.

P5: The joint effects of the task performed by an end user and the external support node accessed for knowledge acquisition will be positively related to performance outcomes.

An end user approached by other end users for knowledge support regarding the system may choose not to provide such support due to a variety of reasons, including insufficient knowledge regarding the system. In other words, knowledge support would be a voluntary act on the part of the end user. It is also possible that an end user may inadvertently provide incomplete and even faulty knowledge regarding the system (Freeze et al., 2012). However, when institutional support structures (such as the help and service desk) are approached by end users for knowledge support, they are required to provide support, and such support would be of higher quality than that sourced from other end users (Magowan, 2019; Smith, 2019). In other words, the optional knowledge support provided by end users is of possibly lower quality than the mandatory support provided by institutional support structures. Hence, knowledge sourced from institutional support structures can result in better performance outcomes than knowledge sourced from other end users.

P5: Knowledge sourced from the institutional support structures of help desk and service desk will lead to higher performance outcomes than knowledge sourced from end users.

6. Research Methodology

The study setting was a recent Enterprise Resource Planning (ERP) system implementation at an agribusiness conglomerate located in midwestern United States. There was widespread concern regarding knowledge support for effective use of the new system. Hence, top management adopted a three-prong knowledge dissemination strategy: use of a shared inbox and establishment of a dedicated help desk and a dedicated service desk.

Data was collected from heavy users of the system in three different operational groups that were most impacted by the implementation. Such users were identified using transaction logs that reflected both the frequency and complexity of their system-related transactions. An online survey questionnaire was used to collect data. The first part of the questionnaire dealt with networking

data – each end user was provided with a list of all other end users within their group and asked to indicate those within their group that they had approached to obtain system-related information. They also had the option to indicate whether they had used the shared inbox, help desk, and service desk for obtaining system related information. This data will be used to generate the knowledge network for each of the three groups using the UCINET and NetDraw software, both widely used for social network analysis (Borgatti et al., 2002). The second part of the questionnaire collected demographic and individual difference variables for participants. Their performance outcome was captured using the individual impact dimension of the DeLone and McLean Information Systems Success (DMISS) model (DeLone & McLean, 1992). This dimension captures productivity improvements, time savings, and client satisfaction, and can be viewed as a composite indicator of end user performance with the new system.

6. Current Status

The data has been collected and is being tabularized for detailed analysis. The networks for two of the three operational groups had 27 end users each (80% response rate), and the third operational group had 25 end users (75% response rate). Subsequent analysis for testing the study propositions are now being conducted.

7. Concluding Remarks

Prior research on knowledge acquisition through social networks during enterprise system implementation has focused on knowledge sourced from other end users. Drawing upon the actor-network theory, this study conceptualizes institutionally mandated knowledge support structures such as the shared inbox, help desk, and service desk as network nodes in a multimodal network. Research-wise, this study shifts the focus from end users to external support structures, encompassing a more inclusive “social order” that can facilitate a better understanding of the knowledge dynamics in play during enterprise system implementation. Practice-wise, the results of this study can facilitate a strategic deployment of resources amongst institutionally mandated knowledge structures depending on the implementation context.

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P15: GROWING IN THE DIGITAL ECONOMY: THE CASE OF A DIGITAL ENTERPRISE IN A DEVELOPING COUNTRY

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Abstract

Africa has a higher business discontinuation rate of 13 percent when compared with that of Europe and the USA. This situation calls for a study that explores the strategic actions and growth of digital enterprises which are able to survive within the African context. Again, studies on Digital Business Strategy (DBS) which is a multidimensional concept focus on digital enterprises with formalised structures. Against this background, using a comprehensive DBS framework, this study explored the DBS evolution of a digital enterprise in a developing economy in the quest to survive and grow. Miles and Huberman's transcendental realism technique was adopted for the case analysis. Three major growth events were identified in the case. The digital business strategic actions of the enterprise were reviewed for each of the phases of growth. It was discovered that the survival of the digital enterprise, in the first stage of growth, depends largely on the entrepreneur's innovativeness, and the competence to govern the available resources to achieve competitive advantage. This research is arguably the first to explore the growth and survival of a digital enterprise using a multidimensional DBS framework. Lessons from the study are of practical importance to managers and executives of digital enterprises who are struggling to develop digital business strategic actions to survive and grow. This study is useful for entrepreneurs who wish to develop DBS to survive and thrive in the digital economy of an African country.

Keywords: Digital Business Strategy, Digital economy, Developing economy, Digital enterprise

1. Introduction

Drnevich and Croson (2013) define business-level strategy to encompass two significant issues; Resources and Capabilities. These two constructs are mainly primary in the field of Information Systems, where the business sees Information Technology as a resource and hence builds capabilities around it to survive the competition. Thus, in the digital economy, enterprises develop specific strategies around digital technologies to survive and grow. This phenomenon is referred to as Digital Business Strategy. Digital Business Strategy (DBS) therefore refers to the fusion between Information Technology strategy and Business strategy.

There is an upsurge of literature on DBS, which has stressed on the role of Information Systems in transforming contemporary business processes (Grover & Kohli, 2013; Mithas, Tafti, & Mitchell, 2013). However, these studies tend to focus on firms with formalised structures and procedures for the implementation of their strategies. For instance, Mithas et al. (2013) researched on examining how the competitive industry environment shapes the nature of a firm's DBS. It was discovered that a firm's DBS is a product of its awareness and ability to respond to the competitive environment

within the digital economy instead of merely optimising operations or reacting to some competitors.

In addition, most economic actors have great difficulties in clearly understanding the digital economy and are not always aware of the problems digital firms have to face (Jansson, 2011). This difficulty has been attributed to the particularities of digital technologies and the specific characteristics of the digital economy (Georgiadis et al., 2013). Academics and researchers are therefore encouraged to prepare for a future in which the digital economy will be a significant part of the whole economic and social activity of countries. Paradoxically research on expounding the strategic actions of firms in the digital economy has arguably been limited to Spain (Águila, Padilla, Serarols, & Veciana, 2003) and Indonesia (Aryanto & Chrismastuti, 2011). Research to explore the strategic actions of a digital enterprise will be opportune in identifying the nature of competition in the digital economy.

In another breadth, most new enterprises are unable to survive beyond 42 months after they are established (Allen, Langowitz, Elam, & Dean, 2007; Boateng, 2016). This phenomenon has been observed to be prevalent in most developing economies. In Africa as a whole, only 13 percent of enterprises survive beyond 42 months after their establishment. Expressly, in Ghana and Uganda, 38 percent and 31 percent of firms survive beyond the 42-month survival threshold, respectively (Global Entrepreneurship Monitor (GEM), 2012). It can be concluded that Africa has a very high business discontinuation rate. The causes of this phenomenon have been attributed to the nature of ownership of these enterprises, managers with limited formal education and managers with limited access to market information (Mensah, 2004). Politicians, academics and other agencies have made calls for African governments to make efforts to avert the high business discontinuation rates. This situation calls for studies to explore the strategic actions of the firms which have survived beyond the 42-month survival threshold. This will allow for identifying the strategic actions enabling them to survival which will serve as lessons for budding and struggling digital enterprises.

The above research gaps call for a study that investigates the strategic actions of digital enterprises without formalised structures, in their quest to remain agile and grow. Thus, this study explores the DBS evolution of a digital enterprise which has no formalised structures. This is significant in the context of a developing economy where this study is conducted. Hence, making the study novel and opening the discussion on the digital strategic actions of digital enterprises in their quest to survive.

2. Literature Review

2.1 The Digital Enterprise in a Digital Economy

It has been asserted that the digital economy is an emerging phenomenon which has had a very significant impact on the annual growth rate of countries (World Economic Forum, 2015). Even though economics and politics have been the driving forces behind this new phenomenon, contributions from innovations in technology cannot be overemphasised (Heeks, 2017).

Transformations in the economies of countries in the 1990s were mainly attributed to the Internet evolution. This evolution continued into the 2000s and the 2010s with the introduction of Information and Communication Technologies (ICTs) which has been the bedrock of economic transformations. These ICTs include but not limited to electronic devices with connected embedded

sensors (the internet of things); and new digital models such as digital platforms, cloud computing and digital services. Others include new sophisticated end-user devices and gadgets such as smartphones, laptops, netbooks, 3D printers, among others. Also, there has been an increase in the usage of data through the application of concepts such as big data analytics and algorithms for decision making (Dahlman, Mealy, & Wermelinger, 2016).

Bukht and Heeks (2017), therefore define the digital economy to consists of all the economic output derived solely or mainly from digital technologies that also has a business model dependent upon digital goods and services. Based on the definition of the digital economy, a digital enterprise will necessarily be that business entity which operates within the digital economy. Rouse (2011) defines a digital enterprise to be "an organisation that uses technology as a competitive advantage in its internal and external operations." Taking the three scopes of the digital economy into consideration, as shown in Figure 2.2 above, a digital enterprise or firm must have a business model that primarily utilises digital technologies. The existence of the digital enterprise is dependent upon the availability of digital technologies. It must also be noted that the term digital enterprise has evolved over the years to include all business activities that incorporate digital technologies in their operations. Tonaton.com, who uses the internet for buying and selling goods and Uber, who also uses internet technology for ride-sharing activities are examples of digital enterprises.

2.2 Digital Business Strategy

The digital economy has redefined business strategy into a term referred to as "Digital Business Strategy." Mithas et al. (2013) see digital business strategy as moving beyond the business strategy to a stage where businesses engage in a category of Information Technology related activities. Bharadwaj et al. (2013) defined digital business strategy as "organisational strategy formulated and executed by leveraging digital resources to create differential value."

The review of the literature revealed different scopes in a firm's application of DBS. The corporate scope had been a significant issue in strategic management research (Wade & Hulland, 2004). The scope of a business refers to "the portfolio of products and businesses as well as activities that are carried out within its direct control and ownership" (Bharadwaj et al., 2013). The scope of a business contributes to its profitability. Similarly, the scope of the DBS also impacts on the output of the enterprise. The review of DBS literature highlighted four major dimensions which fall under the scope of DBS. These include Coordination, Flexibility, Governance, and Competence (Bharadwaj et al., 2013).

1.1.9 2.2.1 Coordination Dimension of DBS

Coordination was highlighted to be one of the dimensions under the scope of DBS literature review. The survival of firms depends heavily on their ability to earn profit from their investments. Thus, the return on investment (ROI) should be higher. Firms are, therefore, supposed to be competitive in this regard. The performance of a firm in the industry is mostly dependent upon its ability to cooperate, collude or coordinate with rival firms which allow for preventing or limiting new competitors from entry and exerting authority over both customers and suppliers. Studies on DBS

that viewed the strategy from the perspective of Coordination asserted that the exchange of rich information enabled by digital platforms both within and outside the firm allows for maximising returns and making the firm competitive (Choi, Raghu, Vinzé, & Dooley, 2017; Rai, Pavlou, Im, & Du, 2012).

1.1.10 2.2.2 Governance Dimension of DBS

Williamson (1999), who is a Business Strategy researcher, asserts that firms will be deemed to have a perfect governance structure when activities are effectively partitioned. In this way, activities which are performed outside of the firm are effectively separated from those within. Studies on digital technologies and Governance have focused on using IT in managing and monitoring supplier networks and the performance of contracts. For instance, earlier studies (e.g. Bøe, Gulbrandsen, & Sørebo, 2015; Chen & Kamal, 2016; Nwankpa, 2015) investigated the role of digital technologies on the cost of transactions. According to Bøe et al. (2015), the elements of transaction cost which include specification, search and contract negotiation does not address the problem of transactions risks and opportunism which have become one of the primary focus of strategic management research in the 21st century.

1.1.11 2.2.3 Competence Dimension of DBS

Competence as a dimension in the review of DBS literature places emphasis on the capabilities and the resources which the firm uses to capture and create value. According to Drnevich and Croson (2013), the firm acquires these capabilities and resources by consciously building them, through inheritance or chance. In the Competence-base perspective, the focus is mostly on the balance which exists between the creation of value and its capture. Thus, serving as the mechanism for determining the economic benefits of investments for the firm. Studies on the competence scope of DBS (e.g. Chuang & Lin, 2017; Mithas et al., 2013) highlight the significant role of digital technologies in the creation and capture of value which makes firms competitive in the industry. Mithas et al. (2013), for instance, explored the digital posture of firms in a competitive environment.

1.1.12 2.2.4 Flexibility Dimension of DBS

DBS literature on the flexibility dimension highlights the ability of businesses to respond quickly to changes that occur in both internal and external environments, which leads to an improvement in efficiency and effectiveness. Emphasising on the dynamic nature of the digital technologies which requires that products are quickly produced, Henfridsson, Mathiassen and Svahn (2014) assert that firms need to adopt a digital strategy which will enable them to be flexible and stay competitive. A significant advantage of Flexibility is the ability to adapt to new situations at minimal costs and being able to seize opportunities quickly.

3. Methodology

The conduct of this study was guided by the Critical Realism paradigm which has arguably been seen to provide researchers with the opportunity to view real-world problems from their underlying causal mechanisms (Mingers, Mutch, & Willcocks, 2013) instead of a situational analysis.

The selected case for this study was Digix Enterprise (a pseudo name) which is a Ghanaian digital enterprise (based on the study's definition of a digital enterprise). That is, digital enterprise is that firm with a business model which primarily utilises digital technologies (Ansong & Boateng, 2019). Digix Enterprise has been in operation since 2011. According to the 2007 Global Entrepreneurship Monitor (GEM), most new enterprises are unable to survive beyond 42 months after they are established (Allen et al., 2007). This phenomenon has been observed to be prevalent in most developing economies. Digix Enterprise is therefore qualified to be selected as a case for this study considering its existence since 2011. A study of the enterprise's DBS over the period will thus be timely and insightful.

In conducting this study, data was collected from multiple sources. Creswell (2014) is of the view that case study research requires an intensive data collection, using various forms of data to offer an evaluation of the activities being studied. Three methods of data collection were used for the study: interviewing, observation of participants, and document analysis. The first interview, which lasted for forty-five minutes, was with the owner, who is also the manager of the enterprise. The enterprise's documents (financial records, receipts, company registration records, partnership records, agreements, etc.) were reviewed to ensure literal replication – whether the documents considerably confirmed information earlier collected through the interviews. Apart from the owner, one auxiliary staff of Digix (the administrator) was interviewed to find out any start-up-specific growth patterns and to confirm or disprove the patterns of behaviour identified in the earlier interview. This interview lasted for one hour. Also, two Digix enterprise's customers and a mentor were interviewed – each lasting for thirty minutes. The information obtained did not lead to any new pattern. Specific growth concepts were explored in-depth to enrich the understanding of the phenomena. Responses from interviewees were mainly audio-recorded in addition to taking notes. Data collection was discontinued because there was no new information to be obtained. The data collection was carried out from February 2018 to March 2018.

Data analysis begins as soon as data collection starts. This research adopted Miles and Huberman (1994) transcendental realism technique, which highlights three main components for analysis; data reduction, data display and drawing and verifying conclusions.

Table 1 presents a detailed plan on how Miles and Huberman's data analysis approach was utilised in this study.

4. Analysis of Findings

The following subsections present findings from Digix Enterprise. Its profile and digital business strategic actions are presented. These strategic actions are later discussed concerning the dimensions of the DBS framework

Steps	Tasks	Outputs
Step 1: Coding of key events	<ol style="list-style-type: none"> 1. Identification of key events in the data collected 2. Establishment of a timeline of the major events 	Presentation of a chronology of key events of the case
Step 2: identification and typifying components	<ol style="list-style-type: none"> 1. Identification of networks of social and technical components 2. Display of components and related data 	A set of components and associated data
Step 3: Retrodution of mechanisms	<ol style="list-style-type: none"> 1. Investigation of the interplay between the micro and macro elements to explain outcomes 2. Identification and analysis of selected mechanisms through the assessment of their explanatory powers. 3. Definition of the mechanisms and development of measures to be used. 	Mechanisms developed for the various dimensions of the digital business strategy, including definitions.

Table 1: In-depth data analysis

4.1 Profile of Case Organisation

Digix is a Ghanaian digital enterprise that began in 2011 as an e-book publisher. Initially, the start-up published e-Journals for higher educational institutions through an online e-book platform. Thus, the company registered as a sole proprietorship in 2011 with the Registrar General's Department of Ghana when the owner was doing his National Service (a period of compulsory service to the country; mostly after tertiary education) and then became a limited liability company in 2017. Figure 1 summarises Digix Enterprise's business activities, including the year the various events were introduced.

Digix currently has seven employees which include; the owner, who is also the manager; a content validator who doubles as a marketer; an administrator who also serves as an assistant to the manager; and four part-time employees. The managing director has a master's degree in Information Systems and is currently pursuing a PhD degree. The content validator holds a first degree in marketing, and the administrator has a masters' degree in communication and public relations. The part-time employees are pursuing masters' degrees in Management Information Systems, and they have varied undergraduate backgrounds in computer science, business management, and e-commerce. The part-time employees assist in developing and managing websites, including Digix's website and the production of online videos. In addition to the part-time employees, Digix has strategic partnerships with two tertiary institutions, a business advisor, and MTN Foundation. The business advisor provides business insights and directions to the manager for considerations. The team is committed to influencing optimal revenue growth while exceeding the clients' expectations.

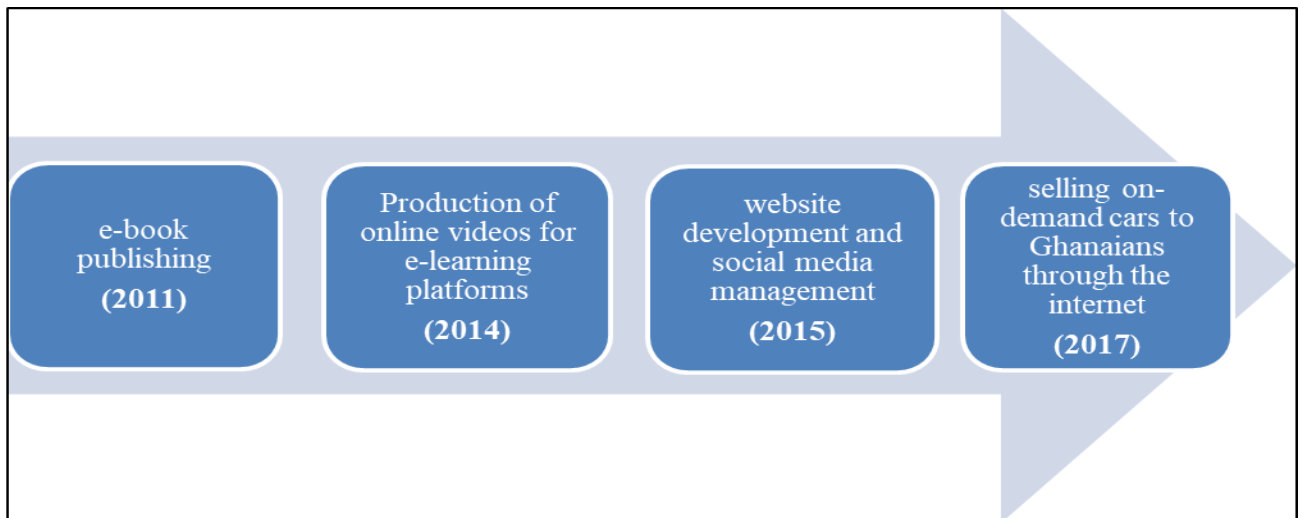


Figure 1: The evolution of Digix Enterprise’s business model

(Source: Authors’ construct)

Communication between employees, clients, customers, and suppliers was carried out via email, social media, and mobile phone calls. It uses online technologies such as e-book pro, email, YouTube, moodle (e-learning platform), IAAI and Corpart (online automobile auction systems) to provide products and services to clients. Other IT infrastructure includes five i7 laptops, Vodafone internet modem, Surfline internet modem, and Adobe CC 2015 Suite. The manager uses his phone as the business' phone.

Digix started operations with a capital of US\$610.54. As of March 2018, the net profit of Digix was US\$32,765.53 with clients from academic institutions, hospitability, and the banking sector.

5. Discussion

Easton (2010) assert that the critical realist’s perspective of causation is made up of four major components. These include; (1) The event (the outcome of the phenomenon of interest to the researcher); (2) the mechanisms (the way the events/things occur or act); (3) structures (the sets of internally related activities or practices); and (4) the conditions within which an event takes place.

Three major growth events were identified in the case. The initial digital business strategic actions characterise the first event – the Founding stage. The second event is the development stage, which is also characterised by digital business strategic actions aimed at delegating some business activities as it expands. The third event is also characterised by the digital business strategic actions geared towards coordinating the business activities as it matures.

The case firm is a digital enterprise consisting of a set of interacting entities (resources, people, processes, and others). Critical realism researchers, therefore, seek causal explanations – aimed at identifying the mechanisms connecting the entities to produce the events within some specific conditions. Thus, there could be the possibility of more than a single causal explanation to a single event. The objective of the Critical Realism researcher is, therefore, to identify and select the causal

explanation suitable in the particular case under study. In this regard, condensation of data and display of data was carried out. This enabled for the identification of the critical combination of entities and conditions within the mechanisms which generated the particular events as postulated by Miles and Huberman (1994).

Four major dimensions of digital business strategy based on the review of digital business strategy literature are postulated. These dimensions are used to review the three major stages of growth of the digital firm. Table 2 summarises the key constructs (entities) and strategic actions (conditions) which underpin these stages of growth and the corresponding Digital business strategic actions.

1.1.1 5.1 Digital Business Strategy in Phase One

The creativity and commitment of the founder characterised the first stage in the growth of the digital enterprise. The most dominant dimension in the founding phase of the digital business is Governance. The focus of the governance dimension is the ability of the digital enterprise to allocate resources to create and capture value efficiently. The analysis of data revealed that, in the first phase of growth of the digital enterprise, the entrepreneur was actively involved in the operations. Again, the entrepreneur's high level of innovation contributed to the survival of the firm. This finding is corroborated by Liu et al. (2015), who postulated that the level of innovation of the founder influences the way resources are managed for the firm to remain competitive. Similarly, Glassman et al. (2015) identified business owner's strategic decisions such as internet filtering and monitoring systems to be effective ways of promoting better compliance which leads to employee empowerment and resource replenishment.

Another crucial digital business strategy dimension in the first phase of growth is competence. The significant capital of digital businesses in the first stage of growth is the intellectual skill of the owner(s) and some technological resources. Alden (2011) asserts that most digital enterprises rely heavily on the innovative skills and expertise of the owner(s) in the first stage of growth. Besides, Biberhofer et al. (2019), in their study, argued that the sustainability of firms is dependent upon the competencies and the more in-depth knowledge levels of the entrepreneur

In terms of Flexibility, the output of the strategic action is the ability of the digital enterprise to be agile; adapt to the changing conditions in the industry. In the first phase of growth, the digital enterprise adopted a simple business model which was agile enough to survive in the economy. Besides, the commitment of the business owner also contributed to the survival of the business. This finding is not different from the globally influential digital enterprises such as Amazon, Facebook, Uber, and Airbnb – who started with highly committed entrepreneur(s) with a simple business model which involved a single product or service (Zaheer et al., 2018). A suggestive finding from this discussion is made;

Table 2: Key digital business strategic actions which underpin the survival of Digix enterprise

Dimension of DBS	Phase One: Founding stage	Phase Two: Developing stage	Phase Three: Maturity Stage
Flexibility	<p><i>The business model:</i> Digix adopted a simple business model which was agile enough to survive in the economy. Thus, the production of online versions of journals.</p> <p><i>Commitment to Business:</i> The owner showed commitment to the survival of the business.</p>	<p><i>Experience accumulation:</i> Digix acquired experience in the market. These experiences led to the expansion of the firm’s portfolio to include on-demand car marketing.</p> <p><i>Knowledge codification:</i> Digix began practising effective documentation of its activities at this stage.</p> <p><i>Knowledge articulation:</i> The owner of the firm acquired a broad spectrum of knowledge through pursuing a degree in Management Information Systems. This helped him to take some strategic decisions which contributed to the survival of the firm</p> <p><i>Opportunity Discovery:</i> The manager identified a need on the market to offer trust-enforced on-demand cars to prospective clients. This market gap and the business opportunity was identified and filled by Digix enterprise</p>	<p><i>Decentralisation:</i> Initially, all decisions and activities were performed by the owner of the firm. At the maturity stage of the business, others were assigned roles and responsibilities.</p> <p><i>Opportunity Discovery:</i> Digix was able to identify new business opportunities in Ghana’s digital economy. The firm started offering discounts to clients and providing free after-sales support to clients. This strategy has positioned Digix very well on the market.</p>
Governance	<p><i>Entrepreneurs’ ownership:</i> The owner of the business was actively involved in the operations of the company.</p>	<p><i>Age of the firm:</i> Over the years, Digix was able to augment its human resources with four National Service personnel. Again, some years of service provided some credibility for potential clients.</p>	<p><i>Venture capitalist’s knowledge:</i> The experience and expertise of the business advisor contributed to providing the needed strategic guidance to the firm.</p>

Dimension of DBS	Phase One: Founding stage	Phase Two: Developing stage	Phase Three: Maturity Stage
	<p><i>Innovation level:</i> There was a high level of innovation in terms of providing an alternative means of publishing the journals</p>	<p><i>Environment Variability:</i> Digix utilised the variabilities in the digital economy to its advantage. Digix benefited from the Government of Ghana's incubator programme.</p>	<p><i>Environment Variability:</i> Changes in the environment which included the Government's implementation of Tax Identification Number (TIN) as a requirement for business operations such as clearing cars</p>
<p>Competence</p>	<p><i>Intellectual Resources:</i> the principal capital of the business at this stage was the intellectual skill of the owner.</p> <p><i>Technological Resources:</i> Technological resources available to Digix were the laptop, internet, and e-Book Pro software</p>	<p><i>Reputation:</i> The firm's association with the two educational institutions made them credible and trustworthy.</p> <p><i>Financial Resources:</i> Enough financial resources became available to the firm. The net profit of the firm increased from US\$3,257.90 in Phase One to US\$6,443.40 by the end of 2015.</p> <p><i>Human Resources:</i> Digix had three employees at this stage who included the owner, a content validator, and the administrator. This workforce provided the requisite expertise to enable the firm to survive.</p>	<p><i>Reputation:</i> The compliance with Government regulations, coupled with effective customer relationship management through social media, has created an excellent reputation for growth. Again, Digix leveraged on its affiliation with the MTN Foundation and other reputable educational institutions.</p> <p><i>Financial Resources:</i> At this stage, the increased profit margin of Digix was reinvested into the company, which supported its growth.</p> <p><i>Human Resources:</i> The workforce of Digix grew to seven employees; the owner, who is also the manager; a content validator who doubles as a marketer; an administrator who also serves as an assistant to the manager; and four part-time employees.</p> <p><i>Physical Resources:</i> Through the support of the Government of Ghana, Digix had free office space, internet access from MTN and office computer.</p>

Dimension of DBS	Phase One: Founding stage	Phase Two: Developing stage	Phase Three: Maturity Stage
Coordination	<p><i>Degree of product differentiation:</i> Digix was able to provide a different product which was the online/ softcopy journals.</p>	<p><i>Number and size of customers:</i> The customer-base of Digix grew exponentially at this stage. Some of the clients included educational institutions and other individual customers.</p>	<p><i>Vertical integration:</i> Digix was able to provide an integrated digital solution to clients, which included the production of lecture videos and the management of the e-learning platform. Again, Digix developed websites for clients in addition to the management of the client's social media platforms.</p> <p><i>Government support:</i> The incubator programme led to the provision of free office space, internet access from MTN, office computer, and business training for Digix enterprise.</p> <p>The Government's pro-business interventions such as the paperless port system for shipping cars to Ghana supported the on-demand car import business of the firm.</p>

Finding One: *The survival of the digital enterprise, in the first stage of growth, depends largely on the entrepreneur's innovativeness, and the competence to govern the available resources to achieve competitive advantage.*

1.1.2 5.2 Digital Business Strategy in Phase Two

The digital enterprise developed in the second phase of its growth. The delegation of tasks characterises this phase as the business expands and engages more workers and customers. The most dominant digital business strategy dimension in the second phase of growth is Flexibility. In the second phase of growth, the digital enterprise acquired some experience, which helped it to become agile and survive. This experience is mostly gained with the knowledge capital of the firm through knowledge codification and articulation (Sardo, Serrasqueiro, & Alves, 2018). Through this experience, the enterprise identifies opportunities within the market. For instance, Sia et al. (2013) discovered that managers acquired some experience, which helped them to cultivate leadership for digital transformation, after operating in the industry for some years. Again, in Smith's (2018) study on two young Scottish entrepreneurs, he discovered that through their ingenuity and creativity, these entrepreneurs were able to set up a hugely successful brewery in 2007 even in the face of the global recession.

Another dominant dimension of digital business strategy in the developing phase of growth is competence. In the second phase of growth, the firm relied on its reputation, financial, and human resources to stay competitive and survive. Enough financial and human resources became available to the digital enterprise in the second phase of growth. In explaining this phenomenon, Chuang and Lin (2017) argue that the ability of the digital enterprise to combine human, business and technological resources effectively helps it to achieve profitability and continue its growth. This assertion is also corroborated by Trkman (2010), who identified the success factors for businesses to be the effective management of all resources. A suggestive finding from this discussion is made;

Finding two: *A successful digital enterprise is the one whose growth is a joint effort between a Business Manager and change agents who are both the middle management and the employees performing their assigned tasks in the process.*

1.1.3 5.3 Digital Business Strategy in Phase Three

The third phase of growth is the maturity stage. This stage is characterised by expansion, delegation and Coordination. The most significant dimension of digital business strategy in this phase is Coordination. In the third phase of growth, the digital enterprise vertically integrated its products and services. The digital enterprise offered a package of services and products which are complementary to each other. In the case of the digital enterprise in this study, it offered lecture video production and the management of the e-learning platform as a package. In addition, the digital enterprise was able to manage its relationship with external entities such as the regulatory bodies and suppliers. Zhao and Xia (2014) argue that the ability of the organisation to work with trading partners determines its market readiness.

Another significant digital business strategy dimension in the third phase is Flexibility. The third phase of growth is characterised by decentralisation and delegation. Initially, all decisions and activities were performed by the owner of the digital enterprise. At the maturity stage of the business, employees are assigned roles and responsibilities. This assertion is not different from the finding of Zaheer et al. (2018). They discovered that one of the strategies for the survival of digital enterprises was a "lean start-up" (one or two initial employees). Functions are centralised initially, but as the firm grows, other personnel are employed, and tasks are decentralised. Also, the firm continues to discover new opportunities as it grows in the third phase.

Competence is another significant digital business strategy dimension in the third phase. The third phase of growth is also characterised by the ability of the firm to manage the available resources, which include financial, human, physical, and IT resources. In terms of human resources, the digital enterprise grows and employs personnel to take up roles in the business. Again, the firm reinvests its profits, which allows an increased financial resource to be available. Nevo and Wade (2010), for instance, conducted a study on identifying a firm IT assets which played strategic roles for competitive advantage. It was discovered that these IT assets could only be used to achieve strategic benefits when other organisational resources are available and combined with them, leading to the creation of IT-enabled resources. Dawson et al. (2016) assert that it is very crucial for the whole team to approach innovation as a unit to succeed in the digital economy. A finding from this discussion is thus made.

Finding three: *The growth of the digital enterprise at the maturity stage is mostly initiated with the knowledge capital which consists of the knowledge-based and human-oriented activities which contribute to innovations leading to value creation and enhancement of competitiveness.*

Figure 2 elaborates the significant digital business strategy dimensions at the various stages of growth.

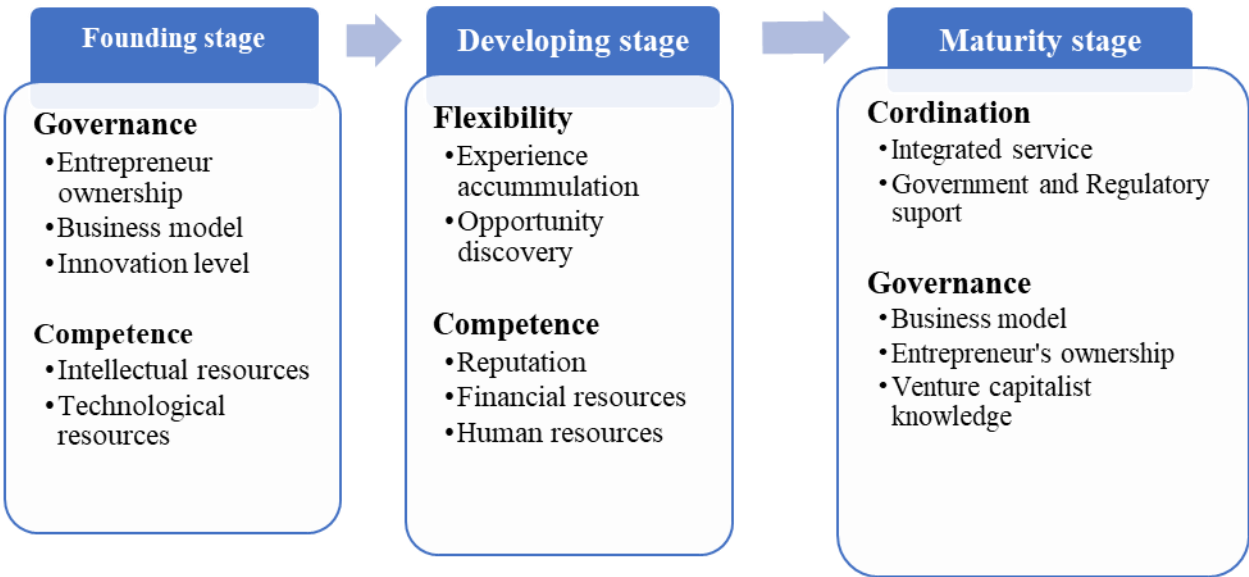


Figure 2: Digital business strategy Framework

(Source: Authors' construct)

6. Conclusions

Three major growth events were identified in the case. The first event, which is the founding stage, was characterised by the initial digital business strategic actions. The second event was the development stage, which was also characterised by digital business strategic actions aimed at delegating some business activities as it develops. The third event was also characterised by the digital business strategic actions geared towards coordinating the business activities as it matured

This study examined the strategic actions of a digital enterprise in an attempt to develop a framework for digital business strategy. Knowledge about the nature of the digital economy of Ghana and the survival strategies of digital enterprises was limited in the literature. The handful of studies that attempted to map the digital economy of countries were conducted in either Spain (del Aguila, Padilla, Serarols, & Veciana, 2003) or Indonesia (Aryanto & Chrismastuti, 2011). Other identified mapping studies were industry reports from practitioners such as the digital economy report of 2019 by the United Nations Conference on Trade and Development (UNCTAD) and the KPMG (2019) report on Taxation in the digital economy. This highlights the paucity of research on the digital economy of developing countries in academia. This research provided a review of the dimensions of the strategic actions of a Ghanaian digital enterprise in the quest to survive. This knowledge is arguably novel in the context of a developing country. It provides a stepping stone for future studies to explore other aspects of the digital economy in terms of challenges and opportunities digital enterprises face.

6.1 Implications of the Study

This research is arguably the first to view DBS from four dimensions on the growth and survival of a digital enterprise in a developing economy. This study, thus, serves as a stepping stone for future research on DBS from a developing economy perspective.

This research has implications for managers of digital enterprises, policymakers, and regulators of the digital economy. Specifically, this study is of practical importance to managers and executives of digital enterprises who are struggling to develop digital business strategic actions to survive. A Global Entrepreneurship Monitor report indicates that Africa has a higher business discontinuation rate. Thus, most new businesses in Africa do not survive beyond 42 months after their establishment as postulated by Allen et al. (2007). This study, therefore, is useful to entrepreneurs who wish to develop DBS to survive and grow.

The findings of the study also inform policymakers of the increasing need for programmes and interventions that seek to support the survival of digital enterprises. Such interventions, as highlighted by the study, include incubator programmes for start-ups and business-friendly government policies.

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P17: Identificando as Competências Informacionais e o Potencial das TIC no âmbito da vulnerabilidade social: um estudo em Associação de Material Reciclável no Brasil

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Resumo

Estima-se que, no Brasil, apenas 13% de todo o resíduo passível de reaproveitamento seja encaminhado para reciclagem, demonstrando um desperdício significativo de material, de potencial econômico e ambiental. O cenário é agravado pelo baixo nível de eficácia das associações de catadores de material reciclável no país. Verifica-se a necessidade de identificar as competências informacionais presentes neste ambiente e de compreender como capacidades de TIC podem melhorar a eficiência organizacional das associações de catadores de material reciclado. Um estudo de caso único embasa a pesquisa, cuja escolha da associação se deu pela sua relevância na inserção social e financeira de famílias da região e pela sua localização em um bairro de grande vulnerabilidade social e marginalização. Identificou-se que as capacidades de gestão do negócio são as mais desenvolvidas, seguidas pelas capacidades de gestão da informação. As capacidades que demandam maior atenção são as relacionadas à tecnologia da informação. A pesquisa aponta a importância da tecnologia e da informação como suporte ao desenvolvimento de processos da cadeia da reciclagem, avança nas discussões sobre contribuições de TICs em organizações com condições de trabalho de vulnerabilidade social e contribui para o desenvolvimento das pessoas que trabalham com a gestão de materiais recicláveis.

Palavras Chave: Uso das TIC, Capacidades informacionais, Gestão da Informação, Cadeia de Reciclagem.

1. Introdução

O conceito de preservação ambiental tem mobilizado organizações governamentais, da sociedade civil e não-governamentais em todo o mundo. No Brasil, a produção de resíduos aumentou nos centros urbanos, tendo como pano de fundo a lacuna social. Diferente dos países desenvolvidos como Canadá, Estados Unidos e países da Europa onde a maior parte do lixo é reciclada (Brandão & Gutiérrez, 2016; Fergutz, Dias, & Mitlin, 2011), no Brasil não há um sistema adequado de coleta de materiais recicláveis e

um segmento da população urbana sobrevive coletando os materiais de forma informal (conhecidos como catadores) ou em associações de materiais recicláveis (Medina, 2008). Magera (2005) aponta duas características sobre a importância das associações de catadores. A primeira é a relevância ambiental, sendo catador o agente minimizador de impacto ambiental. A segunda característica é a inclusão produtiva de uma população estigmatizada pela sua atividade, de modo que cooperativas e associações deveriam ser espaço de transformação social e cultural dos participantes. As associações contribuem para transformar a vida dos indivíduos que aceitam estabelecer-se coletivamente, adotando preceitos democráticos e de solidariedade (Silva, 2017; Bourahli, Kondo, Hedler & Batista, 2011).

Apesar da importância destes agentes na cadeia de resíduos sólidos urbanos, eles ainda praticam suas atividades em situação precária, tanto de estrutura física e gestão, quanto de inclusão social (Silva, 2017; Bourahli, Kondo, Hedler & Batista, 2011). Segundo Silva (2017), as associações e cooperativas de catadores de material reciclável no Brasil possuem baixo nível de eficiência, diminuindo sua rentabilidade. Além de questões da gestão, Rezende (2009) aponta que dentro destes locais há pouca autonomia no acesso e no uso de informações. A capacidade de lidar com a tecnologia de informação e comunicação (TIC) para gerenciar informações aparece como uma das competências mais escassas neste tipo de organização. O uso adequado das TIC poderia proporcionar benefícios imediatos.

Neste aspecto, surge a necessidade de responder a seguinte questão: Quais as competências informacionais que precisam ser desenvolvidas nas associações de material reciclável? A pesquisa foi realizada à luz dos conceitos de TICs, gestão da informação e das competências informacionais. Com isso, buscamos fazer duas contribuições importantes. Primeiro, compreender como desenvolver a capacidade de usar as TIC para melhorar a o trabalho de reciclagem. Segundo, avançar nas discussões sobre como as TIC apresentam soluções aos problemas informacionais em organizações com condições de trabalho extremas e de vulnerabilidade social.

2. Competências Informacionais

Davenport (1998) afirma que informação são dados com significância e propósito, e que é necessário análise e objetivos claros quanto ao que se espera do resultado. Conhecimento é o termo que possui mais intervenção humana, pois requer não só as informações, mas o conteúdo pré-adquirido e o raciocínio individual de quem pretende compreender a informação (Davenport, 1998; Sordi, 2015). Para Tarapanoff (2006, p. 22), a gestão da informação (GI) tem como objetivo “identificar e potencializar recursos informacionais de uma organização ou empresa e sua capacidade de informação, ensinando-a a aprender e adaptar-se às mudanças ambientais”. Ela deve guiar e suportar o gerenciamento de informações, iniciando pelo planejamento, passando pelo desenvolvimento até a distribuição e possível armazenamento das informações, resultando na redução da ambiguidade e incertezas do negócio (Miranda, 2004). Choo (2003) apresenta um modelo de ciclo de gestão da informação composto por seis fases que se adaptam conforme as demandas informacionais. São elas: a) Necessidade de informação: identificação de um problema ou lacuna vivenciada pelo usuário; b) Aquisição: obtenção da informação em fontes confiáveis; c) Organização e armazenamento: trabalha a informação para funcionar

adequadamente no acesso, distribuição e na necessidade de sua recuperação; d) Produtos e serviços: entrega da solução para o problema informacional com foco na forma e/ou formato mais adequado para cada público-alvo; e) Distribuição: direcionar a informação adequada a cada usuário, de acordo com as necessidades e nas mídias apropriadas; e, f) Uso: ponto mais importante, criação de significado para o usuário.

No estudo da Gestão da Informação, a competência informacional é aquela que identifica o conjunto de conhecimentos, habilidades e atitudes que proporciona ao profissional o conhecimento para trabalhar intensamente com informações, adicionando conhecimentos novos às lições aprendidas e propiciando maneiras de relacionar o objeto de informação ao ciclo informacional e às ferramentas de tecnologia da informação e comunicação (Miranda, 2004). Gasque (2011, p.86) apresenta o conceito no contexto organizacional, onde as competências têm por objetivo “melhorar a produtividade e a competitividade em decorrência especialmente do processo de substituição tecnológica que produz novas formas de organização do trabalho”. Para alcançar as competências informacionais, é importante desenvolver as capacidades. A partir da revisão de literatura, identificam-se nove capacidades baseadas em competências informacionais (Tabela 1).

Competência	Capacidade	Autores
Em Tecnologia	Lidar com a tecnologia da informação para gerenciar informações	Santos et al. (2008); Miranda (2006); Silva et al. (2005)
	Adequar a infraestrutura de TI às necessidades da organização	Mithas et al. (2011)
Em Gestão da informação	Utilizar as etapas do ciclo informacional	Santos et al. (2008); Gasque (2011); Miranda (2004); Dudziak (2010)
	Incorporar novos aprendizados de informação ao conhecimento prévio	Santos, Duarte & Prata (2008); Gasque (2011); Dudziak (2010)
	Escolher as fontes de informação mais adequadas para as suas necessidades	Gasque (2011); Miranda (2006); Dudziak (2010)
Para o Negócio	Utilizar informações na tomada de decisões, agregando valor e atingindo objetivos organizacionais	Santos et al. (2008); Gasque (2011); Dudziak (2010)
	Agir em conforme com a ética, seguindo as regulamentações vigentes	Miranda (2004); Gasque (2011); Dudziak (2010)
	Compreender as necessidades informacionais	Miranda (2006)
	Perceber o valor da informação	Miranda (2006); Gasque (2011)

Tabela 1 – Competências e Capacidades (Os autores, 2019)

A competência informacional ultrapassa o desenvolvimento cognitivo do indivíduo para as suas atividades, englobando conhecimento de tecnologia, gestão da informação e do negócio em si. A competência em tecnologia envolve aprendizagem do uso das máquinas e não apenas a aquisição de dispositivos eletrônicos, sendo necessário saber utilizar as TICs a seu favor (Silva et al., 2005). Santos et al. (2008) e Miranda (2004) apontam o desenvolvimento da capacidade em lidar com a tecnologia da informação para gerenciamento de informações como um dos resultados desse desenvolvimento. Mithas et al. (2011) indicam, também, a necessidade de desenvolver habilidades de adequação da infraestrutura de TI às necessidades organizacionais, fornecendo acesso e disponibilidade de dados e informações aos usuários com níveis adequados de qualidade.

A competência informacional também envolve conhecimento em gestão da informação. Santos et al. (2008) apontam a capacidade de identificar as etapas do ciclo informacional e gerenciá-lo. Gasque (2011) entende que esse processo engloba acessar a informação, utilizar critérios para avaliá-la, utilizá-la de forma efetiva e identificar quais devem ser incorporadas ao conhecimento já existente. Na interpretação de Miranda (2004), o processo complementa tópicos como captação, recebimento, criação e distribuição de informações. Dudziak (2010) destaca, ainda, as ações de avaliar, organizar e preservar adequadamente as informações pertinentes. Aprimorar conhecimentos e competências informacionais permite, segundo Santos et al. (2008), o agrupamento de novos saberes semelhantes e a identificação de necessidades futuras. Dentre as ações para se chegar à competência informacional, é preciso saber reutilizar as informações e agregá-las a novas aquisições e conhecimentos, ou seja, a capacidade de incorporar novos aprendizados de informação ao conhecimento prévio (Dudziak, 2010; Gasque, 2011). A qualidade da informação depende, até certo ponto, da sua fonte de origem. Para escolher a fonte mais adequada, é preciso ter conhecimento do que existe disponível na área de conhecimento. Miranda (2004) menciona a importância em saber escolher suas fontes e canais de informação para que possam solucionar problemas. É construtivo procurar informações em diferentes fontes (Dudziak, 2010) sem esquecer, principalmente, de avaliá-las criticamente (Gasque, 2011).

Na perspectiva de negócios, é importante saber avaliar e utilizar uma informação de qualidade para a tomada de decisão, de forma efetiva para que se possam alcançar objetivos definidos. No desenvolvimento de competências informacionais, o indivíduo reconhece como as informações podem agregar valor à organização e auxiliar na tomada de decisão (Dudziak, 2010; Santos et al., 2008). A busca e o uso da informação estão circundados por atitudes que envolvem a integridade e a transparência (Miranda, 2004), captando o contexto legal de uso, de acordo com a ética e as normas vigentes (Gasque, 2011; Dudziak, 2010). A capacidade de reconhecer a importância econômica, legal e social da informação em uso está relacionada aos conhecimentos que o indivíduo manifesta ao tentar aprimorar sua competência informacional (Gasque, 2011). Miranda (2004) menciona como as raízes culturais de cada indivíduo acabam influenciando o ato de perceber o valor da informação, seja da informação que ele obtém externamente ou a que é gerada de forma intrínseca.

4. Gestão de Resíduos Urbanos no Brasil

No Brasil, apesar de ser pauta da agenda governamental, a taxa de coleta seletiva ainda é muito baixa nas cidades brasileiras (IBGE, 2018). Não é possível apontar números consolidados sobre a reciclagem, mas estima-se que apenas 13% de todo o resíduo passível de reaproveitamento é devidamente encaminhado para a reciclagem, o que representa um desperdício significativo de material, de potencial econômico e ambiental (Silva, 2017).

A reciclagem tem um papel relevante na redução do consumo de energia, reutilizando materiais já beneficiados, cortando custos de projeto de um novo produto, amenizando impactos negativos gerados ao meio ambiente e gerando empregos diretos e indiretos (Silva, 2017). Portanto, os trabalhadores da indústria do material reciclável cumprem um papel de mediador, pois "no lixo há valores a serem resgatados através do não desperdício, da separação na fonte e do fomento à cadeia produtiva da reciclagem" (Rezende, 2009, p. 79). As atividades dos principais trabalhadores da cadeia de reciclagem consistem em coletar, separar, transportar, armazenar, beneficiar e negociar o que tem valor comercial. É por meio dessas atividades que o lixo retorna ao papel de mercadoria (Rezende, 2009). O trabalho de catador é, normalmente, informal e marginalizado, executado por cidadãos em situações vulneráveis (Silva, 2017). Sem o reconhecimento da profissão, esses trabalhadores não possuem direitos trabalhistas, como auxílio doença ou fiscalização de situação laboral. As associações e cooperativas agrupam forças de vários indivíduos e conseguem obter recursos para esses trabalhadores. Besen (2011) relaciona, entre os benefícios das associações e cooperativas, a oportunidade de participar de projetos juntos ao município, as melhorias no local de triagem, as melhorias quanto à insalubridade e o fortalecimento deste setor. As organizações de catadores de material reciclável tornam-se um canal para desenvolvimento de aspectos sociais, econômicos e ambientais. Elas também são vistas com uma alternativa às políticas de empregos formais (Besen, 2011).

Algumas capitais brasileiras, como Belo Horizonte, Curitiba e São Paulo, já incorporaram em suas ações públicas contratos com as organizações de catadores de material reciclável (Silva, 2017). Porém, muitos são integrados de forma limitada, apenas aos planos de assistencialismo, permanecendo à margem da construção urbana, como projetos de inclusão social (Besen, 2011). A realidade não é favorável à maioria das organizações de catadores de material reciclável, com diferentes problemas estruturais e pouca força de progressão, devido à situação vulnerável e periférica de suas vidas (Silva, 2017). Contudo, as oportunidades de desenvolvimento de competências, tanto individuais como coletiva, impulsionam o crescimento das associações como organização inserida na economia solidária e como meio de empoderamento social do indivíduo. Para Rezende (2009), a autogestão é bastante presente, dando suporte à economia solidária e garantindo autonomia horizontal na tomada de decisão.

3. Uso das TICs e as associações de material reciclável

O desenvolvimento das tecnologias tem modificado drasticamente a constituição base da informação, corroborando os estudos do comportamento informacional dos usuários e suas interações com ferramentas e TICs (Costa, 2008). Villas e Macedo-Soares (2008) definem TICs como recursos de infraestrutura tecnológica alocados em processos controlados pela ação humana, com funções baseadas

nas suas aplicações, processos, equipe e gestão. Para os autores, as TICs têm a capacidade de otimizar a comunicação interna entre as áreas de uma organização, proporcionando trocas de informação mais rápidas e confiáveis nas suas redes internas e externas.

O uso das TIC pode preencher a lacuna entre catadores e a sociedade (Virgolin et al., 2016, Rolim et al., 2015, Wilson et al., 2006). Coelho et al. (2019) apontam que o uso de TIC podem permitir acesso rápido aos catadores, criar oportunidades de trabalho, aproximar os associados da sociedade e fazer as pessoas apreciarem e reconhecerem seu trabalho. No entanto, Queyras e Quoniam (2006) mencionam sobre a importância de possuir recursos de TICs compatível com o contexto organizacional e suas estratégias. A pesquisa de Bortoli (2012), por exemplo, revela que há precariedade no emprego de TICs nas associações. Os dados apontam desde a falta de acesso a computadores até a utilização de softwares de controle de produção que poderiam melhorar a gestão e o trabalho dos catadores. Contudo, o potencial de sucesso no uso de TICs e outras inovações tecnológicas dependem de treinamentos e desenvolvimento de competências. Cleto (2010) aponta que, se não houver a capacitação dos usuários, a lacuna tecnologia continuará presente.

5. Aspectos Metodológicos

Para identificar as capacidades existentes dentro de uma associação de material reciclável, optou-se por uma pesquisa qualitativa. Quanto ao método, a pesquisa fez uso de estudo de caso interpretativo (Walsham, 2006), com o intuito de compreender profundamente os trabalhadores das associações de materiais recicláveis e sua realidade. O objeto de pesquisa escolhido foi a Associação dos Catadores e Recicladores de Curitiba - Associar, estabelecida no bairro Parolin, em Curitiba. A escolha da associação se deu em decorrência da relevância do seu papel na inserção social e financeira de diversas famílias da região. O bairro onde a associação está sediada é considerado um dos locais de grande vulnerabilidade social e marginalização da cidade de Curitiba.

Quanto à coleta de dados, as entrevistas foram a principal fonte. Na maioria dos estudos interpretativos, as entrevistas são a melhor maneira de acessar as interpretações dos informantes no campo (Walsham, 2006). Um total de seis entrevistas com oito entrevistados foram realizadas. Entre os entrevistados estavam cinco associados responsáveis pela gestão da associação e três consultores ambientais que prestam suporte a Associar. À vista disso, foram elaborados roteiros de entrevistas semiestruturados, diferentes para os consultores e para os associados. Os roteiros elaborados não possuíam questões diretas sobre as competências e sim questões abertas e exploratórias sobre a história das associações, as atividades, as dificuldades encontradas, as rotinas e o uso de tecnologia. As entrevistas iniciaram-se com os consultores ambientais, pois elas auxiliariam na compreensão do papel das associações de material reciclável dentro da cadeia dos resíduos sólidos urbanos e na identificação de aspectos gerenciais e sociais das associações. Após transcrição e análise do conteúdo destas entrevistas, obtivemos embasamento para direcionar os próximos encontros com os entrevistados que se encontravam no papel de gestores da associação. Essa abordagem propiciou uma entrevista mais direcionada e assertiva na identificação das capacidades baseadas em competências. Todas as

entrevistas foram gravadas com consentimento dos entrevistados. Como forma de enriquecimento dos dados e triangulação das informações, também foi realizada a observação não participante, a qual aproximou o pesquisador do ambiente da associação e possibilitou uma interpretação mais acurada das informações coletadas nas entrevistas. A observação ocorreu em duas visitas às associações no período de julho a setembro de 2019. Nestas visitas foi possível acompanhar a rotina dos associados e obter um detalhamento maior de informações. Notas de campos foram tomadas nesta etapa da pesquisa.

Quanto os procedimentos de análise dos dados coletados, a metodologia de análise de conteúdo foi escolhida por permitir “a inferência de conhecimentos relativos às condições de produção/recepção das mensagens” (Bardin, 2011, p.7). Como diretriz de análise dos dados utilizou-se o embasamento teórico e as capacidades baseadas em competências. Foi considerado o contexto socioeconômico da associação envolvida, sendo possível compreender mais sobre os pensamentos e as competências existentes e as que precisam ser desenvolvidas. O software Atlas.ti® foi utilizado como ferramenta de auxílio na análise dos dados. As entrevistas transcritas e as notas de campo foram incluídas no software. Após a leitura, cada trecho do texto que remetia a uma das categorias de análise era codificado. Ao todo foram criados 17 códigos, oito para as capacidades proporcionadas pela competência informacional existentes, oito códigos para as capacidades que precisam ser desenvolvidas e um código para identificar pontos importantes, como contexto, dados quantitativos a serem verificados e outros aspectos relacionados à gestão da informação. Na fase de apresentação dos resultados, a análise é enriquecida com citações das entrevistas, de acordo com o código a qual pertence.

6. Resultados

Nesta seção apresentamos os resultados da pesquisa. Primeiro, descrevemos o caso, a Associar. Em seguida, apresentamos os principais achados pertinentes às competências.

6.1 Associação de Catadores de Material Reciclado - Associar

A Associar é uma associação de catadores de material reciclados, fundada em 2015, com sede no bairro Parolin – Curitiba, sul do Brasil. A associação trabalha como prestador de serviço para a prefeitura da cidade, a qual conta com um programa de coleta seletiva, onde o resíduo urbano com potencial de ser reciclado é recolhido pela prefeitura e destinado às associações. Por meio deste programa, há o repasse de verba proporcional à quantidade de material recebido por mês para cada associação, mediante a comprovação do cumprimento de uma série de requisitos estabelecidos no momento do credenciamento como prestador de serviço, como por exemplo, recolhimento de imposto trabalhista para todos os associados e infraestrutura adequada para as condições de trabalho.

A associação possui entre vinte e vinte e cinco associados por mês. A quantidade de associados se altera conforme os rendimentos aumentam ou diminuem. Um grupo de quinze pessoas frequenta a associação com mais regularidade. Todos desse grupo possuem mais de sete anos trabalhando na cadeia de resíduos sólidos urbanos, já tendo passando pela atividade de catadores de material reciclável puxando carrinhos em via pública ou trabalhando em barracões na triagem do material, atividade que todos exercem atualmente. Os associados são na sua maioria mulheres. São elas que também ocupam a maior

parte das vagas da diretoria das associações, incluindo a presidência e a tesouraria. A associação conta com uma consultoria externa de soluções ambientais desde 2017, pois perceberam que não seria possível atender sozinho todos os requisitos do programa da prefeitura. A consultoria externa é utilizada para auxiliar o processo de adequação às normas do programa de reciclagem da prefeitura e atuam na busca por parceiros que os auxiliam nesta atividade. Ela também dá suporte na área administrativa, contábil, jurídica e técnica para obtenção de licenças ambientais, venda do material reciclado e comunicação com a prefeitura.

6.2 Capacidades baseadas em competências informacionais

A partir da análise dos dados, foram identificadas as capacidades desenvolvidas e a desenvolver pela associação, apresentadas na revisão de literatura e consolidada no quadro 1. Nas seções subsequentes, os principais achados desta pesquisa, nas três dimensões das competências informacionais são apresentados.

6.2.1 Competências em Tecnologia da Informação

A capacidade em lidar com a tecnologia da informação para gerenciar informações mostrou-se como uma das mais escassas. Esta capacidade está relacionada às atividades que envolvem dispositivos eletrônicos para fins administrativos, como controle de presença, gestão de custos, utilização de editores de textos e planilhas eletrônicas, busca e acesso rápido às informações seja local ou via web, gestão de conteúdo e comunicação por correio eletrônico. Mesmo os associados que demonstram mais habilidades em manusear planilhas eletrônicas, editores de imagens e textos, apresentam certa resistência em inserir a utilização efetiva dos meios eletrônicos. Segundo o entrevistado 5 *“Ela joga tudo [na planilha] no final de semana, mas para ela fazer isso, eu tenho que colocar aqui [no caderno]. Eu prefiro no caderno”*.

Percebe-se uma alta dependência do sistema físico (papel) e até mesmo uma dificuldade em utilizar a tecnologia nos processos da associação. *“Boa parte desses processos é no computador, eles até são capazes de fazer isso. Se eu sentar do lado eles fazem, mas se estivermos longe, já não acontece” (Entrevistado 1)*. Apesar dos associados afirmarem preferir utilizar o caderno, há evidências de que não há eficiência na forma como utilizam. Durante as entrevistas, houve momentos em que folheavam os cadernos para encontrar uma informação da semana vigente. Identificamos que dificuldades na gestão envolvendo a divergência de informações parecem ser comuns. Segundo relato do entrevistado 6, *“uma vez foi feito várias vezes [o acerto] e não batia, como sobrou dinheiro, nós repartimos. Tem vezes que terminamos mais de meia noite, tentando conferir as contas”*. Esse relato demonstra a necessidade de se saber utilizar as TICs como forma de agregar valor (Silva et al., 2005).

Em poucos momentos percebe-se o progresso no gerenciamento de informações por meio da TI na elaboração de prestação de contas que fazem mensalmente à prefeitura. *“Tem as planilhas de acompanhamento - qual a média de ganho das pessoas, isso nós temos que passar pra eles, são informações pra perceberem a evolução na associação” (Entrevistado 7)*. Para manter o recebimento dos materiais por parte da Prefeitura Municipal de Curitiba (PMC), as associações precisam enviar eletronicamente os controles. Elas cumprem esta exigência, mas sempre com o auxílio dos consultores.

Para garantir uma boa gestão, é necessário possuir recursos de TICs compatíveis com a organização e seus usuários, que, se não capacitados, não farão uso de forma adequada (Cleto, 2010). No contexto das associações de materiais recicláveis, existem grandes limitações entre os associados, como a falta de instrução básica, barreiras sociais, dificuldades financeiras, etc. Nas entrevistas houve muita menção ao uso do computador como ferramenta de gestão, ao uso de internet e de câmeras de monitoramento. Contudo, seu uso ainda é limitado e a capacidade em lidar com a TI para gerenciar informações é precária: *“Hoje quando fazem muito é no excel. A maioria fica no caderninho. Aí perdem, chove e molha, perde tudo as informações. O caderninho é comum em todas [as associações]. Facilita a vida colocando na planilha” (Entrevistado 1).*

Mithas et al. (2011) destaca a necessidade de desenvolver habilidades de adequação da infraestrutura de TI às necessidades organizacionais. As TICs auxiliam na comunicação interna, na otimização dos recursos e gestão (Villas & Macedo-Soares, 2008). As competências se desenvolvidas levam ao êxito em lidar com as informações para atingir os objetivos do negócio (Tarapanoff, Suaiden & Leite, 2002). O desenvolvimento das competências, principalmente das capacidades de usar as TIC e adequar a infraestrutura de TI, dando acesso e melhorando a gestão dos dados, podem proporcionar ganhos às associações, no controle, no planejamento financeiro e na comunicação, evitando situações de perda de tempo e diminuindo custos operacionais. Identificamos que, embora considerada importante, as competências em tecnologia da informação não estão totalmente desenvolvidas na associação. Existe uma infraestrutura de TI considerada adequada para o contexto, com computador conectado à internet, câmera de vídeo e controles eletrônicos, porém pouco se usa ou se busca saber como utilizar os dispositivos eletrônicos. Esta infraestrutura é subutilizada e poderia gerar mais valor para a organização.

6.2.2 Competências em Gestão da Informação

Foi identificado uma carência na capacidade de utilização das etapas do ciclo informacional. Todos os associados entrevistados disseram que documentam as informações da mesma forma, em cadernos e, posteriormente, no computador. Atualmente há um processo deficitário de armazenamento e controle das informações, muitas vezes, informações ou documentos importantes acabam sendo perdidos, acarretando prejuízo à associação. Segundo o entrevistado 5, *“[...]deixávamos as notas tudo aqui. Nossa, já sumiu muito papel aqui [...]. Já perdi muito dinheiro aqui porque somem os papéis”*. Os consultores enxergam resistência quanto à implantação de um processo documental nas associações.

As capacidades de escolha das fontes de informação mais adequadas às necessidades da associação foi a menos presente nas entrevistas. Nas poucas menções, notou-se que os entrevistados associados são dependentes de uma única fonte de informação confiável, ou seja, os consultores ambientais, e vão de encontro com as recomendações de Dudziak (2010), ao destacar ser construtivo procurar informações em diferentes fontes. A ausência da capacidade de escolher fontes de informação pode estar relacionada à carência de fontes acessíveis e confiáveis. Segundo os consultores, há falta de fontes e pessoas qualificadas para fornecer as informações às associações de material reciclável. Como relatado

pelo entrevistado 6, “[...] a primeira ação é pedir orientação dos meninos [da consultoria]. Pedimos a orientação primeiro pra eles”.

Observa-se a retenção de um conhecimento a partir de outras experiências que os associados já possuíam (Santos et al., 2008; Gasque, 2011; Dudziak, 2010). Este conhecimento foi adquirido ao longo do tempo, a partir das experiências vividas na cadeia de reciclagem, seja como catador de rua, gestão ou triagem. No entanto, esta capacidade está relacionada ao conhecimento tácito, que é intrínseco em cada indivíduo. É importante ressaltar que não foi identificado indícios de desenvolvimento desta capacidade no coletivo. Segundo o entrevistado 2, todo o trabalho de gestão é revisado pelos consultores, e os associados não se sentem seguros sem essa revisão. Divergências são analisadas sempre em conjunto: associados e consultores. Na visão do entrevistado 2 “[...] poucas associações têm capacidade [de fazer a gestão sozinha]. Se sentem mais seguros com apoio técnico. É o que a consultoria vem fazendo com algumas”.

6.2.3 Competências em Negócio

As competências em gestão do negócio foram as mais identificadas na associação. A capacidade de utilizar informações para tomar decisões, agregar valor e atingir objetivos organizacionais foi a mais presente. Mesmo a associação não sendo uma instituição que visa prioritariamente lucro, as informações são importantes na tomada de decisões mais assertivas, principalmente quando envolve a negociação dos preços para a revenda de material. Se a competência não continuar a ser desenvolvida, pode-se antever que acordos que acarretem desvantagens à associação venham a acontecer. Há evidências de situações assim no relato do Entrevistado 5 “[...] começou a vender por 4 centavos, depois 6, foi pra 10. Vimos uma planilha que tinha [a informação] de um cara que comprava por 17 centavos, mas tinha que levar lá. Aí negociei com o comprador e ficou por 15 centavos”.

Em relação à capacidade de compreender as próprias necessidades informacionais, a maioria dos associados demonstra ter consciência sobre as informações necessárias e os fatores que precisam para aprimorar a gestão da associação. A diretoria da associação possui alguns controles de presença, entrada e saída de dinheiro, das documentações necessárias mensalmente, mas não conseguem encontrá-las facilmente, ou mantê-las atualizada, e acabam dependendo de ajuda externa. Segundo relato do entrevistado 4, “sem a ajuda deles [consultores] estávamos perdidos. [...] da papelada, financeiro eles cuidam, eles fazem a conta, veem o que está errado, vê o que precisa melhorar”.

A capacidade de agir em conformidade com a ética está relacionada, principalmente, no entendimento de todas as regulamentações que permeiam a área de atuação da associação, como leis municipais, contratos de credenciamento e normas públicas. O entrevistado 6 comentou que “ela [a prefeitura] deu a responsabilidade: eu vou te dar esse recurso, mas em contrapartida tem que seguir aqui, tem um padrão a ser seguido. Se você sair fora desse caminho vai perder”. Identifica-se a valorização quanto a seguir as normas das licenças ambientais, da constituição de associação e da idoneidade na prestação de contas.

A capacidade de perceber o valor da informação se refere à importância que os associados demonstram dar às informações que eles recebem, produzem e que poderiam beneficiá-los. Houve um ponto convergente nas falas dos associados e consultores sobre o valor social das informações que eles produzem, que, se disseminadas externamente, trariam reconhecimento profissional, ambiental e até social perante a sociedade. *“Boa parte da eficiência dessa cadeia depende dos consumidores primários, também precisam ser envolvidos no processo, com alguma informação ou vídeo que mostre a realidade” (Entrevistado 1)*, pois, segundo a prefeitura, *“só se aproveita 20%. 80% do material recolhido vai direto pro aterro [...] um material que deveria gerar renda, diminuiria o volume dos aterros” (Entrevistado 7)*. Essas falas reforçam a visão de Miranda (2004) quando menciona como as raízes culturais de cada indivíduo acabam influenciando o ato de perceber o valor da informação.

7. Considerações Finais

A pesquisa buscou identificar as capacidades baseadas nas competências informacionais que se encontram dentro do contexto de gestão das associações de material reciclável. Foi identificado que as capacidades de gestão do negócio são as mais desenvolvidas, seguidas pelas capacidades de gestão da informação. As capacidades que demandam maior atenção são as relacionadas à tecnologia da informação. Entre as capacidades já desenvolvidas na associação, listam-se: a) capacidade de adequar a infraestrutura de TI; b) incorporar novos aprendizados ao conhecimento prévio; c) capacidade de utilizar informações para tomar decisões, agregar valor e atingir objetivos organizacionais; d) capacidade de compreender suas próprias necessidades informacionais; e) capacidade de agir em conforme com a ética, seguindo as regulamentações vigentes; e f) capacidade de perceber o valor da informação. Por outro lado, as capacidades que demandam maior atenção da associação incluem: a) capacidade de lidar com a tecnologia da informação para gerenciar informações; b) capacidade para utilizar as etapas do ciclo informacional; e c) capacidade de escolher as fontes de informação mais adequadas para as suas necessidades. As capacidades que demandam desenvolvimento geram impactos negativos na gestão das associações, como perda de tempo para realizar o fechamento do balanço financeiro semanal, perda de documentos importantes que acarretam prejuízo financeiro, falhas na segurança da informação e dificuldade de negociação com os compradores de reciclados.

Percebeu-se que muitas das atividades nas associações exigem um conhecimento multidisciplinar, envolvendo saber lidar com as TICs, conscientização e capacitação para reconhecer suas necessidades e desenvolver habilidades focadas em gestão para tomadas de decisão mais assertivas. Neste sentido, as competências se desenvolvidas levam ao êxito em lidar com as informações para atingir os objetivos do negócio (Tarapanoff, Suaiden & Leite, 2002). Tem-se também que as TICs podem ser úteis para diminuir a distância entre o trabalho realizado nas associações e a sociedade (Virgolin et al., 2016, Rolim et al., 2015, Miura & Sawaia, 2013). No entanto, avanços em infraestrutura e no desenvolvimento de competências relacionadas ao uso de TICs nas associações ainda precisam ser alcançados (Bertoli, 2012).

Esta pesquisa apresenta duas contribuições. Primeiro, aponta a importância do desenvolvimento de capacidades em TIC como suporte para o desenvolvimento de processos da cadeia da reciclagem. O desenvolvimento destas associações para atingir plenamente o seu objetivo depende de uma gestão eficaz. O investimento em infraestrutura de TIC e o desenvolvimento de habilidades para usar as TIC são

necessários para o bom funcionamento das associações, evitando perdas e falta de controle. Neste sentido, é importante capacitar os usuários para que se possa aproveitar o potencial oferecido pelas TIC (Cleto, 2009).

Segundo, avança nas discussões sobre como as TIC contribuem nas soluções à problemas informacionais em organizações com condições de trabalho extremas e de vulnerabilidade social. Diante do problema social que é o lixo reciclável, as associações se tornam um ator importante na geração de renda e acolhimento das famílias que estão vulneráveis (Rezende, 2009; Besen, 2011; Bourahli, Kondo, Hedler & Batista, 2011). As TICs se tornam importante na disseminação da informação e do valor social destas associações. Ao compreender a vulnerabilidade existente na gestão das informações nas associações, se destaca a importância de ter a sistematização das informações tanto para as operações da associação, quanto para a divulgação dos dados para a sociedade.

Dentro do campo específico a que essa pesquisa se enquadra, há possibilidades de outros trabalhos que investiguem e indiquem soluções para desenvolver competências informacionais específicas, suas capacidades e conhecimentos, formas de elevarem a autonomia dos associados e os direcionem a entender suas próprias necessidades informacionais. Contudo, a falta de formação básica é uma realidade vivida pelos membros das associações, sendo necessário refletir em como aliar esta realidade com o uso de tecnologia. Outros estudos podem ser realizados a fim de identificar se há outras capacidades a ser desenvolvidas, além daquelas previamente exploradas neste trabalho, trazendo novas contribuições teóricas para o campo de competências informacionais.

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P18: Impact of Security Awareness on Smartphone Security

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Abstract

Smartphones are among the most ubiquitous and indispensable of today's ICTs, with personal devices being used to support both business and personal life, and store and convey the most sensitive and valuable of information. Their protection is therefore important and highly dependent on what people do. Yet many do little to protect their devices. Why this is so, is not clear. Therefore this study seeks to investigate what motivates people to protect their devices. Using Protection Motivation Theory (PMT), this paper introduces a model of the impacts of threat and coping appraisal on smartphone security, and of threat and countermeasure awareness in informing these appraisals. The findings of the model tests are reported, and implications for practice and further research presented.

Keywords: Smartphones, Security, Protection Motivation Theory, threat awareness, countermeasures

1. Introduction

Over the past decades smartphones have become an inextricable part of daily life. Statista (2019)'s forecasts that by 2021 there will be 3.8 billion smartphone users worldwide. Advances in mobile operating systems (Android, IOS) also mean that compared with traditional mobile phones, smartphones can perform far more complicated tasks supporting social media interaction, financial transactions and entertainment, and provide functionality traditionally associated with desktop and laptop computers. Smartphones may therefore collect and store a great deal of personal and even sensitive data including personal contacts, photos, video, and texts as well as financial (e.g. banking and insurance information), medical and biometric data. The increasing use of smartphones by employees to access work-related data and emails also means that non-personal yet confidential information such as business and government data may also be stored on or accessible via their mobile device. These data,

both personal and non-personal, are valuable and increasingly just as important as the information assets held on personal and work computers (Park, et al., 2014).

In recognising the value of data stored in smartphones, the attention of attackers and hackers seeking to illegally access those data has been drawn to these devices. Indeed, smartphone users are finding themselves exposed to many different threats whenever they use their devices, whether these are by way of malicious apps, or threats through public Wi-Fi, viruses, or malware. Indeed, attacks on users' personal data are becoming more frequent, with Kaspersky Lab (2019, 2020) reporting over 8.8 million malicious packages detected on mobile devices for 2018-2019. Over 24,000 malicious mobile apps are blocked from various app stores each day, some are likely to get through. Although advances are being made in data-centric security and countermeasures for smartphones, keeping devices safe is a challenge given the increasing threats. The importance of the individual's role in securing their devices cannot be understated. To reduce the impact of the threats that smartphone users face, it is essential to improve device security by implementing appropriate countermeasures.

Information security awareness can help reduce the vulnerabilities that users face. Indeed, strong cybersecurity awareness along with adequate preventive actions can be one of the most cost-effective ways for individuals to safeguard themselves from cybersecurity threats (Koyuncu & Pusatli, 2019; Whitman & Mattord, 2018). However studies of the security awareness of smartphone users and their security practices have found these inadequate (Das & Khan, 2016; Mylonas et al., 2013). Furthermore, most studies of security practices focus on employees and workplace settings including BYOD and compliance with organisational policies (Ameen, et al., 2020; Hanus & Wu, 2016; Johnston & Warkentin, 2010); some have also examined smartphone protective behaviours of employees (Ameen, et al., 2020; Das & Khan, 2016), but few emphasise personal devices (Verkijika, 2018). Focusing on personal smartphone devices, this study examines the impact of information security awareness on factors that motivate people to improve security of their devices.

2. Prior Research and Model Development

Information security awareness refers to individuals' understanding of the relevant risks of cyber threats toward information assets and preventive actions that can help eliminate or reduce these threats (Hanus & Wu, 2016; Koyuncu & Pusatli, 2019; Whitman & Mattord, 2018). These include cybersecurity threats such as viruses, malicious apps and spyware, and countermeasures such as use of anti-virus software and a VPN on public wifi. Prior studies suggest people are the weakest link in cybersecurity, as many precautionary actions are only effective when properly adopted by people (Hanus & Wu, 2016; Whitman & Mattord, 2018).

Drawing on Protection Motivation Theory (PMT) and research on user security awareness (Hanus & Yu, 2016; Johnston & Warkentin, 2010; Rogers, 1975) this study suggests a model of smartphone security focusing on security awareness and behaviour. As the technology becomes more embedded in our everyday lives and the threat environment more complex, the task of

protecting one's devices effectively is compounded. As such it is important to determine to what extent individuals' awareness of potential threats to smartphones and the countermeasures inform their security responses. More specifically, this study will examine the influence of threat and countermeasure awareness and people's appraisal of threats to their smartphones and their coping ability, to inform practice and research.

2.1 The Research Model

Protection Motivation Theory (PMT) is rooted in expectancy theory and was developed in the health field to show how fear appeals impact peoples' attitude and behaviour (Rogers, 1975). Although the initial focus of the PMT was on fear appeals, the model has been successfully used to examine decision-making related to risk and preventive behaviours including security behaviour (Floyd, et al., 2000; Johnston & Warkentin, 2010). Two key appraisals under the PMT determine people's motivation to take protective actions: (i) *threat appraisal* which evaluates the risk of not taking action – this includes an appraisal of one's *vulnerability* to the threat and the consequence (*severity*) that may derive should the threat be realised, and (ii) *coping appraisal* which looks at ones' ability to reduce and even eliminate identified threats – this includes beliefs in one's ability to take protective action (*self-efficacy*) and the extent to which protective actions would be effective in reducing the threat (*response efficacy*).

In addition to core constructs in the PMT, research suggests *information security awareness*, that is, an individual's knowledge of security threats and the steps (*countermeasures*) that can reduce or eliminate the threats, would influence the threat and coping appraisals respectively (Hanus & Yu, 2016; Martens et al., 2019). These relationships are represented in Figure 1.

2.2. Hypothesis Development

A key element of protection motivation theory is the threat appraisal which comprises *perceived vulnerability* and *perceived severity*. Perceived vulnerability refers to a persons' belief that the threat applies to their situation or is likely to occur, and perceived severity refers to the degree to which they believe its impact will bring harm (Boss et al., 2015; Johnston & Warkentin, 2010). More specifically for this study perceived vulnerability is conceptualised as individuals' belief in the probability of smartphone security events occurring, such as a data breach or theft of sensitive information, while perceived severity refers to the degree of harm that might occur. Prior research suggests that perceived vulnerability and severity can impact people's security actions such that if persons believe their smartphones are subject to potential security breaches and that this will bring harm to them they are more likely to take actions to reduce the threat and protect their devices (Boss et al., 2015; Thompson et al., 2017). Hence:

H1: Perceived vulnerability is positively related to smartphone security intention

H2: Perceived severity is positively related to smartphone security intention

Response efficacy and self-efficacy are key aspects of the coping appraisal. *Response efficacy* refers to an individual's belief that preventative methods would be effective, while *self-efficacy* refers to people's beliefs that they are capable of carrying out the preventative action. In the non-work setting, some studies show that response efficacy and self-efficacy influence security behaviours (Liang & Xue, 2010). Other studies are mixed. For example, while Thompson et al (2017) and Verkijika (2018) found self-efficacy had a strong impact on mobile device security intentions, response efficacy was not significant. On the other hand,

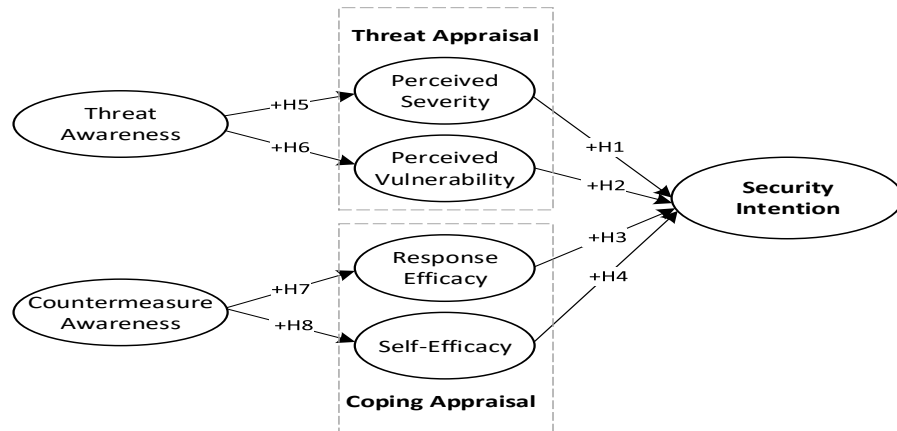


Figure 1: The Research Model

Martens et al (2019) in a study of cybercrimes found that response efficacy had a direct and significant impact on attitude towards security protective behaviour but self-efficacy did not. Taken together these studies suggest the importance of context and that the coping assessment needs to be relevant to the individuals' situation. So for a positive coping appraisal to occur people must believe they are capable of taking action, and that the action would be effective. Hence it is expected that:

H3: Response efficacy is positively related to smartphone security intention

H4: Self-efficacy is positively related to smartphone security intention

Threat Awareness and Countermeasure Awareness. Prior research points to the importance of security awareness including awareness of potential threats and countermeasure awareness (Hanus & Wu, 2016; Martens et al., 2019). In this study, these are expected to impact security behaviours through their impact on informing the threat and coping appraisals. Hanus and Wu (2016) define *threat awareness* as a person's awareness of the threats that can negatively impact smartphone security, while *countermeasure awareness* refers to peoples' awareness of countermeasures (or preventative actions) that can eliminate or minimise the risks associated with

threats to smartphone security. For threat awareness, it is expected that as people's familiarity with potential threats increases they are better able to recognise and evaluate (appraise) threats to smartphone security, both in terms of vulnerability to such threats and the consequences that may arise in the likelihood of a security breach (Hanus & Wu, 2016; Martens et al., 2019). Further, it is expected that greater familiarity with smartphone security practices will help individuals be more confident in their ability to take steps to secure their devices (self-efficacy), and in the effectiveness (response efficacy) of such steps in protecting their devices (Hanus & Yun, 2016; Martens et al., 2019;). Hence:

H5: Threat awareness is positively related to perceived vulnerability.

H6: Threat awareness is positively related to perceived severity.

H7: Countermeasure awareness is positively related to response efficacy

H8: Countermeasure awareness is positively related to self-efficacy.

3. Data Collection, Analysis and Results

This paper provides insights into the research model using data collected from 62 persons, 18 years and over who own a smartphone. 40.3% were male, and 53.2% female (4 selected Other/Prefer not to say); most were 18-24 years (58.1%) and 25-34 years (33.9%), and had an undergraduate or postgraduate degree (77.4%).

Partial Least Squares (PLS) path modelling (PLS-PM) supported by SmartPLS 3.2.7 and bootstrapping (with 1000 resamples) was used to assess the model. Measurement items (Table 1) were adapted from existing sources: perceived vulnerability (3 items), perceived severity (3 items), response efficacy (3 items), self-efficacy (3 items), threat awareness (3 items), countermeasure awareness (4 items) and smartphone security intention (2 items) (Hanus & Wu, 2016; Ifinedo, 2012; Johnston & Warkentin, 2010; Verkijika, 2018). Responses were recorded on 7-point Likert scales with Strongly Disagree/Agree as end-points.

Five constructs were modelled as reflective (i.e. response efficacy, self-efficacy, perceived vulnerability, perceived severity and intention) and two constructs as formative (i.e. threat awareness and countermeasure awareness). For the reflective constructs, item loadings ranged from 0.717 to 0.927 satisfying the suggested threshold of 0.70 (Hair et al., 2017). Composite reliability values ranged from 0.842 to 0.904, and average variance extracted (AVE) from 0.642 to 0.825, suggesting adequate convergent validity. The results also showed construct AVEs were greater than the squared correlations among the constructs; item loadings also exceeded the cross-loadings, indicating adequate discriminant validity (Hair et al., 2017). The heterotrait-monotrait (HTMT) ratio of the correlations was also evaluated. All values were below 0.85 suggesting discriminant validity (Hair et al., 2017).

For the formative constructs, indicator weights and loadings and collinearity (VIF values) are evaluated (Hair et al., 2017). The results showed VIF of less than 5, suggesting collinearity was not an issue. Loadings, which reflect the absolute importance of the indicators ranged from 0.481 to 0.961 with one item measuring threat awareness (0.481) falling just below the recommended lower threshold of 0.50. Indicator weights signal the relative importance of each item; only one item measuring countermeasure awareness (i.e. installing operating system updates) was significant. Since all items represent common security threats and countermeasures and were important to the awareness constructs, with only one item falling just below 0.50, they were retained (Hair et al., 2017; Hanus & Wu, 2016).

Construct	Sample Item
Perceived Severity	A security breach on my smartphone would be a serious problem for me
Perceived Vulnerability	I am facing more and more information security threats on my smartphone
Response Efficacy	Implementing security measures on my smartphone is an effective way to prevent hackers
Self-Efficacy	Taking the necessary security measures to protect my smartphone is easy
Threat Awareness	Please indicate how familiar you are with each of the following: e.g. virus, malicious apps.
Countermeasure Awareness	Please indicate how familiar you are with each of the following: e.g. anti-virus software
Security Intention	Over the next three months, I am likely to implement security measures on my smartphone

Table 1. Sample Items

For the structural model, the results showed 0.306 of the variance explained intention towards smartphone security. Perceived vulnerability (H2, 0.346, $p \leq 0.05$) and self-efficacy (H3, 0.412, $p \leq 0.05$) were significant; response efficacy was not significant (H4, 0.120). Perceived severity was significant (H1, -0.299, $p \leq 0.10$) but not in the expected direction. For coping appraisal, countermeasure awareness explained 0.173 and 0.114 of the variance for response efficacy (H7, 0.416, $p \leq 0.05$) and self-efficacy (H8, 0.337, $p \leq 0.05$) respectively. Threat awareness was not significant for threat appraisal; H5 and H6 were not supported.

4. Discussion and Conclusion

Focusing on smartphones this study proposes a model that aims to understand what motivates people to take actions to secure their devices against cyber threats. To do so, core constructs from the PMT are combined with threat and countermeasure awareness as key sources that inform the threat and coping

appraisals. Similar to prior research, the analyses provide some support for the proposed model suggesting the importance of user awareness of countermeasures so they can appraise their ability to cope with security threats (Hanus & Wu, 2017; Martens et al., 2019). However, response efficacy did not have a significant impact on security intention. This mirrors results found by Thompson et al (2017) and Verkijika (2018). Why this may be so is not entirely clear and requires further exploration. One explanation Verkijika (2018) is that response efficacy may have a limited impact on security intentions in the mobile context. For example, people may believe the protective actions available to them are limited in securing their devices.

For the threat appraisal, the findings did not show a significant link between threat awareness and the threat appraisal. This was unexpected and suggests further work is needed to better understand the threat awareness of people and its impacts. Indeed while people may be aware in general, that there are risks to their mobile devices, their familiarity with specific risks may be low (Koyuncu, & Pusatli, 2019), and could be a reason for the non-significant effects. For the threat appraisal itself, the results suggest perceived vulnerability is significant such that if people believe they could be a victim of a threat they are likely to take protective action. On the other hand, perceived severity was negatively related to protective intentions suggesting that the more severe the threat, the less likely people are to take action. This is unexpected, but like response efficacy, this may signal a sense of helplessness such that people may believe that as the severity of security threats rise they are less able to address it.

This study provides insights for theory and practice. For example, this study suggests a negative relationship between perceived severity and security intentions; this was unexpected. Coupled with the non-significance of response efficacy, the findings suggest that as the cyber threat environment becomes more complex and impactful people may believe their actions are not effective, and do little to protect their devices. This is problematic given the increasing value and sensitive nature of the data stored on smartphones. How this poor response towards device security can be mitigated warrants further investigation. For practice the results signal the need for mobile service providers to provide mobile security awareness programs that inform people of the threats and countermeasures. Such programs should also assure people not only of the efficacy of the solutions available to them, but also that their actions are just as important in mitigating threats against their devices.

There are also opportunities for further work. First, the study entailed a small sample which largely comprised persons under 35 years, who as digital natives may be more optimistic than others concerning their knowledge of the threat environment and ability to cope with security threats (Gkioulos et al., 2017). Extending the study to a more diverse sample or other groups, such as older people will help strengthen the findings and provide further insights into smartphone security behaviour. The unexpected findings regarding threat awareness and perceived severity also require further exploring to understand and mitigate the potential for non-action as the severity of the threat environment increases. Factors such as response cost (Verkijika, 2018) may also improve understanding of smartphone security behaviour further.

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P19: Innovation Capabilities and the role of Strategic Intelligence

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Abstract

In rapidly changing environments, innovation allows firms to maintain their market competitiveness. A firm with well-developed innovation capabilities stands a better chance to sustain its competitiveness. Additionally, strategic intelligence practices will also contribute to positive results, as a firm's economic sustainability depends on installed processes to obtain informational elements coming from the external environment to support its decision-making process. In this way, innovation often benefits from intelligence processes, especially when it provides new knowledge, monitors technological trajectories, and expands understanding of the external environment. To survive in a competitive market a firm needs innovation capabilities and strategic intelligence practices, but how are they related? Firms that are proactive in terms of their strategic intelligence practices have more developed innovation capabilities when compared to those reactive ones? This study aims to identify whether firms with activities associated with the strategic intelligence process differ in terms of their innovation capability level, verifying differences when comparing reactive and proactive groups. We analyzed secondary data of 1,331 Brazilian manufacturing firms. From the analysis, we have identified that development, operations and management capabilities are higher in those firms where there are strategic intelligence practices in place.

Keywords: Strategic Intelligence, Innovation Capabilities, Decision-Making, Proactivity.

1. Introduction

New products, new production methods, new forms of organization and new markets are different ways of perceiving innovation as a result of the change efforts made by companies. The neo-Schumpeterian tradition, even based on Schumpeter's main pillars (1911 and 1942), goes further. More than the 'novelty'

itself, innovation must be perceived as a behavioral and evolutionary process (Nelson & Winter, 1982; Teece et al., 1997; Zawislak et al., 2012; Nelson et al., 2018). Data, information and knowledge must be intertwined with resources, routines and practices to give rise to different arrangements of intelligence, creativity and innovation capability. From the development of new products through commercializing them, including their operations and the firms' management (Alves et al., 2017), innovation capability is the "ability to absorb, adapt and transform a given technology into specific operational, managerial and transactional routines that can lead a firm to Schumpeterian profits, i.e., innovation" (Zawislak et al., 2012, p.23). In short, innovation depends on the behavior of companies, which can determine their attitude towards changes in the environment (Nieto et al, 2015). Studies have shown that proactive and reactive strategic behaviors have different effects on innovation (Fan et al, 2013). There are proactive companies, which anticipate the movements of the environment, define markets, face the future as something to be built; and there are reactive ones, more deterministic, followers, who see the future as something defined, to which they must adapt (Shankar, 2006; Chen et al., 2012). Environmental monitoring, early detection capabilities, and innovation capability were identified by Helfat and Raubitschek (2018) as three critical dynamic capabilities to the strategic organizational context. The first two are closely related to strategic intelligence activities. The principle of strategic intelligence is that firms' economic sustainability depends on installed processes to obtain informational elements coming from the external environment to support the firm's decision-making process (Aguilar, 1967; Ansoff, 1975; Mintzberg, 1994; Day & Schoemaker, 2006; Lesca & Lesca, 2014). By origin an activity associated with the proactive behavior of organizations and environmental attention activities which convert signals into strategy (Ramirez et al., 2011).

In consequence, innovation benefits from intelligence processes because it provides new knowledge, identifies new opportunities, monitors technological trajectories, and expands understanding of the external environment (Cainelli et al., 2019). As a matter of fact, it is our major assumption that, to survive in competitive markets, companies need both innovation capabilities and strategic intelligence practices. What, however, and to the best authors' knowledge, is not yet fully understood by the literature is how innovation capabilities are in fact related to strategic intelligence practices. How strategic intelligence practices play a role in innovation capabilities? Do proactive companies in terms of their strategic intelligence practices have more developed innovative capabilities than reactive ones? These questions led us to investigate whether strategic intelligence may have an influence on the level of innovation capabilities when comparing the reactive and proactive groups. Thus, this study aims to identify whether firms with activities associated with the strategic intelligence process differ in terms of their innovation capabilities' level, verifying differences when comparing reactive and proactive groups. For this purpose, we analyzed secondary data from 1,331 Brazilian manufacturing companies, based on the Innovation Capabilities Model (Zawislak et al., 2012).

In the following sections of the article, we present some of the theoretical foundations of innovation, innovation resources and capabilities, strategic intelligence and decision-making associated with firms' proactive and reactive behavior. In the methodological procedures, we explain how we use the independent sample t-test to analyze the data. Then, we discuss the results to finally present the conclusions of our study.

2. Background

Innovation is related to change and novelty (Schumpeter, 1942; Nelson & Winter, 1982; Dosi, 1988; Nelson et al., 2018). Especially in rapidly changing environments, the innovative transformation has a clear value in sustaining competitiveness (Amit & Schoemaker, 1993). To survive, a firm needs to be in constant change and innovation capabilities have the key role to lead that process (Cohen & Levinthal, 1990; Lall, 1992; Bell & Pavitt, 1995; Teece et al., 1997; Augier & Teece, 2007; Zawislak et al., 2012). Firms might have stronger or weaker levels of capabilities, which, in turn, makes them more or less capable to pursue innovative outcomes. It is our assumption that firms with developed strategic intelligence processes, focusing on early warnings and anticipation (Lesca & Lesca, 2014) of potential threats and opportunities, can react proactively in the field of decision-making and, thus, may present stronger levels of capabilities.

2.1 Innovation Capabilities

Any firm is a collection of resources (Penrose, 1959). From tangible, such as machinery and equipment, to intangible, such as human capital and knowledge, the arrangement of such resources results in the development of new products, processes, management and marketing solutions. It is the successful arrangement of resources that will reflect on any firm's economic performance (Wernerfelt, 1984). From this resource-based view, Nelson and Winter (1982) had enlarged the approach by considering that innovation will further depend on specific routines and skills. The combination of certain resources, the adapted routines and the special skills to run them all should allow any firm to be dynamic and to timely adapt to the constant market changes. This ensemble of resources, routines and skills summarizes the concept of capabilities.

In short, innovation might be understood as the result of a set of complementary capabilities (Wonglimpiyarat, 2010; Forsman, 2011). Capabilities were, first, considered as focused on the technological issues of the firms. Technological capabilities are the way to better understand how firms deal with technical progress and change (Lall, 1992; Bell & Pavitt, 1995; Helfat, 1997). Here, innovation is majorly considered as the result of investments in technological development (R&D activities), mainly new products and processes. In that sense, firms would be more or less innovative, depending on the complexity of their technological activities (Lall, 1992). Furthermore, from an organizational and business orientation, researchers tried to understand how firms built their strategies, made their decisions and allocated their resources in order to innovate (Pralhalad & Hammel, 1990). In other words, they aimed to understand organizational change.

Teece et al. (1997, p. 516), by linking resource-based view with technological and organizational capabilities approaches, left the static environment approach to a changing one and defined dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments". According to Dosi and Marengo (2000), dynamic capabilities cannot simply be built by sole investment in research and development (R&D). As the competitive pace quickens, coordination between R&D and the firm's strategic business functions, as well as with suppliers

and alliance partners, is increasingly essential to identify and link technological options to market opportunities. This highlights the importance of coordination and transaction capabilities as complements to technological capability (Tello-Gamarra & Zawislak, 2013). If technological capabilities emphasize R&D and operations, dynamic capabilities highlight the importance of management and strategy (Dutrénit, 2000). These studies have been important to depict the innovative behavior of the firm (Nelson et al, 2018). However, there is still no unanimity on what are the capabilities that ensure survival and superior performance, nor a consensus on the ultimate definition of innovation capability as a meta-capability. Innovation capabilities include firms' abilities, knowledge, skills, and routines to convert knowledge into technology and thus into a business (Zawislak et al., 2012). The different ways of building innovation capabilities are in the essence of the heterogeneity of firms (Reichert et al., 2016).

One of the first innovation capabilities models that tried to evaluate the firm in terms of both its technological developments as well as its organizational changes was Guan and Ma's (2003). They say the firm is the result of seven capabilities. Further studies have tried to simplify the model without losing comprehensiveness (e.g. Francis & Bessant, 2005; Yang, Marlow & Lu, 2009; Zawislak et al., 2012). For Zawislak et al. (2012, p. 17), the innovation capabilities are "the technological learning process from the firms translated into the technological development and operations capabilities, as well as the managerial and transactional routines represented by the management and transaction capabilities". In this article we use the model proposed by Zawislak et al. (2012, 2013) (Figure 1).

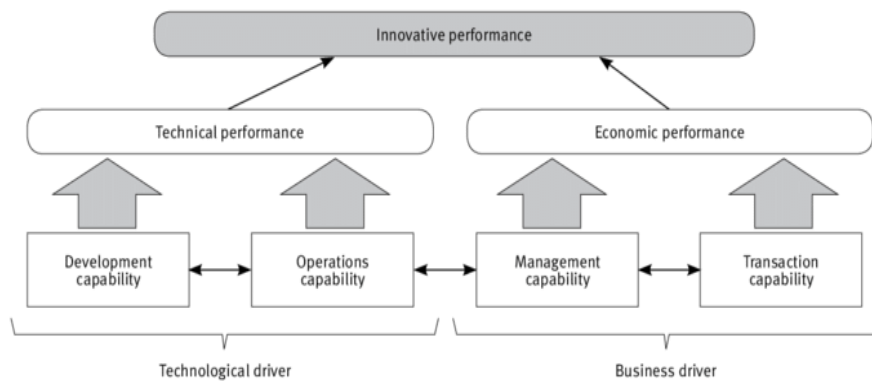


Figure 1: Innovation capabilities of the firm (Source: Adapted from Zawislak et al., 2012, 2013)

The choice of the Zawislak model (2012, 2013) was based on three aspects. First, the chosen model avoids technological bias by presenting a balanced view of the firm: the coexistence of a technological driver with a business driver. Second, the building blocks of the model are derived from the Schumpeterian theoretical definition of innovation (i.e. development, operations, management and transaction capabilities). And third, without losing theoretical robustness, the model is easy to apply to different sectors. Therefore, as suggested by Zawislak et al. (2012, 2013), the four-fold capabilities model covers

the key aspects underlying any firm's existence. In short, the firm is hereinafter viewed as a technological set of products and processes that works under a specific business model and a management arrangement, to trade and profit from the market. Those are its capabilities to combine resources, routines and skills in order to reach successful competitive performance.

Although there are differences in the approaches that involve the concept of innovation, the importance of an institutionalized process that seeks information from the external environment in order to increase organizational innovation performance is recognized (Borges et al., 2019; Cainelli et al., 2019). According to Tsoukas and Shepherd (2004), creating and maintaining a high-quality, coherent and functional prospective view can generate useful insights for innovation. Janissek-Muniz (2016) reinforces that, just as threats arise due to the instability of the environment, opportunities can also emerge from it, offering the organizations that monitor it the possibility of innovating their business by collecting, interpreting and using relevant information. This process is recognized as a set of strategic intelligence activities, systematized in the firm that learns from the environment and transforms information, knowledge and technology into an organizational endeavor and successful business. This is innovation.

2.2 Strategic Intelligence

Strategic Intelligence is understood as a process of transforming information from the firm's relevant environment into strategies. The identification and use of strategic intelligence can potentially increase competitiveness, using pertinent information to support the decision-making process in organizations (Svensson et al, 2011; Nadarajah et al, 2014). Strategic intelligence consists in processes that help monitoring events in the external environment of the organization, identifying potential risks or opportunities (Dou et al, 2019). The major importance of this process is to feed decision-making, allowing to establish proactive actions to respond to environmental changes in an early movement (Alhamadi, 2020). A broad definition of strategic intelligence involves a set of necessary skills to conduct strategic actions. Strategic intelligence allows the company to perceive, analyze, interpret and generate information based on signals from the business environment (Mandel & Barnes, 2014). Based on learning from monitoring the environment, through processes of transforming data into knowledge, it sustains strategic decision-making for competitiveness. It is the relationship between different information in a continuous way to develop strategies through intellectual resources around information processing (Rossel, 2012; Lesca & Lesca, 2014; Muhlroth & Grottko, 2018; Miller et al, 2018; Joseph & Gaba, 2019).

When analyzing information through a systematic process, they enable their positioning and future planning, anticipating decisions in the face of changes in the business environment (Dou et al., 2019). Strategic intelligence generates advantages by providing better, fact-based decision-making, in addition to improve the monitoring of its internal performance, although there is the challenge of measuring results considered intangible (Pellissier & Kruger, 2011). The role of strategic intelligence is to reduce the degree of uncertainty existing at any time to adopt a specific strategic decision (Seitovirta, 2011; Marín, 2020).

2.2.1 Strategic Intelligence as a Proactive Decision-Making Process

Strategic intelligence, by its nature, is a proactive process, giving to the company that adopts it a proactive feature (Lesca, 2003). In the decision-making process, decision-makers generally use arbitrariness based on their experience and intuition, rather than using a technique that can be improved with a systematic intelligence process (Simon, 1972; Corso et al., 2014; Borges et al., 2019). This is the difference between an individual approach, in which the proactive behavior comes from one professional, from a systematized process, that characterizes the company as a whole (Borges & Janissek Muniz, 2017). Glueck and Jauch (1984, *apud* Larson et al, 1986) define a proactive strategy as one in which strategists act before they are forced to react to environmental threats or opportunities.

In a systematized intelligence process (Cainelli & Janissek-Muniz, 2019), proactivity is favored, as it allows the decision to be based on information resulting from this process. In a decision-making process, proactivity is initially understood as a thought process (Weick, 1983), and the relationship between strategic intelligence and decision-making occurs, therefore, in the aspect of reducing uncertainty (Fleischer & Bensoussan, 2003). By accepting to work with degrees of uncertainty (Moreno et al, 2016), the decision-maker benefits from the use of prospective information, also known as weak signals (Aguilar, 1967; Lesca, 2003).

To expand the use of this type of information, so that decision-making becomes more proactive, the need for strategic intelligence is recognized (Corso et al, 2014). Once analyzed through strategic intelligence processes, signals can become relevant for decision-making and innovation (Bessant & Tidd, 2009). Through these processes, proactive firms can anticipate environment movements, define markets, and face the future as something to be built (Chen et al., 2012; Shankar, 2006), which have positive effects on innovation (Fan et al., 2013).

2.2.2 Strategic Intelligence and Innovation

The need for firms to innovate arouses interest in the use of strategic intelligence and the development of studies to identify how intelligence processes act in the innovation process of organizations (Sarpong & Meissner, 2018; Cainelli et al., 2019). In other words, when developing the innovation process, companies should look for signs that allow the generation of innovation, which can be improved through intelligence processes. Information-based activities enable a wide scan, especially in areas where uncertainty and change are perceived in high levels, such as technology, consumer preferences and environmental impact (Borjesson et al., 2006). The recognition that the environment is a vital source of information for developing new ideas enables companies to identify future opportunities in time, and be proactive to detect threats or problems, aiming at the implementation of structural or strategic changes to their products and services through strategic monitoring (Augier et al., 2018).

The ability to innovate appears as one of the topics that have attracted the most attention in research related to intelligence. Studies emphasize the importance of strategic intelligence for innovation, suggesting a positive relationship between both (Ramirez et al., 2011; Rohrbeck & Gemünden, 2011; Ruff,

2015). The intelligence literature generally identifies positive relationships of this process that may influence the development of new products and/or technological advancements (Ramirez et al, 2011; Vishnevskiy et al., 2015). Although there is a consensus that continuous performance of strategic intelligence mechanisms improve the firm's innovative performance (Vecchiato & Roveda, 2010), there is also skepticism about how it affects it. Duan and Cao (2015) point out that using the strategic value of this process in decision-making remains as a challenge in current innovation practices. Vecchiato and Roveda (2010) also argue that the formulation of an optimal innovation strategy is the function derived from an effective intelligence process. According to Jahn and Koller (2018), engaging in strategic intelligence processes can be beneficial for any company's future-readiness. Thus, it works as a facilitator for innovative thinking.

As strategic intelligence and innovation both facilitate novelty in future market environments, strategic intelligence can be utilized to generate anticipatory intelligence for gaining insight on future customer needs (Ruff, 2006; Jahn & Koller, 2018). In addition, Capatina et al. (2016) point out that strategic intelligence is at the service of innovation as it helps to find alternative solutions to emerging challenges in the environment and helps to find the blind spots in the innovation process. They also argue that innovation benefits from the intelligence process when it provides access to new knowledge, identifies opportunities for diversification of the innovations themselves, monitors technological trajectories, explores different business models and expands understanding of the external environment. In sum, the systematic practice of strategic intelligence enables the reorganization of information in order to generate meaningful, future-oriented knowledge capable of developing narratives of how it can unfold and how to position innovations in these scenarios (Adegbile et al., 2017).

Despite many approaches already devoted to innovation capabilities, from the point of view of strategic intelligence, it seems that the innovation-information relationship is not yet much addressed (Goria, 2018). It seems important to be able to point to the information and knowledge requested or produced during an innovation process to help understand how they are interpreted and used. To be effective, the intelligence process must be considered from a strategic and informational standpoint when the innovation process must result in the production of something with a competitive advantage, be it technological or organizational. The thing is to provide relevant information, ideas and prototypes at a time that allows action and, if possible, resulting in innovation processes (Goria, 2018; Jahn & Koller, 2019).

Innovation has been found as a result of many processes, including intelligence activities and innovation capabilities. Intelligence is an important factor in generating larger profitability and market valuation growth (Hojland & Rohrbeck's, 2017), i.e., innovation, however, the reach of this effect has not been measured yet in terms of innovation capabilities. Meanwhile, different combinations of innovation capabilities also reflect different levels of innovative performance (Reichert et al., 2016). In this sense, both activities are intertwined, but the details of these relations still need to be explored. Thus, considering that companies with proactive processes may create positive effects on innovation (Fan et al., 2013), there is still the need to understand if the proactiveness of the intelligence processes relates to the level of the companies' innovation capabilities - as opposed to any intelligence process, even reactive, being able to generate innovative outcomes.

3. Methodological Procedures

This study uses secondary data from 1,331 manufacturing firms in Brazil, collected through a survey by NITEC Innovation Research Center (for further details, see Reichert et al., 2016; Alves et al., 2017). The study aimed at identifying the innovation capabilities arrangements that lead firms to achieve superior performance. The survey was based on the Innovation Capability Model (Zawislak et al., 2012), gathering information on four innovation capabilities: development, operations, management and transaction. The survey collected additional information about the manufacturing firms, including the question used in the present study as a proxy for strategic intelligence. The intention of the present study is not to discuss the components of each innovation capability (development, operations, transaction and management), since it is a validated model in previous studies (Zawislak et al., 2012; Zawislak et al., 2013; Reichert et al., 2016; Alves et al., 2017).

The present study does not concern the formulation of an innovation capabilities model *per se*, but rather, the understanding of the relationship between the levels of firms' innovation capabilities and firms' strategic intelligence. It is also not the main intention of this paper to propose changes to the innovation capabilities model, but to use the database applied to the innovation capabilities model to identify different groups of firms in terms of the association of these capabilities and strategic intelligence (i.e., reactive and proactive). It is our proposition that companies that are proactive in terms of their strategic intelligence practices have more developed innovative capabilities than reactive ones.

The question used to represent strategic intelligence concerns the strategic decision-making process of these firms and was chosen because it represents the essence of strategic intelligence, namely information collected in the environment from players relevant to the business, which justifies the use of the question for this study, as follows. "*The decision-making process is based on: (a) tradition; (b) recent performance history; (c) information from clients; (d) information from competitors; (e) information from suppliers and; (f) new knowledge developed internally*". From it, we divided the sample into two groups: firms that have some strategic intelligence procedures in place, which will allow them to have a proactive approach in their decision-making processes, herein called *Proactive Firms* [marked alternatives (c), (d), (e) ou (f)]; and firms that do not have strategic intelligence procedures in place, resulting in a reactive approach to their decision-making processes, herein called *Reactive Firms* [marked alternatives (a) or (b)].

It is our expectation that, when strategic intelligence processes are present in firms, they have a proactive role in their development, operations, management and transaction capabilities. When these procedures are absent, their role is reactive. A proactive role should require higher levels of innovation capabilities to deal with information, decision processes and, hence, to innovate. Alternatively, a reactive role will require basic levels of capabilities to deal with processes on the operational level. The measures related to innovation capabilities are presented in Table 1.

For each item there was a statement to which respondents rated their level of agreement using a five-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5). We then calculated the mean value of each capability for each firm. To verify if there is a significant difference in the mean values between both groups, Reactive and Proactive, we performed an independent sample t-test, which is used

to test the hypothesis that the variable means associated with two independent groups are equal (Hair et al., 2005). The t-test compared the means for each innovation capability in each group (reactive/proactive).

Innovation Capability & Items	
<p>Development Capability (DC):</p> <ul style="list-style-type: none"> ● Product Prototyping ● Product Launching ● Product Design ● Technology Monitoring ● Technology Adaptation 	<p>Management Capability (MC):</p> <ul style="list-style-type: none"> ● Financial Management ● Updated Management Tools and Techniques ● Formal Strategy ● HR Training
<p>Operations Capability (OC):</p> <ul style="list-style-type: none"> ● On-time Delivery ● Rework ● Product Return ● Production Planning 	<p>Transaction Capability (TC):</p> <ul style="list-style-type: none"> ● Prices Definition ● Customer Negotiations ● Supplier Negotiations ● Suppliers Selection

Table 1: Items of each Innovation Capability (Alves et al., 2017)

4. Result Analysis

In order to identify if there are differences in the mean of each innovation capability when comparing firms with strategic intelligence procedures in place (proactive firms in terms of their decision-making process) with those without strategic intelligence procedures (the reactive ones), we present results for the independent sample t-test. The Proactive firms are represented by 'P' and the Reactive, by 'R'. Table 2 brings the results of the group statistics.

Group Statistics					
Decision		N	Mean	Std. Deviation	Std. Error Mean
Mean_DC	P	443	3,7750	,79766	,03790
	R	876	3,6120	,85433	,02887
Mean_OC	P	442	4,1151	,52448	,02495
	R	876	3,9386	,55988	,01892
Mean_MC	P	443	3,7648	,63514	,03018
	R	876	3,6836	,62924	,02126
Mean_TC	P	443	3,4807	,76289	,03625
	R	876	3,4593	,70448	,02380

Table 2: T-test Group Statistics

It is noteworthy that, for all four capabilities, Proactive firms have higher means than Reactive ones. Results show, however, that while the TC shows no significant difference in means between both groups (Reactive and Proactive), the other three innovation capabilities, DC, OC and MC, do. In the three

instances, the innovation capabilities means are higher for the Proactive firms. The higher mean, for both groups, is on OC. Of course, manufacturing companies naturally tend to be process oriented. However, in that case, this is probably much more related to the fact that the profile of most of the Brazilian manufacturing companies is operations based (Alves et al, 2017). This is even reinforced by the Brazilian historical strategic focus on investing in process technology rather than on product development (Tironi, 2011). Brazilian data on innovation expenditures are much more related to the acquisition of machinery and equipment than on the launching of new products (IBGE, 2016). The second higher mean, however, differs from one group to another, reinforcing our assumption. For Proactive firms, DC is more important, while, for Reactive ones, MC is more relevant. One should state that proactive firms are willing to search for new ventures and to develop new products while reactive firms would strategically be much more concerned with efficiency and cost. Table 3 brings the results of the Independent Sample test.

Independent Sample Test										
		Levene's		T-test for equality of means						
		F	Sig.	t	df	Sig. (2 tailed)	Mean difference	Std. Error	95% Confidence	
									Lower	Upper
Mean_	Equal variances assumed	4,916	,027	3,345	1317	,001	,16299	,04872	,06741	,25858
DC	Equal variances not assumed			3,421	943,232	,001	,16299	,04764	,06950	,25648
Mean_	Equal variances assumed	,850	,357	5,518	1316	,000	,17650	,03199	,11374	,23925
DC	Equal variances not assumed			5,637	937,686	,000	,17650	,03131	,11506	,23794
Mean_	Equal variances assumed	,514	,474	2,206	1317	,028	,08119	,03680	,00899	,15338
MC	Equal variances not assumed			2,199	880,136	,028	,08119	,03691	,00874	,15363
Mean_	Equal variances assumed	4,475	,035	,507	1317	,612	,02142	,04224	-,06146	,10429
TC	Equal variances not assumed			,494	827,658	,622	,02142	,04336	-,06370	,10653

Table 3: T-test - Independent Sample Test

Proactive firms perform, more frequently and in a more systematic way, activities related to searching for new technologies, developing prototypes of new products, incorporating new methods of production or management systems and techniques. Such elements are directly related to strategic intelligence activities, providing a proactive stance for these firms. Proactive firms are aware of the steps their clients and competitors are taking and, from that, bring new ideas to their own firm with the aim to produce novelties, which will, in turn, allow them to maintain their market competitiveness.

While reactive firms adopt a more deterministic stance, with the behavior of followers, needing to see to believe, in a role of conformism, the proactive ones have a more forward-looking stance, which means that they define the future, anticipate opportunities and threats, open and build their paths, defining the market rules, being more innovative and, by their choices, influencing the environment movements and defining markets. Specifically, the proactive role is traditionally associated with strategic intelligence practices in organizations (Lesca & Lesca, 2014), having positive effects on innovation (Fan et al., 2013).

These findings reinforce the association between proactive companies and strategic intelligence activities, highlighting the importance of these activities in organizations that wish to adopt a more proactive attitude, aiming at increasing their innovative capacity and more assertive decision-making. Interestingly, TC does not show significant difference between the groups of firms. One would expect that being

attentive to the market would allow them to be more proactive. One reasonable explanation is that when an idea is already in the market, it is not new anymore; so strategic intelligence may not play a crucial role in capturing that.

4. Conclusion

The aim of this study was to identify whether firms with activities associated with the strategic intelligence process differ in terms of their innovation capabilities level, verifying differences when comparing reactive and proactive groups. Using an established database with secondary data from 1,331 manufacturing companies in Brazil, collected through a survey by the NITEC Innovation Research Center, we explored relationships that may be associated with strategic intelligence activities.

Within the major objective, we identified that there are two roles of strategic intelligence in terms of innovation capabilities, namely proactive and reactive, which are associated with the innovation capabilities and the use of intelligence by organizations. Both roles depend on the innovative behavior of companies, which determine their attitude towards changes in the environment. While reactive firms adopt a more deterministic stance, proactive ones have a more prospective stance, anticipating opportunities and threats, and by their choices, influence movements and define markets. This is in line with Lesca & Lesca (2014), who argue that proactive behavior is one of the requirements to execute strategic intelligence in organizations, which takes, according to Fan et al. (2013), positive effects on the capacity for innovation.

We also identified that three capabilities of the model (Zawislak et al., 2012) had higher averages in the proactive group, namely Development, Operations and Management innovation capabilities. In the three instances, the innovation capabilities means are higher for the proactive firms than the reactive ones, which allows us to indicate, through the larger averages, that the level of capabilities of those companies are more developed. On the other hand, TC does not present significant differences between the proactive and reactive ones. We identified that in the TC there was no difference in means and this is probably due to the fact that the market brings what is already “in place” and not showing weak signs, for example. One reasonable explanation for that is that when an idea is already in the market, it is not new anymore, so strategic intelligence does not play a crucial role in capturing that.

Based on the results of this study, there is an association between innovation and strategic intelligence, according to Konnola et al (2007) who state that the anticipation of alternative futures is a fundamental practice in the initial stages of the innovation process. In this sense, there is adherence to the results found also with Heiko et al (2010) who highlights that strategic intelligence enables a way to orient business towards the future and, when associated with innovation, enhancing ways of understanding new demands. In short, it is possible to state that strategic intelligence processes and innovation capabilities of firms are related. They are not only related, but they also differ in level - the higher the proactiveness of intelligence processes, the higher the level of innovation capabilities. These findings should guide decision-makers to implement strategic intelligence processes in their companies. Once they know that innovation capabilities have an impact on firms' innovative performance and that the level of

proactiveness of their strategic intelligence processes also influences that outcome, they are able to develop the most adequate process to their firms. Decision-makers should then take into account that implementing a strategic intelligence process just for the sake of it may not generate the expected results, instead, they must guarantee they will be really acting in anticipation of the market to be able to produce disruptive outcomes, i.e. innovation.

One limitation of our study is the fact that we took secondary data from an innovation survey that had a different purpose than our study. The original survey intended to map the innovation capabilities that lead firms to an innovative outcome, while this one evaluated the level of innovative capabilities for two groups of firms that differ in terms of their strategic intelligence processes. As a suggestion for future research, we could bring together both objectives and detail the differences between proactive and reactive firms, by identifying the innovation capabilities arrangement for each group. Additionally, we could include specific questions for strategic intelligence in the original questionnaire and perform a new survey that would allow primary data to be analyzed. Another limitation of our study is related to the performance of the firms. We have evaluated only the level of their innovation capabilities, but in a future study, it would be interesting to evaluate the differences between proactive and reactive firms in terms of their economic and innovative performance. Besides, we have tested the level of innovation capabilities for proactive and reactive firms uniquely from manufacturing industries and, in that sense, we believe that a broader approach (including services) could enhance our analysis.

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20: INTEGRANDO GERENCIAMENTO ENERGÉTICO E BEM-ESTAR ANIMAL UTILIZANDO APRENDIZADO DE MÁQUINA E VISÃO COMPUTACIONAL

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Abstract

Electricity plays an important part in production costs, but there is a scarcity of systems that consider the production chain as a whole and express all relevant performance indices. This work initiates the integration of two currently independent management systems: PGEN project (from Federal Institute of Santa Catarina, Brazil), focused on energy management of public buildings, and Barn 4.0 project (from Häme University of Applied Sciences, Finland), focused on Animal Welfare Management in the dairy industry. The main results of those two projects are briefly presented, including a system of cows' behavioral activity recognition (interactions, agglomerations, among 8 other classes) using Computer Vision, and a predictive system of electrical consumption using an ensemble of 6 Machine Learning models. We elaborated a conceptual framework of an Integrated Production Management System, also pointing out important directions for future research and the possibilities of applying this system to other industries.

Keywords: Integrated management, computer vision, machine learning, energy management, animal behavior.

1. Introdução

A energia elétrica representa uma parte importante nos custos de produção, e um gerenciamento integrado da produção e do consumo de energia é fundamental para identificar os pontos de maiores custos e que propiciem otimização da produção e eficiência energética. Há uma escassez de ferramentas que permitam as indústrias terem economia significativa de energia, envolvendo integralmente a logística de produção, a otimização da automação dos processos, análise e troca de equipamentos elétricos por outros mais eficientes e um modelo matemático de otimização que trace decisões ótimas de todo o processo. Para tanto, é necessário um sistema de monitoramento e controle detalhado, acessível a todos os interessados e que expresse todos os índices de desempenho pertinentes. Nesse

sentido, a ISO 50001 – Sistemas de Gestão de Energia (*Energy Management Systems – EMS*) (ISO, 2018) recomenda que ações em eficiência energética terão efeitos significativos se forem verificados com precisão e implementadas dentro de um amplo sistema de gestão energética. Esta norma baseia-se em um sistema permanente, cíclico, de medição, estudo e tomada de decisão dentro de um Sistema de Gerenciamento Energético, baseado no ciclo PDCA da ISO 50001 (*Plan, Do, Check, Action*).

O sistema de medição apresentado acima baseia-se, tipicamente, em sensores e variáveis de produção. O uso de Aprendizado de Máquina, uma subárea da Inteligência Artificial (Faceli, Lorena, Gama, & Carvalho, 2011), permite estabelecer padrões e reconhecer com facilidade níveis de desempenho energético e de qualidade de produção de uma indústria. De todo modo, o consumo de energia e a qualidade da produção de uma empresa depende, também, de variáveis subjetivas e/ou de difícil medição. O uso de câmeras de vídeo permite capturar imagens e identificar uma série de outras informações *a-priori* não detectadas, como por exemplo o fluxo de pessoas em um determinado setor ou de animais na indústria pecuária. Ainda, o uso de técnicas de Aprendizado Profundo (Chollet, 2017) possibilita analisar automaticamente essas imagens e identificar padrões comportamentais.

Em particular, a indústria de criação animal já vem utilizando técnicas de Internet das Coisas e Inteligência Artificial em diversos exemplos, como monitoramento da produção de leite, (Steenefeld & Hogeveen, 2015; Thornton, 2010), detecção de agressões entre animais (Viazzi et al., 2014; Chen et al., 2019), identificação de problemas de saúde (Zin, Tin, Kobayashi, & Horii, 2018), suporte ao gerenciamento e à tomada de decisão (Bell & Tzimiropoulos, 2018; Berckmans, 2014), entre outros. Entretanto, para genuinamente agregar valor, abordagens de Indústria 4.0 devem considerar toda a cadeia produtiva (Berckmans, 2014), estendendo o sistema em direção às duas pontas da cadeia: dos campos de plantação, à fábrica de processamento, e ao consumidor final. Apesar da importância de um gerenciamento produtivo integrado, poucos trabalhos vêm avançando nessa direção: (Quevedo, Puig, Escobet, & Pala, 2017) desenvolveu um sistema de gerenciamento de água e energia para processos produtivos de leite, elaborando teoricamente a sua integração com a gestão da segurança; (Aerts et al., 2004) implementou um sistema de controle para o crescimento de aves, usando a ingestão de ração como variável de controle.

Este trabalho apresenta a concepção inicial de um sistema de gerenciamento integrado, a partir da união de dois projetos em desenvolvimento. O primeiro, Portal de Gerenciamento Energético (PGEN) que visa o gerenciamento energético de instituições públicas e indústrias no Brasil (Rodrigues, Zatta, Souza, Espindola, Carvalho, 2016). O segundo, em desenvolvimento na Finlândia, chamado Barn 4.0, visa o uso de câmeras de vídeo e Aprendizado de Máquina para o gerenciamento do bem-estar animal na indústria de laticínios. Ambos, focados em otimizar aspectos importantes dos seus respectivos setores, mas cada qual com objetivos específicos e particulares.

O projeto PGEN é um sistema piloto de Gerenciamento Energético utilizando como norte a ISO 50001, desenvolvido pelo Instituto Federal de Santa Catarina (IFSC), campus Florianópolis, Brasil. Este sistema tem como aspectos competitivos o uso de plataforma web e por utilizar informações disponíveis nos medidores eletrônicos das concessionárias de distribuição de energia. A comunicação entre o medidor eletrônico da concessionária e a interface eletrônica utilizando o protocolo de comunicação definido na NBR 14522 (ABNT, 2000). Por sua vez, o sistema computacional é desenvolvido com servidor para o

banco de dados PostgreSQL e as linguagens PHP, HTML5, CSS3, Javascript.

O projeto Barn 4.0 está sendo desenvolvido em um estábulo leiteiro da *Häme University of Applied Sciences* (HAMK), campus Tammela, Finlândia. Diversas variáveis ambientais, climáticas e físico-químicas (relacionadas ao leite produzido) estão sendo monitoradas, bem como câmeras de vídeo das quais conseguimos analisar automaticamente o comportamento das vacas, utilizando técnicas de Aprendizado Profundo. Dessa forma, o sistema automatiza o monitoramento e análise dos animais, o que por sua vez melhora a qualidade do alimento, sua segurança, sua rastreabilidade e diminui seu impacto ambiental.

2. Projeto de Portal de Gerenciamento Energético (PGEN)

Sistemas de Gerenciamento de Energia (SGE) têm por objetivo trazer informações detalhadas sobre o consumo energético, possibilitando ao consumidor alcançar resultados de longo prazo por meio da compreensão e administração do uso da energia. O projeto PGEN possui três fases de implementação. A primeira fase, chamada Projeto smartIFSC, visou o desenvolvimento do sistema aplicado a alguns campi do IFSC. A segunda fase, teve por objetivo uma prova de conceito para os Ministérios da Educação e do Planejamento do Governo Federal no Brasil, com a instalação de monitoramento de algumas edificações da Esplanada dos Ministérios em Brasília, Brasil. A terceira e atual fase visa a implementação de um portal único que reúna todas as instituições envolvidas e monitoradas.

2.1 Interface eletrônica de comunicação

O envio de dados oriundos dos medidores eletrônicos para o concentrador na nuvem é realizado por uma interface Eletrônica de Comunicação, ilustrada pela Figura 1. A interface recebe os dados via pinos RX-TX e verifica a integridade por meio de *checksum*, com posterior envio ao servidor usando o número de série e uma chave de acesso usando um protocolo de comunicação HTTPS.



Figura 1: Esquema básico da comunicação de dados medidor-interface-nuvem

2.2 Fases de Implementação

O protótipo do sistema de gerenciamento energético foi o smartIFSC, inicialmente para alguns campi do

IFSC. O objetivo é terminar 2020 com todos as 23 unidades educacionais do IFSC atendidas pelo sistema. A Figura 2 ilustra algumas telas desse protótipo: Consumo de Energia e Estatísticas de Consumo. Adicionalmente, em função do Programa para Desenvolvimento em Energias Renováveis e Eficiência Energética na Rede Federal (EnergiF), do Ministério da Educação do Brasil (MEC), há um piloto na Esplanada dos Ministério, em Brasília, na Capital Federal do Brasil, acessado via <http://labsmart.ifsc.edu.br/esplanada>. Posteriormente, também em função da necessidade de instalação de pilotos em outras universidades e em prefeituras, está em desenvolvimento um protótipo expansão do smartIFSC, chamado PGEN - Portal de Gerenciamento Energético (<http://labsmart.ifsc.edu.br/pgen>). A Rede de Institutos Federais possui mais de 500 unidades em todo Brasil (Ministério da Educação, 2020), mas a previsão 2020-2021 é expandir para alguns campi de institutos federais de Minas Gerais, São Paulo, Rio de Janeiro, Paraíba e Goiás.

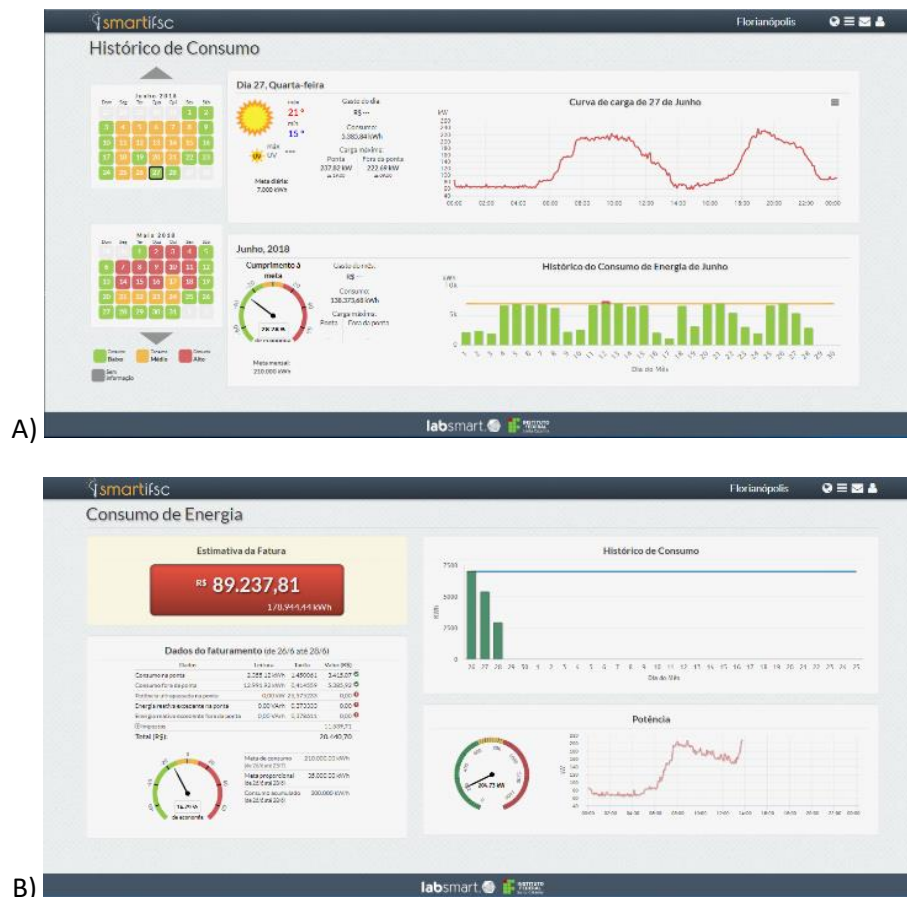


Figura 2: Principais telas do sistema smartIFSC, em ordem: A) histórico de consumo, B) previsão de fatura

2.2 Apresentação e análise de dados

1.1.4 2.3.1 Monitoramento do Consumo de Energia

Um primeiro caso que ilustra a importância de monitorar em detalhes o consumo de energia elétrica está na avaliação do uso da iluminação externa durante a madrugada no campus Canoinhas. A Figura 3 apresenta a carga do campus nos dias 19 de julho e 29 de agosto de 2017. Note-se que o consumo na madrugada era em torno de 30 kW. A gestão do campus não tinha ideia razoável de qual era o consumo na madrugada e qual seria o benefício em desligar a iluminação durante a noite. O campus tomou a decisão de desligar tais circuitos de iluminação as 23 horas. Por sua vez, a carga em 29 de agosto de 2017 ilustra que a carga da madrugada diminuiu para aproximadamente 10 kW. Em média, uma redução de 20 kW por 8 horas/dia (das 23 horas até as 07 horas do dia seguinte), equivale a uma redução de 4800 kWh/mês, aproximadamente.

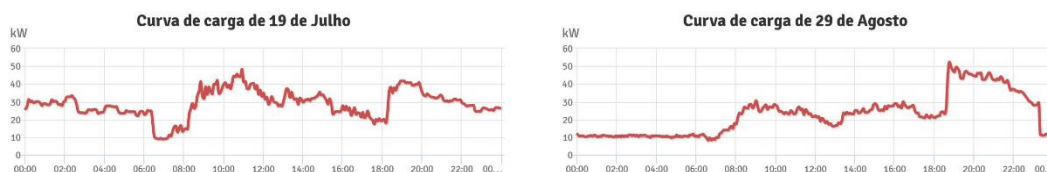


Figura 3: Curvas de carga do campus Canoinhas, 19/07/2017 e 29/08/2017

Por sua vez, a Figura 4 apresenta a curva de carga em 15 e 18 de fevereiro de 2018 do campus Florianópolis. O uso das informações obtidas pelo sistema permitiu calcular níveis ótimos de contratação de potência, evitando multas e sem exagerar no valor contratado. Um outro aspecto importante foi identificar que a carga na madrugada do campus Florianópolis é em torno de 70 kW. Esse valor é maior que os máximos de consumo de outros campi monitorados no IFSC. A partir desta descoberta, há um trabalho intenso de mapeamento de todas as cargas do campus Florianópolis e algumas instalações elétricas estão sendo revistas, identificando o potencial de economia de cargas fixas. O sistema também permitiu evidenciar que a inserção da geração solar fotovoltaica no campus Florianópolis (figura do dia 18 de fevereiro) reduziu a demanda de energia da concessionária durante o dia, que antes era estável em torno de 70 kW nos finais de semana.

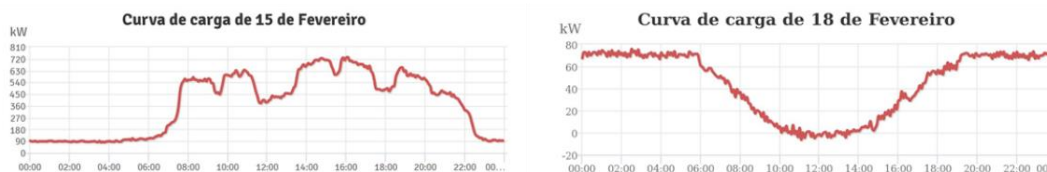


Figura 4: Curva de carga do campus Florianópolis, 15/02/2018 e 18/02/2018

A Figura 5 apresenta as curvas de carga dos Blocos C e K da Esplanada dos Ministérios para o dia 21 de fevereiro de 2019. Pela figura é possível observar que os níveis de potência máxima são próximos a 560 kW e 330 kW, respectivamente. Em particular, o Bloco K possui sistema de ar condicionado central, faturado em outro medidor de energia, o que explica a diferença no consumo de energia. Embora os Blocos C e K sejam apenas dois prédios, o consumo de energia nessas edificações é muito elevado, quando em comparação aos campi do IFSC, por exemplo. Trata-se de um caso com maior potencial de economia de energia, o que reforça a importância de medir com precisão os impactos das ações de eficiência energética.

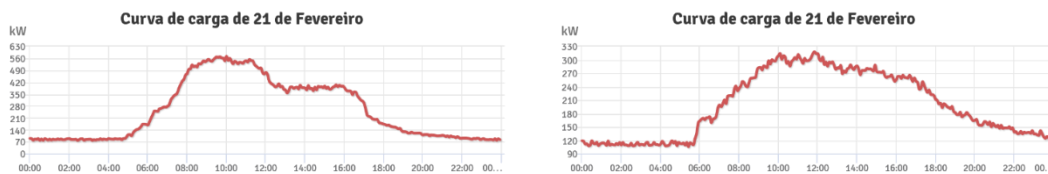


Figura 5: Curva de carga dos Blocos C e K da Esplanada dos Ministérios, 21/02/2019

1.1.5 2.3.2 Aplicação de Aprendizado de Máquina

Para facilitar a análise da grande quantidade de dados coletados, foram desenvolvidas diversas ferramentas baseadas em Aprendizado de Máquina. Em um trabalho anterior (Benitez & Rodrigues, 2019) analisamos a influência que as variáveis climáticas, especialmente temperatura, possuem sobre o consumo elétrico de edifícios. No trabalho (Benitez & Rodrigues, 2020) desenvolvemos um modelo preditivo de consumo elétrico para um prédio da Esplanada dos Ministérios, utilizando 6 (seis) técnicas de Aprendizado de Máquina combinadas pelo método de Generalização em Pilha (Faceli et al., 2011), cuja arquitetura é mostrada na Figura 6, que pode ser usado para:

- Prever o consumo futuro e estimar a fatura de energia.
- Gerar alertas quando o consumo atual estiver acima do esperado, dadas as condições atuais.
- Analisar o impacto de ações de eficiência energética, comparando o consumo pós-ações com o previsto por modelos treinados em dados pré-ações.

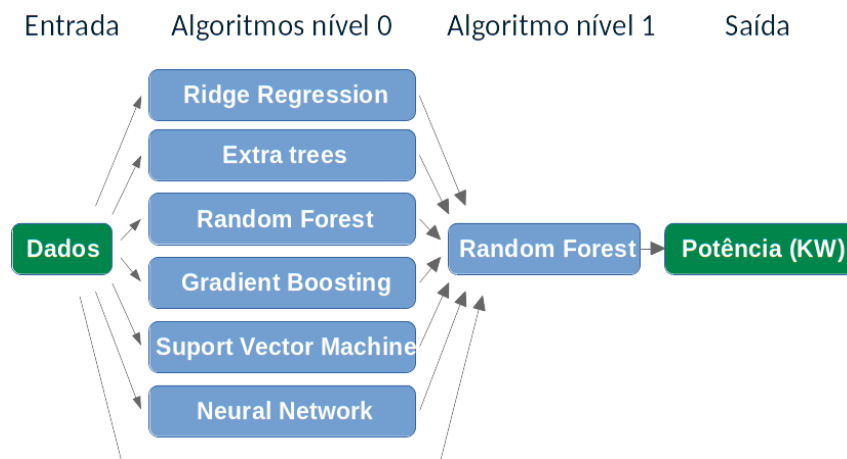


Figura 6: Arquitetura do modelo de Generalização em Pilha

O modelo demonstrou-se capaz de prever o consumo com erro de MAE=9,32 KW (equivalente a 5,10% do valor médio da variável prevista). A Figura 7 apresenta uma interpretação gráfica deste resultado: o eixo horizontal representa os valores reais da **potência consumida** e o eixo vertical os valores previstos pelo modelo; quanto mais próximo de uma reta $y=x$ (plotada em **laranja**, para referência), mais preciso é o modelo.

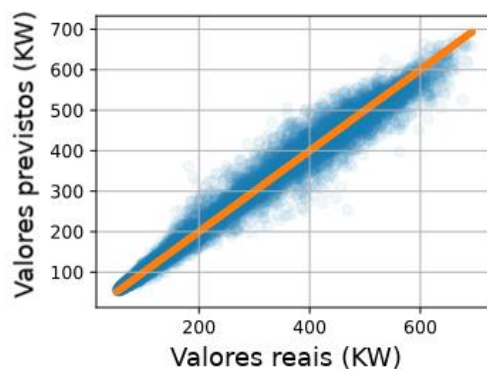


Figura 7: Desempenho do algoritmo de Generalização em Pilha

3. Gerenciamento de bem-estar animal

Vários estudos indicam que produtividade e a qualidade de leite são afetados pela saúde e bem-estar do animal (Berckmans, 2014; Wegner, Schuh, Nelson, & Stott, 1976), bem como por condições ambientais como temperatura e umidade (Webster, Stewart, Rogers, & Verkerk, 2008). A principal norma em nível mundial sobre bem-estar animal é o Código Terrestre de Saúde Animal (OIE, 2019), da Organização Mundial para a Saúde Animal (OIE), que define os seguintes indicadores de performance (ou *measurables*, na versão original em inglês): comportamento (como comportamentos agressivos ou baixa ingestão de água); taxa de morbidade (doenças); taxa de mortalidade (morte); Mudanças no peso corporal ou no estado corporal; eficiência reprodutiva; aparência física; resposta ao manejo; e

complicações decorrentes de procedimentos comuns. Muitos desses indicadores são subjetivos (como o comportamento) e/ou difíceis de medir (como a aparência física). Além disso, “conforme aumenta o número de animais e os sistemas de inspeção, maior o número de pessoas requeridas para inspecionar os animais” (Vannier, Michel, & Keeling, 2014, p. 2). Dessa forma, é fundamental desenvolver sistemas que automatizem monitoramento e análise dos animais, o que é feito no projeto Barn 4.0 através do uso de câmeras de vídeo e técnicas de Aprendizado Profundo.

Além do supracitado uso de câmeras de vídeo (Figura 8-B), há instalados sensores ambientais (Figura 8-A e Figura 8-C), coletando dados continuamente das condições dentro do estábulo (temperatura, humidade, iluminação e dióxido de carbono, em 4 pontos diferentes do estábulo). Os dados ambientais são complementados com dados climáticos (temperatura ambiente, nebulosidade, precipitação, pressão e humidade atmosférica, de uma estação meteorológica próxima) e analisados em paralelo com dados da produção de leite obtidos da máquina de ordenha automática (quantidade de leite, percentual de gordura, percentual de lactose, entre outras 9 variáveis).

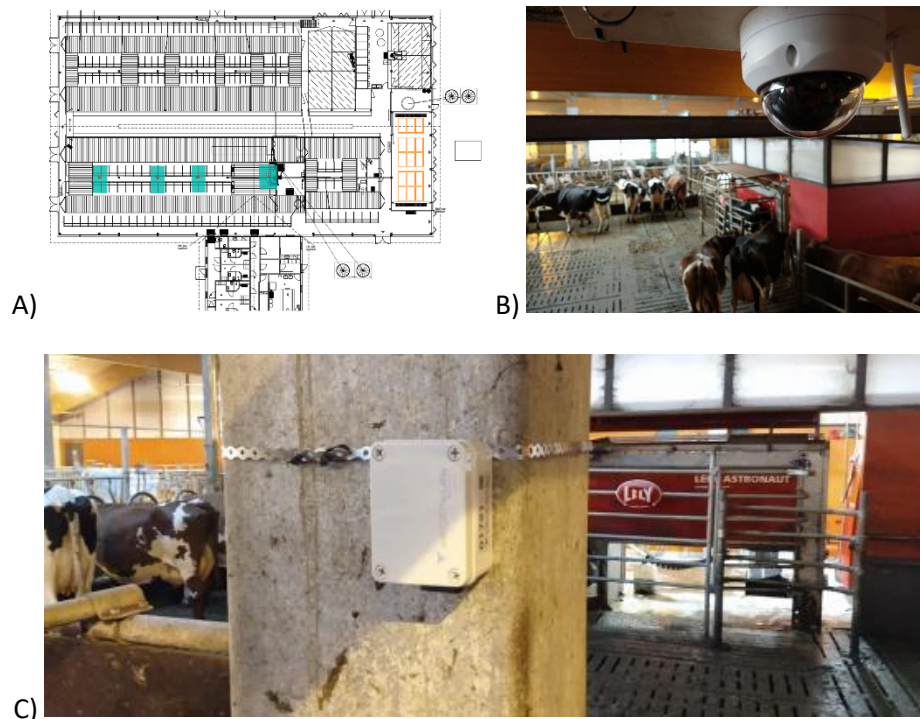


Figura 8: Posicionamento dos sensores no estábulo (A); uma das câmeras de vídeo (B); um dos sensores e a máquina de ordenha automática ao fundo (C)

3.1 Infraestrutura de coleta de dados

Utilizou-se sensores comerciais alimentados por baterias e comunicando-se por uma rede LoRaWAN™. Escolheu-se utilizar as *Azure Functions*, um recurso que permite implementar pequenas funções sem a

complexidade de configurar um ambiente para isso. Foram implementadas funções para coletar, descriptografar e sincronizar as diferentes fontes de dados. Após serem armazenados em um banco de dados, os dados podem ser facilmente integrados com os serviços *Azure Machine Learning Studio* ou requisitado pela interface web desenvolvida.

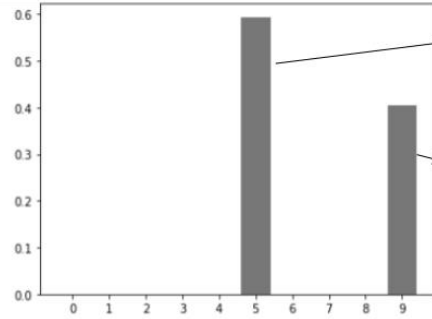
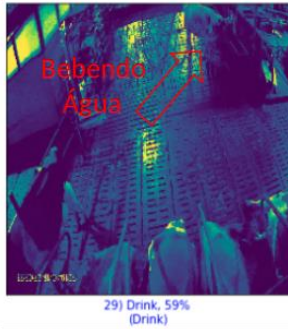
3.2 Reconhecimento de atividade comportamental

Os vídeos são analisados em tempo real utilizando Redes Neurais Convolucionais, uma técnica de Aprendizado Profundo. (Chollet, 2017) fornece uma ampla fundamentação teórica e prática sobre essa técnica, que não será abordada em mais detalhes neste trabalho. Cada frame do vídeo é classificando em uma das 10 classes estabelecidas, segundo a descrição e a prioridade da Tabela 1, que foram escolhidas para representar os comportamentos que, segundo a literatura (Boissy et al., 2007; Mellor, 2016), são mais relevantes para produção. A publicação (Benitez, Koskela, Kunttu & Kukkamäki, 2020) expõe de forma detalhada a arquitetura dessa rede neural, o seu processo de treinamento e uma análise do seu desempenho, cujas descrições que estão fora do escopo deste artigo.

A Figura 9 apresenta dois frames, classificados pela rede neural respectivamente como Bebendo Água (corretamente classificado) e Nada (incorretamente, pois há uma pessoa na imagem). Para cada frame apresentado, a saída da rede neural é um vetor com a probabilidade de o frame pertencer a cada uma das 10 classes. O sistema desenvolvido também gera uma interpretação em linguagem natural dessas classes (em inglês), e os resultados são exibidos em uma plataforma web.

Classe	Nome	Descrição
0	Humano	Há uma pessoa na imagem. Classe com maior prioridade em relação às demais.
1	Interação Frontal	Vacas interagindo cabeça-contra-cabeça, cabeça-contra-pescoço
2	Interação Lateral	Vacas interagindo cabeça-contra-corpo, empurrando lateralmente
3	Interação Vertical	Montando; Forçando a cabeça por cima da outra vaca
4	Aglomeracão	Mais de 5 vacas na cena (situação anormal)
5	Bebendo Água	Uma ou mais vacas estão bebendo água
6	Exploração	Vaca explorando a abertura para o depósito (comportamento exploratório/curioso)
7	Enfileiramento	Vacas formando uma fila para a Máquina de Ordenha Automática
8	Sem visibilidade	Não há visibilidade suficiente para identificar a cena
9	Nada	Nenhuma das situações anterior, o que inclui: sem vacas, vacas deitadas, urinando, etc. Classe com menor prioridade em relação às demais.

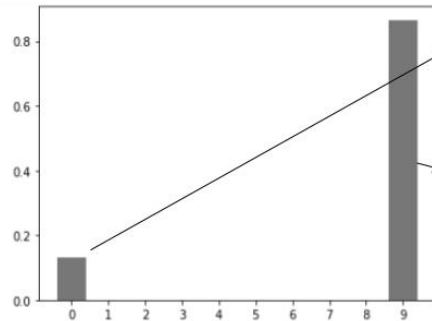
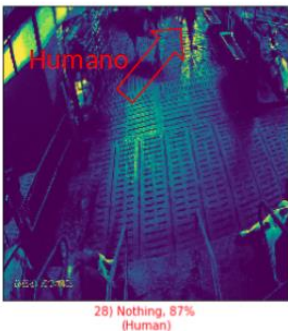
Tabela 1: Classificações que podem ser atribuídas para cada frame



Classe 5: Bebendo água
(59% de confiança)

Classe 9: Nada
(41% de confiança)

Our Artificial Intelligence identified that there is a cow drinking water. This is a normal behavior that happens 8.3% of the time.



Classe 5: Humano
(13% de confiança)

Classe 9: Nada
(87% de confiança)

Using Machine Learning, we detected that this is a normal situation. This is common and happens 9.8% of the time.

Figura 9: Funcionamento do sistema de reconhecimento de atividade comportamental

	Precisão	Recall	F1 score	suporte
A rede neural possui precisão de 86% e recall de 85%, considerando a média entre todas as classes ponderadas pelo número de frames pertencentes a cada classe, avaliado pela metodologia de Validação Cruzada (Chollet, 2017). O				

desempenho da rede neural em cada classe (precisão, recall, F1 score e suporte) é mostrado na tabela 2. Classe				
Humano	91%	50%	65%	224
Interação Frontal	100%	27%	43%	147
Interação Lateral	79%	28%	42%	510
Interação Vertical	100%	9%	16%	23
Aglomeración	86%	96%	91%	1455
Bebendo Água	82%	74%	78%	869
Exploração	99%	31%	47%	5817
Enfileiramento	81%	97%	88%	4160
Sem visibilidade	100%	100%	100%	1005
Nada	92%	95%	94%	1020

Tabela 2: Desempenho da rede neural, por classe

4. Gerenciamento Produtivo Integrado

A consumo de energia elétrica, e consequentemente o gerenciamento energético, possui uma importância significativa na indústria de laticínios. Segundo (Schneep, 2004), o gasto com energia elétrica representa quase 7% dos custos totais de produção, equivalente nos Estados Unidos em 2002 a **\$ 1.2 bilhões de dólares americanos**. Aquecimento, ventilação e iluminação estão entre os processos que mais consomem energia elétrica na produção de leite (Quevedo et al., 2017). A literatura indica, bem como os resultados parciais obtidos no projeto Barn 4.0, que a temperatura é a variável que mais afeta a produtividade da vaca (Brügeman et al., 2012; Webster et al., 2008) e, portanto, um sistema integrado que otimize os níveis de aquecimento/ventilação/iluminação, levando em conta o gasto com energia, o stress térmico do animal, e a produção final de leite, pode trazer grandes benefícios para a indústria de laticínios.

Após identificar as relações entre as principais variáveis que afetam a cadeia produtiva, será possível maximizar a produção considerando uma melhoria no processo como um todo, como ilustra a Figura 9, ao invés de cada parte separadamente. Ao possuir uma avaliação precisa da produção, um sistema integrado também permitirá a rápida elaboração de relatórios e análises, voltados para os gerentes, stakeholders e consumidores.

O sistema Barn 4.0 foi inicialmente desenvolvido para vacas leiteiras, mas pode ser facilmente aplicado para vacas de abate (carne) e também para porcos de abate, pois a literatura aponta que estes possuem comportamentos muito semelhantes e seu bem-estar é afetado pelas mesmas variáveis (Halachmi et al., 2019). No futuro o sistema pode ainda ser expandido para o monitoramento de qualquer animal de interesse, pois as tecnologias utilizadas são altamente flexíveis e escaláveis. O sistema também está sendo integrado com outro projeto em desenvolvimento na mesma universidade, DigiDale (Tran & Penttilä, 2019), cujo objetivo é o monitoramento de fardos de feno. Por sua vez, o sistema PGEN está avançando na direção de um sistema para gerenciamento energético em indústrias, provendo um ambiente completo para análise de eficiência energética e otimização de processos.

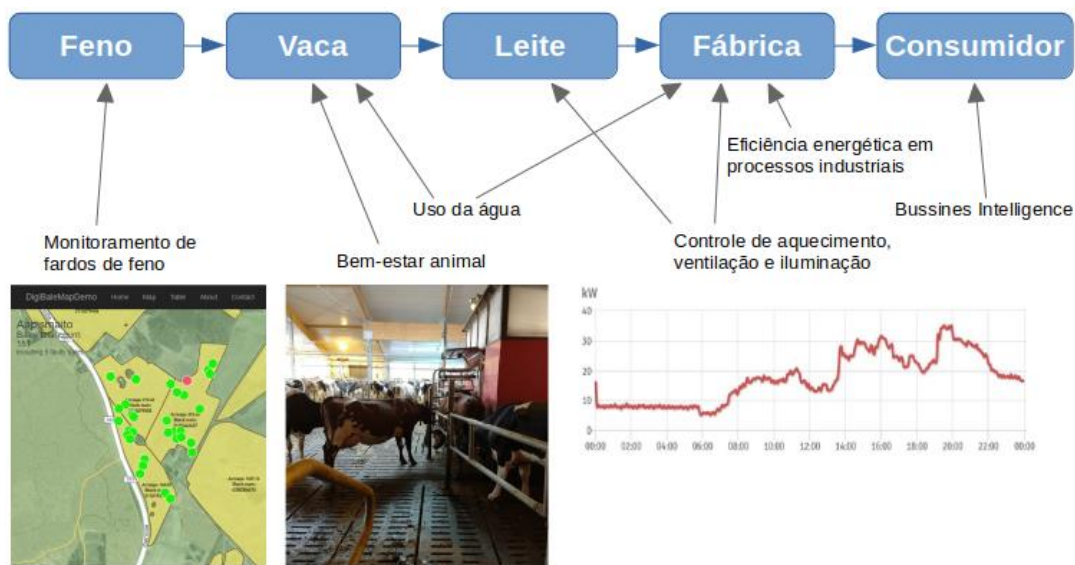


Figura 9: Framework conceitual do sistema integrado, com imagens do DigiBale, do estábulo do Barn 4.0 e de uma curva de carga típica do SmartIFSC

Apesar das aplicações serem inicialmente diferentes, a arquitetura e o fluxo dos dados nos dois projetos são similares: ambos monitoram variáveis de características diversas e enviam os dados diretamente para um servidor web; esses dados são processados utilizando técnicas de Aprendizado de Máquina, e os resultados (bem como os próprios dados crus) são visualizados em plataformas web. Portanto, acreditamos que os esforços para integrar os dois sistemas serão frutíferos, e em trabalhos futuros pretendemos explorar resultados reais obtidos com essa integração.

5. Conclusões

Os projetos Barn 4.0 e PGEN utilizam tecnologias e conceitos avançados - como Aprendizado de Máquina, Visão Computacional e Internet das Coisas – para melhorar a eficiência e produtividade em suas respectivas aplicações: indústria de laticínios e prédios públicos. Ambos estão sendo testados em ambientes reais e vêm mostrando resultados positivos. O *framework* conceitual desenvolvido para integrar esses projetos possui um baixo custo de implantação, pois os sensores/câmeras são de baixo custo e a infraestrutura computacional é baseada em nuvem.

Agradecimentos

Os autores agradecem o apoio financeiro ao CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) e ao Programa PROPICIE (Programa de Intercâmbio Internacional para Estudantes do IFSC) que possibilitou intercâmbio na HAMK (Häme University of Applied Sciences).

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P22: MANIPULATION OF ONLINE REVIEWS: ANALYSIS OF NEGATIVE REVIEWS FOR HEALTHCARE PROVIDERS

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Abstract

There is a growing reliance on online reviews in today's digital world. As the influence of online reviews amplified in the competitive marketplace, so did the manipulation of reviews and evolution of fake reviews on these platforms. Like other consumer-oriented businesses, the healthcare industry has also succumbed to this phenomenon. However, health issues are much more personal, sensitive, complicated in nature requiring knowledge of medical terminologies and often coupled with myriad of interdependencies. In this study, we collated the literature on manipulation of online reviews, identified the gaps and proposed an approach, including validation of negative reviews of the 500 doctors from three different states: New York and Arizona in USA and New South Wales in Australia from the RateMDs website. The reviews of doctors was collected, which includes both numerical star ratings (1-low to 5-high) and textual feedback/comments. Compared to other existing research, this study will analyse the textual feedback which corresponds to the clinical quality of doctors (helpfulness and knowledge criteria) rather than process quality experiences. Our study will explore pathways to validate the negative reviews for platform provider and rank the doctors accordingly to minimise the risks in healthcare.

Keywords: Online reviews; healthcare providers, fake reviews, Web 2.0, Crowdturfing

1. Introduction

Web 2.0 systems such as online forums, blogs, and reviews sites became popular as they enhanced interactions between online users. This phenomenon reversed the direction of information flow from 'providers to consumers' to 'consumers to providers'. Modern lives increasingly revolve around the use of the Internet to interact with others and share and make online purchasing decisions. Users increasingly rely on user-generated content (UGC) such as online reviews, while making purchasing decisions (Barbu et al. 2019; Motyka et al. 2018; Mayzlin et al. 2014; Ma & Lee 2014; Ott et al. 2012; Jurca et al. 2010). Never have we had a significant amount of reviews for products and services so readily available online, to assist us in making decisions to purchase. These reviews offer a vantage point for consumers to voice their opinions and influence future potential customers (Fayazi et al. 2015). A study by Podium revealed that 93% of its participants stated that purchasing decisions had been impacted by online reviews (Fullerton 2017). With an incredible power to persuade consumers, online

reviews help build, establish and maintain business credibility and trust.

Online reviews are popularly used across many industries but have mainly impacted the hospitality industry such as hotels, restaurants, bars, the entertainment industry (movies and video games) and others like buying items online and hiring tradesmen. In general, when consumers are buying online through e-commerce sites, online reviews are considered to be very helpful because they show previous buyers' opinions on products or services. The healthcare industry is not immune to the phenomenon of using online reviews to assess service provided by health professionals. Patients research the doctors online and begin to form perceptions based on those reviews, before making an appointment.

Companies are aware of the popularity and dependency of online reviews, and therefore, some of them actively recruit consumers to write online reviews and share their positive experiences and opinions online (Motyka et al. 2018; Malbon 2013). This is in line with the manipulation theory (McCornack 1992), wherein a false perception is generated. One of the common practices of generating biased reviews is incentivising consumers to get positive reviews (Motyka et al. 2018; Fayazi et al. 2015; Yang & Kwok 2013). Thus, fake reviews are growing at an alarming rate making the review systems unreliable (Yao et al. 2017). This phenomenon has raised the question of the legitimacy of the online reviews and threatens the consumers' trust. The study (Ott et al. 2012) showed the use of human annotators is helpful to differentiate truthful (real) or deceptive (fake) reviews, however it has also shown that it is difficult for human readers to identify the differences. Therefore, there is a tendency to use fake reviews writing services to attract more revenues by companies.

With increasing dependency of consumers on online reviews, there is an ever growing urgency to ensure the presence of genuine responses by reviewers (Dohse 2014), especially in the case of the healthcare industry. Misinformation in the healthcare industry can have a large effect on consumers and can lead to misadventures, compared to other industries. It is important to investigate the malpractices in the healthcare industry and protect the patients/consumers from potential risks. This research-in-progress paper briefly outlines the prevalence of online review manipulation in the next section. It is followed by a research approach and results in the following two sections. Future research direction and conclusion is drawn in the end.

2. Online review manipulation

Web 2.0 has made searching for products and services easier with an additional assurance from reviews provided by previous consumers. Nevertheless, several issues and concerns have risen about the truthfulness of reviews online. Information manipulation theory (McCornack 1992) recognises the deceitful nature of communication and motivation for those violations. The falsification of user-generated content for various purposes, such as nefarious monetary gain or deliberately compromising genuine products and services, has become a significant problem (Malbon 2013; Shukla et al. 2019). Since online reviews have been recognised as a powerful marketing tool to attract new customers, falsified online reviews have been promoted by some companies, either by providing discounts to consumers or recruiting dummy consumers to write positive reviews for money, also known as

crowdturfing. It is a form of malicious crowdsourcing, which is based on generating deceptive information by optimising the power of the crowd. Businesses can solicit fake or deceptive reviews to boost business reviews from malicious crowdsourcing marketplaces (Hajek et al. 2020; Yao et al. 2017). Instead of creating economic and societal values through genuine user experiences and opinions, crowdturfing creates false digital impressions (Rinta-Kahila & Soliman 2017) and poses a major threat to the accuracy of online reviews. For example, a recent study shows that one in three reviews in the world's largest travel platform, TripAdvisor, is fake (Hajek et al. 2020).

With an aim to maintain credibility and create digital impression, business owners are fabricating positive reviews, seeking web services and utilising paid writers to produce trustworthy comments which replicates a genuine consumer user experience and opinion (Shukla et al. 2019; Dohse 2014). Consumers are unable to differentiate these inauthentic online behaviours (Rinta-Kahila & Soliman 2017; Dohse 2014). These malicious practices exist in different forms like 'undercover promotion', 'astroturfing', and 'opinion spam' (Dohse 2014). For example; a number of companies offer their services to help build business credibility by boosting positive reviews, and preventing or hiding negative reviews. They advertise saying "If you have existing bad reviews, no worries. We will ensure that your customers see your good content on Google first." (Wood 2018). In addition, businesses have a choice to buy legitimate reviews from other providers selling the same products, this is referred to as 'review brokerage'

2.1 Existing relevant algorithms to detect fake reviews

There are multiple computational models to detect the prevalence of fake reviews online, and they are classified into two broad approaches: behavioural and linguistic approaches (Shukla et al. 2019) however 'relatively little is known about the actual prevalence, or rate, of deception in online review communities' (Ott et al. 2012). Despite several types of fake review detection models, there is not a perfect detection system as the fraudsters are gaming the system (Hunt 2015). Malbon (2013) posed the presence of two information risks – honesty of the seller, and honesty of the review. It is important to note that there is 'no definitive evidence' as to how to prevent and differentiate fake content from the genuine ones, based on a text review and a simple star rating; it is a pervasive problem (Hunt 2015) and problematic to diagnose.

Review spam is difficult to detect as spammers can easily disguise themselves in a plaintext situation (Wang et al. 2012). Malbon (2013) identified a number of factors affecting the authenticity of online consumer reviews: the creation of false identities for the purpose of writing reviews 'stealth campaign'; seller incentive 'buzz marketing'; search engine rank ordering of information, for example, buying better search result visibility; astroturfing - fake grassroots marketing where the seller or a seller's associate poses as a consumer; and spam reviews, including 'sockpuppeting' where a single user creates multiple accounts to generate more reviews. The pursuit of detecting manipulated reviews started as discussions over the internet forums were manipulated by interested parties. Jindal and Liu (2007) scrutinised review spam through the similarity of reviews and product features. Hu et al. (2012) examined

sentiments and readability of reviews. Verbal features and non-verbal behavioural features such as review posting behavior and social interaction with other reviewers were analysed to detect fake reviews (Hu et al. 2016). Deep neural network combining with word embeddings and lexicon-based emotion indicators, used in another study (Hajek et al. 2020).

2.2 Legislative implications from fake reviews

This is not only a theoretical concern, but has legislative implications, although cases against fake reviews have been difficult to prosecute (Hunt 2015), there are some cases, for example a 2015 case against Yelp in which plaintiffs unsuccessfully sought to sue for the presence of fake reviews as security frauds (Goldman 2015); a 2014 case about a British budget hotel reviews in TripAdvisor (Hunt 2015); a lawsuit filed by Amazon in 2016 against fraudulent reviewers who wrote fake reviews in exchange for cash (Tech Crunch 2016); and in 2017, the Australian Competition and Consumer Commission (ACCC), a consumer watchdog, has taken Perth-based building company Aveling Holmes to court for allegedly creating fake review websites for their products (Powell & Trigger 2017). This sort of activity continues for hotel price comparison site 'Trivago.com' as the site prioritised and ranked first for those who were willing to pay the highest cost per click fee (ACCC 2018). When the similar practice was detected in healthcare providers' advertisement through Chinese Search Engine Baidu, a 21 year old student passed away in Shaanxi Province, China (Wikipedia).

2.3 Reviews in Healthcare

With the imminent rise in online platforms and social media to help decide how to choose products and services, the healthcare industry has also seen a rise in the use of online reviews. Increase in the user-generated content also increases the burden on the healthcare providers, including public health authorities to constantly analyse and maintain their online presence within the social media health networks (Tang et al 2018). Patient expectations of the service and experience from a physician is not dissimilar to any other customer-oriented businesses like restaurants, hotels or retail outlets. A 2019 Survey Report by PatientPop about online reputation and patient perception indicates how online reviews are playing a crucial role in shaping patients' perspectives (Cheney 2019). The survey showed that 74.6% of people searched online to find a suitable healthcare provider and 69.9% consider a positive online reputation, whether it is a dentist, doctor or medical care. Another interesting finding was that there was an increase in the patient satisfaction rate (99%), when the negative feedback was addressed by the practice.

During the course of attaining a treatment from a doctor, there are two primary and distinct elements of quality a patient experiences, namely clinical and process quality (James et al. 2017). Clinical quality related to components like medical procedures, tests, diagnosis and quality of care whereas the process quality is specific to the service delivery like bedside manners, waiting time, staff aptitude etc. (James et al. 2017; Marley et al. 2004). Both these experiences are a major force in influencing a patient's

healthcare quality perception. Misleading information on clinical quality through manipulated information may have a significant negative implication on patient's health. The scale of impact in healthcare risk is substantially bigger, complex and debilitating in comparison to other industry sectors.

3. Research approach

For reviews to reflect genuine user experiences and opinions as well as the reviews platform to gain consumers' trust and reputation, spam and fake reviews should be detected. However, despite several attempts to detect the authenticity of those reviews, it is difficult to assure the detection with a higher accuracy (Shukla et al. 2019). This study explores an alternative approach to provide a fair view to consumers by analysing negative reviews for healthcare providers. Our approach to detecting fake reviews only makes use of negative reviews for doctors which to our knowledge, is the first study conducted with this aspect. For this study, we selected one of the most popular review sites, RateMDs.com, which allows patients to rate with four separate criteria 'staff', 'punctuality', 'helpfulness' and 'knowledge' to provide feedback. The first two criteria impose process quality of the clinic and the latter two determine the clinical quality or describe the quality of the healthcare provider.

We selected the top 500 doctors from three different states: New York (NY) and Arizona in USA and New South Wales (NSW) in Australia from the RateMDs website. The reviews of doctors was scraped, which includes both numerical star ratings (1-low to 5-high) for the above mentioned criteria and textual feedback/comments. We aim to examine the negative reviews to find out which criteria the reviewer corresponds to. As the majority of negative reviews corresponds to the process quality, this study will analyse the textual feedback which corresponds to the clinical quality of doctors. Based on the reviews which correspond to the latter two criteria (helpfulness and knowledge), we will propose a new method to validate the negative reviews for the platform provider and rank the doctors accordingly. Since the positive reviews could have been generated through biased and dedicated companies (crowdturfing), we propose to analyse negative reviews to determine the accurate rankings of doctors by the review platform.

4. Preliminary Results

RateMDs.com is one of the popular reviews sites for healthcare providers. This platform allows users to read reviews and submit reviews anonymously. Users can review their doctors across four criteria: staff', 'punctuality', 'helpfulness' and 'knowledge' and write free textual message as a comment or feedback. There are more than 2 million reviews in this platform around the world. Table 1 below shows the number of negative reviews and percentage of negative reviews among the best 500 doctors in the selected locations for this study.

Location	No. of Reviews for the best 500 Doctors	Total no. of -ve reviews	% of -ve reviews	No. of doctors with -ve reviews	Total no. of reviews for doctors with -ve reviews	% of -ve reviews for these doctors	Average -ve reviews per doctor	Std. Dev.
NY	23,345	871	3.73%	256/500	15,884	5.48%	3.4%	3.73
Arizona	10,876	757	6.96%	265/500	8,077	9.37%	2.86%	2.93
NSW	9,882	1048	10.6%	252/500	7,494	13.98%	4.16%	6.87

Table 1: Basic statistics of reviews for the best 500 doctors in RateMDs.com

The number of doctors who had negative reviews among the best 500 doctors in three separate locations: 256 (NY), 265 (Arizona) and 252 (NSW), are very similar. Although there are many reviews for the best 500 doctors in NY, negative reviews for them are comparatively low, 3.73% versus 6.96% in Arizona, and 10.6% in NSW respectively. The actual number of negative reviews is high in NY (15,884) in comparison to 8,077 in Arizona and 7,494 in NSW. Most prevalent negative issues are non-clinical in nature and relate to service delivery experiences like long waiting times, difficulty making appointments, billing, staff behaviour and healthcare professionals manners, therefore it is important to scrutinise the clinical or technical expertise of doctors which correspond to the latter two criteria in RateMDs site (helpfulness and knowledge) before ranking the doctors.

5. Conclusion and Future Direction

Online review platforms represent the digital word of mouth and has become an integral part of consumerism. Online reviews equip new potential consumers with knowledge and experiences of other fellow users, increase transparency and provide space for grievances; and opportunity for improvement. They also provide valuable insight to the healthcare consumers, providers and regulatory authorities to progress towards achieving patient-centered care. However, inauthentic reviews promote misinformation, mistrust and tarnish the reputation. To rectify the problem of increasing use of fake reviews, we are working towards proposing a model for platform providers of review systems which can be used to investigate the negative reviews further and provide a more accurate ranking of doctors. The model will follow the following steps:

- Extract negative reviews (star rating of 3 or less) for doctors. Include star ratings and comments for doctors who have more than one negative review.
- Conduct text mining analysis of the review to verify whether the comments/feedback correspond to the third (helpfulness) and fourth (knowledge) criteria of the RateMDs site.

- If the negative review does not correspond to the third or/and fourth criteria, but the negative comment is about 'queueing time' or 'payment difficulty' etc. this review should not affect the ranking of the doctor.
- In contrast, if it does, we will conduct cross-validation with other similar negative reviews for the same doctor to classify the doctor. The review platform needs to verify this with another source, e.g., as discussed in Gao et al. (2015) and rank doctors.

We propose that negative reviews can be scrutinized and analysed to find the accurate representation of doctors as positive reviews could have been generated from malicious intentions. Review platforms can consider this to provide helpful independent recommendations of doctors as the number of reviews continues to grow, to protect potential risks to both patients and doctors in the future. We will continue to work on this study to present some kind of results in the future.

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P23: MOBILE MONEY AND FINANCIAL INCLUSION FOR THE UNBANKED – A CHOICE ANALYSIS

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Abstract

This study explored the impact of mobile money on financial inclusion and development from Kleine's Choice perspective in the lives of entrepreneurs of a least developed country (LDC). A thematic analysis of data gathered from in-depth semi-structured interviews of twenty-three micro and small enterprise entrepreneurs based in Lesotho's capital city Maseru suggested a variety of primary outcomes that result when the entrepreneurs exercise their choice to use mobile money technology. These include achieving a higher quality of life through increased revenue and profits due to the transactional convenience, financial management capabilities and improved access to banking services (financial inclusion) provided by the mobile money technology. For the entrepreneurs to achieve these primary outcomes, a choice must exist and be accompanied by an awareness of the available choices that can be made. Furthermore, the entrepreneurs must possess the agency to make a choice and actively make a choice before an outcome can be achieved. Mobile money is not without limitations such as withdrawal limits, network failures and safety issues which limit the entrepreneurs' agency to exercise choice. This study proposes a practical model based on Kleine's Choice Framework for assessing development that is based on a rich and contextualised understanding of choice, agency and structure.

Keywords: Mobile Money, MPESA, Choice Framework, ICT4D, Financial Inclusion.

1. Introduction

Mobile money has been promoted to assist the estimated 30% of the world's population denied financial inclusion through banking the unbanked (Finmark, 2018; Hughes & Lonie, 2007; Schwittay, 2011). Over the past decade, mobile money has delivered exceptional benefits to the micro and small enterprise (MSE) sector in developing countries (Adaba, Ayoung & Abbott, 2019). In Lesotho, many people are not only unbanked but also lack financial access (FinMark, 2016). Simultaneously, Lesotho suffers from unemployment issues in a vicious cycle of unemployment, further increasing unemployment (Damane & Sekantsi, 2018). Each unemployment shock can result in increased

unemployment for eight years after such an event (Damane & Sekantsi, 2018). Productivity shocks can increase unemployment for the following three years, which led to Damane and Sekantsi (2018) recommending government intervention in increasing both productivity and employment. Sekantsi and Motelle (2016) recommend developing closer relationships between mobile money operators and commercial banks which could lead to greater access to banking services and an expansion of financial inclusion.

The underlying assumption of these authors is that mobile money provides developmental outcomes for MSE entrepreneurs through financial inclusion and overall improvement of their financial wellbeing. However, before government and commercial intervention is undertaken, it is advisable to consider if the citizens want and would make use of the proposed interventions. This has led authors such as Dube, Chitakunye and Chummun (2014) to conclude that there is a need to understand customer choices for financial inclusion better and that governments be sensitive to consumer choices.

Sekantsi and Motelle (2016) recommend the use of mobile money supported by education and improved network infrastructure in rural areas. They also recommend that Lesotho use Chinese businesses for the diffusion of mobile money due to their existing reach into rural communities. Nevertheless, both Damane and Sekantsi (2018) as well as Sekantsi and Motelle (2016) take a collective view which discounts the views of individual entrepreneurs.

Mobile money falls in the ambit of information and communications technology (ICT) which is promoted as a solution to assist in improving both individual and collective lives in developing economies. When used for developmental purpose, ICT is commonly referred to as ICT4D which seeks to better understand two challenges: the provision of access to ICT that people wish to use; and the implementation of technologies that improve value in their individual and collective lives of the citizens (Kleine, Light & Montero, 2012).

Drawing on a study amongst MSE entrepreneurs in Maseru, Lesotho, we use dimensions of choice from the Choice Framework (Kleine, 2010) to assess the awareness and use of mobile money in an emerging economy. ICT4D, financial inclusion and development are complex issues, and we need to acknowledge both for- and against points of view. Through an exploration of the connections between mobile money and well-being, this study aims to contribute empirical evidence and insights to the under-explored role of choice in the broadening of individual developmental outcomes through mobile money use.

The paper progresses as follows. In the next section, a background to financial inclusion and mobile money is provided. Mobile money is contextualised in the developing economy of Lesotho, and the Choice Framework is described as a theoretical framework for the research. The third section describes the research approach, which provided the findings in section four. The paper ends with a discussion and conclusion in section five.

2. Related Work

The relationship of mobile money in providing financial inclusion is described in the following sections

and related to the context of Lesotho. An overview of MSE entrepreneurs in Lesotho is provided, followed by the dimensions of choice and developmental outcomes from the Choice Framework as a theoretical framework for our research.

2.1 Financial Inclusion

Mobile money has led to financial inclusion with substantive economic benefits in developing countries (Suri & Jack, 2016). Financial inclusion is the availability, accessibility and affordability of financial services and products for all people (FinMark, 2016). The FinMark view is more comprehensive than the naive definition of “banked” versus “unbanked” which erroneously assumes that the mere provision of a banking account will meet individual needs. Financial inclusion is multi-dimensional with access to financial services as one dimension to which FinMark (2016) add usage and quality.

Access - Access must be both available and appropriate to the community. Without access, financial products and services are not able to provide financial inclusion.

Usage - Usage of financial products and services serves as a proxy to determine access and uptake of the products or services.

Quality - Quality of financial products and services has a direct influence on usage but is challenging to measure. Poor quality will reduce usage over time. FinMark (2016) recommends four ways of understanding quality: product fit; value-add; convenience; and risk.

The financial products must be appropriate and tailored to the needs of clients while adding value to their financial situation. The products must be accessible and user-friendly and not increase the financial risk of the client. Consequently, Schwittay (2011) proposes a more complicated system of global financial inclusion assemblages which combines people, equipment and organisations from various nationalities.

Moreover, existing clients want the ability to move money over time – using instruments like savings, insurance, and access to credit (Donovan, 2012). Thus, in addition to purely banking products, financial products and services must incorporate micro-finance services, including loans products, savings mechanisms, and insurance policies. These requirements render financial inclusion, both a development problem and a market opportunity (Schwittay, 2011). Financial inclusion rests on the materialistic assumption that financially poor people desire financial inclusion. The potential that this is not the case threatens the foundation of the financial inclusion assemblage (Schwittay, 2011). Nevertheless, the complexity of the financial inclusion assemblage is challenging to research in the context of financially excluded individuals. Fortunately, the increasing access and usage of mobile money, which has been seen to have a positive bearing on financial inclusion (Dube, Chitakunye & Chummun, 2014) provided a proxy for research purposes.

2.2 Mobile Money

Mobile money uses mobile wallet apps on mobile phones to provide unbanked people to ability to pay for goods and services from merchants using mobile phones (Ntale & Bosire, 2018). Mobile money replaces physical cash when paying for goods and services or when receiving payments from customers (Kemal, 2016) and provides convenience for other micro banking services such as payment of bills, money transfers and savings (Gichuki & Mulu-Mutuku, 2018). Mobile money originated in Africa in Kenya through M-Pesa by Safaricom in 2007 (Ezeh & Nwankwo, 2018). M-Pesa has been accompanied by numerous benefits, including the emergence of a mobile banking ecosystem which has provided socio-technical transformation (Lepoutre & Oguntoye, 2018). Research indicates that the presence of M-Pesa has benefited both rural and urban communities because it is regarded as a safe way to transfer and save monies. The attraction of mobile money is the ability to increase productivity, reduce transaction costs, and create employment opportunities and growth for businesses (Donovan, 2012).

Mobile money attracts investment and spurs revenue growth; supports the sustainability of businesses; formalises the informal sector; enables efficiencies through digitisation, and reduces frictions associated with cash usage (Gencer, 2011). The mobile money technology is considered to be transformational (Donovan, 2012), bringing about a positive impact on financial wellbeing (Gencer, 2011). Mobile money serves to improve business efficiencies as traders make payments to suppliers (Ng'weno & Ignacio, 2010; Plyler et al., 2010) through a secure means of transferring money between the unbanked and the banked (Ntale & Bosire, 2018).

Mobile money can reduce transport costs, improve manageable cash flow and reduce customers' credit exposure while saving time, such as by avoiding long queues at banks (Perekwa, Prinsloo & Venter, 2016). Supporting shortened supply chains and delivery times, mobile money can improve an enterprise's growth (Perekwa et al., 2016) which is associated with the creation of employment opportunities (Gencer, 2011) resulting in economic development (Kushnir, 2010). The ease of use of mobile money has resulted in mobile money technology being adopted by small firms to conduct their business transactions (Mbiti & Weil, 2011).

Although the literature on mobile money in Lesotho discusses the context of agency, financial exclusion and inclusion, it takes a collectivist stance (Sekantsi & Lechesa, 2018; Sekantsi & Motelle, 2016; FinMark, 2016; Jefferis & Manje, 2014; Tsemame 2015) and neglects the individualistic contexts. Moreover, extant literature does not theoretically stress mobile money phenomena from an ICT4D perspective. Thus, the gap in ICT4D and mobile money literature in Lesotho calls for more research.

2.3 Mobile Payments in Lesotho

As of 2014 subscribers to Lesotho mobile money providers, M-Pesa and EcoCash, numbered more than the registered bank account holders (Anderson & Reynolds, 2015) with Lesotho receiving 29% of GDP through M-Pesa. Six months after the inception of M-Pesa in Lesotho, the adoption and use of mobile money rose to 62% of all money savings and transfers (Central Bank of Lesotho, 2013). During the 2018-2019 financial year, M-Pesa revenues grew by 32.2% and accounted for USD2,8 billion in transactions from 13,5 million customers across all of Africa (Vodacom, 2019).

M-Pesa services are accessible across the entire country through retail shops who act as M-Pesa agents. Both withdrawals and fund deposits can be processed at M-Pesa agents. Services associated with M-Pesa include sending and receiving money across mobile networks; paying electricity and water bills; buying goods and services from shops where mobile money is allowed as a mode of payment; paying for television subscriptions; paying monthly insurance premiums; and transferring airtime to M-Pesa (Tsemame, 2015).

2.4 Micro and Small Enterprises (MSEs) in Lesotho

MSEs in Lesotho employ less than nine employees and generate annual turnover less than the equivalent of USD65 000 (Mokoatleng, 2014). MSEs have begun to be recognised by the Government of Lesotho for their contribution to job creation, poverty alleviation and economic development (Malihe, 2018; Workman, 2019). However, MSEs face challenges that hinder their operation in the business ecosystem, including lack of funding, lack of business skills, lack of ICT expertise, and limited business connections (Renny, 2011). Mokoatleng (2014) observed that due to the lack of access to banking services and financial assistance, the growth of the MSE sector in Lesotho is negatively impacted, resulting in further unemployment and poverty.

Business funding is predominantly from personal funds with few entrepreneurs acquiring funding from financial institutions (Khoase, 2015; Mokoatleng, 2014; Siringi, 2011). Frequently cited reasons for lack of funding by financial institutions are a lack of collateral, lack of a business plan, lack of information required by financial institutions, lack of financial literacy, and high-interest rates for loans (Mokoatleng, 2014; Mazanai & Fatoki, 2012). Mots'oene (2014) pointed out that financial institutions do not provide financial credit to people from disadvantaged economies as they are not considered financially viable. Mobile money platforms which provide accounting services such as financial history over a specific period may deliver an affordable, accessible and acceptable solution for the financial institution (Mramba et al., 2017).

Donovan (2012) recognised a need for time-based movement of money in the form of savings, insurance and loans. However, Dube, Chitakunye and Chummun (2014) observed that savings and loan facilities were not popular despite mobile money service having a positive bearing on financial inclusion. This led Dube, Chitakunye and Chummun (2014) to conclude that there is a need to understand customer choices for financial inclusion better. They support this with a further conclusion that the impact of financial inclusion initiatives could be increased if, amongst regulatory and infrastructure concerns, governments were sensitive to consumer choices.

2.5 Choice Framework

The Choice Framework (Kleine, 2010) is a theoretical framework built on Sen's Capabilities Approach to assess the contribution of ICT to development. Sen's Capabilities Approach posits that development is a

process of expanding the real freedom that people enjoy that leads to the lives they desire (Sen, 1999). The objective of the Capabilities Approach is to measure an individual's economic well-being in terms of capabilities and functionings (Kuklys & Robeyns, 2005). Sen (1999) explains that development is the freedom to make choices from personal, social, economic, and political perspectives.

In Sen's broader scope, economic well-being is the leading indicator of development. Sen stresses the significance of social, cultural and political dimensions of development. Thus, the Capabilities Approach is a paradigm that provides crucial information about a person's well-being and social engagement (Yousefzadeh et al., 2019). However, Robeyns (2003) argued that the Capabilities Approach does not adequately explain or describe the social structures and how individuals use ICTs to make choices. While ICT4D authors have used the Capabilities Approach to understand the impact of mobile money on development (Adaba, Young & Abbott, 2019; Donovan, 2012), our study employs the Kleine Choice Framework (2010), as shown in Figure 1. The Choice Framework places the focus on choice, including the choice of an ICT such as mobile money, as the principal developmental outcome that determines all subsequent development outcomes.

The Choice Framework uses qualitative research methods to gain in-depth information about an individual's choices based on the life they desire (Kleine, 2010). The Choice Framework is geared to ICT4D studies but is equally applicable to other development areas (Kleine, 2010). To maintain the holistic and systemic richness of the Choice Framework, it must be operationalised appropriately, for which Kleine (2010) recommends working systematically backwards from development outcomes through dimensions of choice (degrees of empowerment) to agency and structure.

Development outcomes require the capability to make decisions and are influenced by a person's choice of what they value as part of their life (Kleine, 2010). There are two parts to development outcomes, namely primary outcomes and secondary outcomes. The current study is limited to the primary outcome, which according to Kleine (2010) is the individual's choice. As depicted in Figure 1, Dimensions of Choice result from combinations of agency and structure (Kleine, 2010). Dimensions of Choice are attained when an individual utilises ICT to enhance their lives. Choice comprises two subcategories: Dimension of Sense of Choice, which comprises the existence and sense of choice; and Dimension of Use of Choice which comprises the use and achievement derived from the use of choice. Sense of choice relates to an individual's awareness of a choice while the use of choice is the operationalisation of the identified choice.

Freedom to make a choice may be considered in a given social context relative to a person's resources (Kleine, 2010). Resources refer to material resources, financial resources, natural resources, geographical resources, psychological resources, cultural resources, social resources, education and skills resources, health resources, as well as information as a resource (Kleine, 2010). Structure in the Choice Framework includes formal and informal laws, regulatory policies, norms and customs that frame the empowerment process (Kleine, 2010). However, we restrict the current study to the primary outcome of choice and the relevant dimensions of choice.

2.6 Research Aim and Research Questions

To meet the objective of this study of assessing the use of choice in using mobile money towards the outcome of financial inclusion, we posed the following questions: What mobile money usage choices do MSE entrepreneurs make? And, What dimensions of choice – existence, sense, use and achievement – do MSE entrepreneurs engage in when making mobile money choices?

3 Research Approach

Guided by the Choice Framework (Kleine, 2010), the current study made use of qualitative semi-structured interviews. Interviews were considered an appropriate approach to collect data and provided the ability to engage socially with the respondents who were identified through a purposive-snowballing technique. This sampling method provided referrals from interviewees. The study targeted MSE entrepreneurs from multiple trading industries – food, clothing, health, ICT, hairdressing and saloons. All the interviews were conducted in Maseru, where it was convenient to obtain a sample due to constraints of time and logistics. The respondents were all enterprise owners. Some of the interviews were conducted in English, but most were conducted in Sesotho (Lesotho's national language) and translated into English by the first author. After completion of each interview, the recordings were saved in a .mp3 format, translated and transcribed into text and analysed thematically. Braun and Clarke (2006) hold that thematic analysis is an appropriate method for analysing qualitative data pertaining to well-being. The process consists of six phases, as shown in Table 1. Phase 1 familiarises researchers with the data from which initial codes are generated in phase 2. Phase 3 collates the initial codes into themes which are reviewed in phase 4. Phase 5 refines that themes through an iterative process from which the final output of 3 to 8 concepts is produced (Phase 6).

A pilot study to evaluate the feasibility of the study was undertaken. Based on the pilot study, minor changes were made to the interview guide and the acquisition of a better quality recording device. A total of 23 interviews were undertaken and thematically analysed from which a summary of findings is presented in the next section. The interviews for the pilot project and the main study were all conducted by the first author. All ethical guidelines (dignity, privacy, confidentiality, anonymity, informed consent) were duly approved by the academic institution and were observed by the researchers.

4 Findings

Interviews were conducted with 23 MSE entrepreneurs in Maseru, Lesotho. The respondents represented a range of businesses, as shown in Table 2. The majority of interviewees operated clothing businesses (n=5, 22%) followed by pharmacies and salons (n=3, 13% respectively).

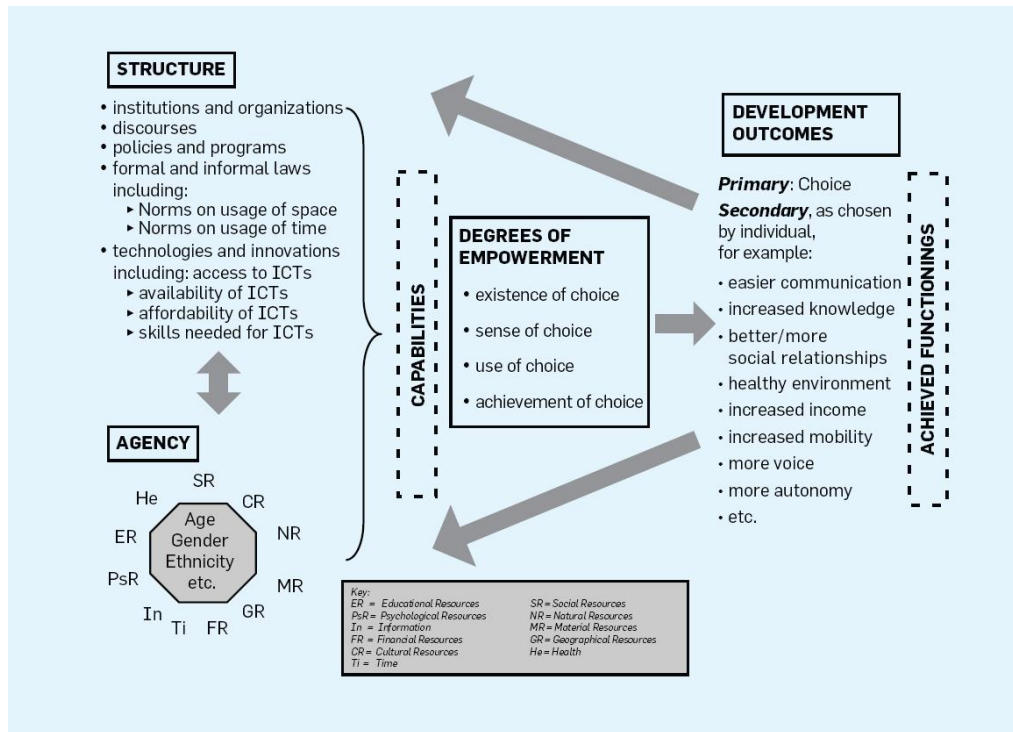


Figure 1. Illustration of Choice Framework (Kleine et al., 2012)

Phase	Description of Process
1. Familiarising yourself with your data	Transcribing data (if necessary), reading and rereading the data, noting down initial ideas.
2. Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes	Checking in the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic map of the analysis.
5. Defining and naming themes	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, the final analysis of selected extracts, relating back to the analysis to the research question and literature, producing a scholarly report of the analysis.

Table 1. Thematic Approach Process (Braun & Clarke, 2006).

Business	Count	Average Years	Business	Count	Average Years
Clothing	5	8.8	IT and Office Equipment	2	8.5
Pharmacy	3	10.0	Stationery and Printing	2	14.0
Salon	3	4.3	Not Specified	2	11.0
General Dealer	2	1.0	Cigarette Vendor	1	5.0
Herbal Products	2	7.0	Cleaning Services	1	4.0
			Total	23	7.3

Table 2. Business Type and Average Years of Operation.

The respondents had collectively traded for an average of 7.3 years. Stationery and printing businesses showed the highest average number of years of trading (average=14 years), followed by pharmacies (average=10 years) and clothing operations (average=8,8 years).

Nine respondents (39%) situated their businesses for accessibility to their market, while three (13%) were located their business based on the availability of space. One respondent (4%) did not have a fixed business location, and another (4%) operated online. The balance of 9 (39%) did not reveal any reasons for the location of their businesses.

The respondent businesses employed between one and eleven staff with an average headcount of 3.5 staff. Skill acquisition by the respondents stemmed predominantly from experience (n=13, 57%) while three (13%) had specialised training. Three respondents (13%) suggested that they require financial skills and one respondent (4%) showed an interest in acquiring marketing skills.

The majority of businesses were registered (n=15, 65%) and four (17%) were not registered. The balance of the respondents did not indicate their registration status. Half of the respondent businesses (n=12, 52%) were explicitly self-funded with one respondent acknowledging the use of bridging loans. The balance of the respondents was implicitly self-funded. For example, respondent four used deposits for funding “... you just deposit it into my M-Pesa account, and I withdraw money. That money I buy t-shirts with it and then print them”.

4.1 Primary outcome

The primary outcome occurred when MSE entrepreneurs chose to use mobile money. For the MSE entrepreneurs, outcomes primarily revolved around achieving a higher quality of life associated with successful enterprises. Mobile money increased revenue and profits, often generating income from commissions on mobile money transactions.

Three primary outcome themes were observed: (1) convenient transacting with improved business outcomes; (2) financial management activities; and (3) financial inclusion and financial information access. The first outcome, having convenient access to financial information, was a goal stated by most of the entrepreneurs. Mobile money provided outcomes of time-saving, empowerment of economically disadvantaged individuals, financial management skills and cost reductions. Respondents found mobile money convenient for transacting. *"I know that when I have deposited money today, tomorrow I can find it at my convenience."* (Res 13). Mobile money made it convenient to process bill payments and to save, transfer and receive funds. *"It has improved my life, like all the money that I have goes to M-Pesa. Whenever I want it, I just go get it. It is just makes my business easy."* (Res 2). Mobile money was more convenient than handling cash. *"It is the easiest way of handling cash."* (Res 23). Mobile money led to improved business performance and increased turnover. *"...but since M-Pesa came in the business flows quite easy"* (Res 2). *"it helps me get increased turnover"* (Res 7). At the same time, mobile money helped the respondents to reduce costs. *"it cut my transportation costs such as putting fuel into my car..."* (Res 12). Overall, mobile money improved respondents' well-being and quality of life. *"It has improved my life like ehh all the money that I have goes to M-Pesa. Whenever I want it, I just go get it. It is just makes my business easy."* (Res 2). *"M-Pesa plays a huge part in my life."* (Res 6).

The second outcome of financial management was observed. Respondents considered mobile money as enabling them to manage money. *"I am able to manage money... Therefore, that enables me to save it."* (Res 4). Respondents also benefitted from more accurate transactions compared to handling cash. *"And while dealing with hard cash that might make a person to miss numbers during calculations. As well as misplacement of cash."* (Res 17).

Thirdly, the respondents pointed out that the use of M-Pesa made them have a feeling of accessing commercial bank services, *"It forms something like a bank where a person can keep money because its fees are quite low as compared to bank fees"* (Res 6). Respondents showed appreciation for financial equality. *"On M-Pesa, there is not platinum members or gold cardholders. All people are the same"* (Res 19). *"I do allow them to use M-Pesa to transfer money to me. Especially those people from the rural areas."* (Res 21).

4.2 Dimensions of Choice

For entrepreneurs to achieve the primary outcomes, choices must exist, and entrepreneurs must be aware of them. The entrepreneurs must also make use of the choices and have the ability to achieve the taking of choice before achieving an outcome. MSE entrepreneurs were observed to identify possible choices. The majority of respondents indicated that cost and access to mobile phones, the usability of mobile money services, education and geographic locations were not barriers for choosing an M-Payment platform. *"M-PESA provider officials came in here and asked me to join so I joined from that time,"* (Res 16) *"they gave me a phone and I didn't pay,"* (Res 16). MSE entrepreneurs guided customers through the purchasing process, especially customers who were not familiar with mobile money

platforms.

The respondents knew about the opportunities that M-Pesa would bring into their businesses. They noted that using M-Pesa could enable them to improve their lives and enterprises' performance - both financial and non-financial performance. It was evident that MSE entrepreneurs knew the opportunities provided to their businesses by M-Pesa. Moreover, the telecoms provider made an initiative of offering free mobile phones to MSE entrepreneurs; hence, it was up to them how they used the resources and opportunities to achieve their desired outcomes. *"...I want to see myself having a better life ... I know that when I have deposited money today, tomorrow I can find it at my convenience."* (Res 13). *"...but since M-Pesa came in the business flows quite easy ... to get more customers..."* (Res 2). *"it helps me get increased turnover"* (Res 7). Respondents used mobile money for business purposes and to transfer and receive money to and from relatives and friends. *"When someone came in to buy a laptop and then payment processing becomes easy through M-Pesa."* (Res 2). *"...M-Pesa helps me transfer money to friends and relatives"* (Res 14). *"Things such as business's water bills and electricity bills can be covered with M-Pesa money."* (Res 22). *"I do pay my employees through M-Pesa. Especially those ones who are working at home."* (Res 11).

Achievement of choice related directly to the primary outcome whereby the use of mobile money combined a convenient method of transacting with financial inclusion and the ability to manage finances. Respondents were impressed with the role that mobile money played in their lives. Most respondents indicated that mobile money influenced their lives significantly. *"We have a lot of customers. So M-Pesa, just like you are eager to know about it, it is one of the technological innovations that helps us a lot ... Through M-Pesa my business was able to broaden its market."* (Res 12). *"That contributed significantly to an increase in customers because today not everyone goes around holding cash. People use M-Pesa or bank cards ... The reason why I am living today it's because of this business."* (Res 10). *"I am now able to help my family as well as myself financially."* (Res 9).

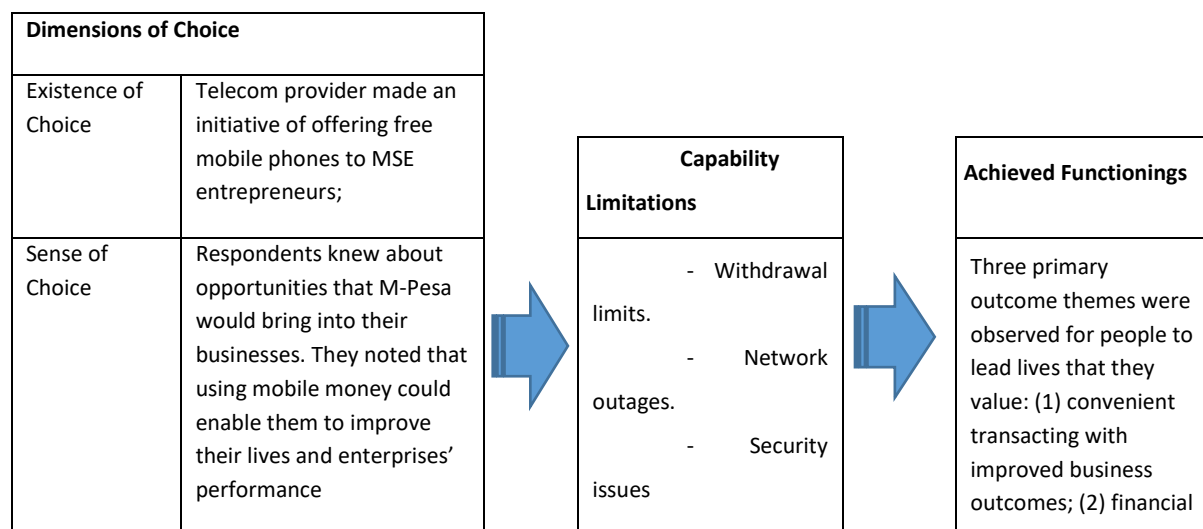
4.3 Limitations Affecting Choice

The respondents pointed out that although mobile money benefited them, they encountered challenges in using the technology. Withdrawal limit, network failures and safety issues were observed. M-Pesa restricted withdrawal amounts for business accounts as well as personal accounts. These restrictions limited access to the MSE entrepreneur limited to their financial information. *"Since I have a lot of customers, even before the end of the month I will be told that I have reached the limit."* (Res 60). *"Limit is a major problem because I often withdraw money from M-Pesa and find that I even exceed a monthly limit."* (Res 4). Network outages were seen to restrict business operations. *"Problems arise when there is no network connectivity. So in that case when a customer has paid we don't get a notification..."* (Res 19). Security issues were a cause for concern. *"I want to use M-Pesa as my bank. So such things need us to have a tight security especially towards late hours. Even when I am walking on streets I know that people already know that I am a bank and there is money with me."* (Res 13).

5 Discussion and Conclusion

This study set out to explore MSE entrepreneurs choice to use mobile money in a developing economy. Using the setting of Lesotho, the current study observed MSE entrepreneurs being aware of the choice to use mobile money. MSE entrepreneurs were shown to choose to use mobile money and achieved positive outcomes from their choices. The findings confirmed that the use of mobile money within the MSE sector enabled micro-entrepreneurs to access financial information conveniently which led to lives that they value (Donovan, 2012). Consequently, calls for additional government and financial institution interventions could be justified from an individual perspective (Aker et al., 2013; Duncombe & Boateng, 2009). Nevertheless, the entrepreneurs faced several issues while using mobile money, including network disruptions, withdrawal amount limits and security risks. Thus, although mobile money provided capabilities for choices to be made, limitations to capabilities hamper development outcomes and achieved functionings as depicted in Figure 2.

Financial exclusion in the global South, particularly in the context of extremely impoverished countries such as Lesotho, remains a significant challenge that ICT4D researchers should seek to understand from various perspectives (Adaba et al., 2019; Tsibolane, 2016). Using Kleine’s Choice Framework (Kleine, 2010), this paper highlights the need to align personal choice and its enablers and impediments in order to gain better insights about the role of ICTs in affording all humans the power to live the lives they desire to live. The implication of this study for state institutions and policymakers is that the creation of enabling structural conditions as well as the diffusion of mobile money products among micro-enterprises can help alleviate the sense of financial exclusion while promoting a culture of savings (Aker & Wilson, 2013). The study had a few limitations. It is a cross-sectional view of the entrepreneurs' experiences located in one city of a developing country where access to technology is superior compared to the majority of the country. Furthermore, the sample of 23 entrepreneurs from the business section of Maseru could be broadened to cover a broader population of entrepreneurs across more sectors of Lesotho life for a more generalisable study.



Use of Choice	Mobile money used to transfer and receive money
Achievement of Choice	A convenient method of transacting with financial inclusion, mobile money influenced respondents' lives significantly.

management activities;
(3) financial inclusion and access to financial information.

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P24: OPEN GOVERNMENT DATA INITIATIVES: OPEN BY DEFAULT OR PUBLISHING WITH PURPOSE

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Abstract

Over the last decade, after a set of Open Government Data (OGD) principles were developed, governments around the world started to radically change their culture on data governance. However, at the implementation stage of OGD initiatives governments needed to consider whether publishing the massive quantities of open datasets did meet public needs for use and re-use, in view of the enormous investment and resources put into the production of publishable OGD. This research-in-progress adopts an exploratory case study approach combining it with a narrative literature review to investigate how the “Open by default” principle and the “Publishing with purpose” strategy were involved in facilitating OGD usage and public participation. The study’s goal is to overview the current implementation of OGD initiatives and to explore best practices when working with open data. We expect to present a new logic model or to show the modification of existing government organisational logic models by analysing the findings on the nature of the New Zealand government effort in opening data up relates with the possible advantage experienced by the government and the public at large.

Keywords: Open Government Data initiatives, open data, Open by Default, Publishing with Purpose, organisational logic model.

1. Introduction

The concept of open data is introduced in the Open Data handbook by The Open Knowledge Foundation (O. K. Foundation, 2009) as “*Open data is data that can be freely used, reused and redistributed by anyone – subject only, at most, to the requirement to attribute and share alike*”. The goal is not only to promote transparency, efficiency and public participation but also to gain social and economic benefits. In an executive order issued by the USA President in 2013 (White House, 2013), it is postulated that the most significant benefit of open data is the provision of information resources that are freely available, easy to find and accessible as open data has high value when shared, and little or no value when locked (Janssen, Charalabidis, & Zuiderwijk, 2012). Furthermore, the value enhancement of open data based on their granularity, accuracy and congruence may contribute to creating new product and service

offerings, coupled with a higher level of accountability (McKinsey, 2014). Of specific importance in the last years has been the demand for Open Government Data (OGD). As per the definition found in the OECD working paper (Ubaldi, 2013) OGD are produced by governments with public funding as a set of policies that aim to boost transparency, accountability and value creation. However, there have also been concerns about how to open government-produced data in order to maximise the benefits of their usage. All levels of government agencies ought to develop policies and processes to unharness relevant, accessible, and beneficial open data to encourage innovation, foster a better-informed public, and build economic opportunities. Moreover, OGD will create a crucial distinction in promoting business innovation and the development of innovative services both within and outside the government that provide and use the data.

The six principles below were elaborated upon by governments, experts, and community stakeholders in order to derive an agreed set of global standards about how to publish OGD (Charter, 2015):

1. **Open by Default:** All government agencies establish a culture of data openness. Data should be readily available to the greatest extent possible.
2. **Timely and Comprehensive:** Release data without undue delay in order to keep their relevance.
3. **Accessible and Usable:** Publish data in a machine-readable format in order to facilitate easy public access for analysis and reuse.
4. **Comparable and Interoperable:** Meeting the agreed data standards will ensure the quality of the open data sets and will increase their value potential.
5. **Improved Governance and Citizen Engagement:** Open data promote information sharing between governments and the public, increase public trust in governments, and promote public participation in decision making.
6. **Inclusive Development and Innovation:** Open data can allow users to innovate and create new social and economic value by integrating OGD with other data.

Following government adoption of the six charter principles, the Open Data Charter was reviewed in 2018. There was a consideration of the core principle “Open by default”; concerns were expressed that adhering to the principle may put too much pressure on governments to open all their data without considering data quality, and disregarding security considerations. It was also suggested that it could be more useful to publish data targeting specific problem domains, or aiming to provide specific public benefits. These reflections resulted in the Open Data Charter 2018 Strategy (Charter, 2018b) that emphasised on “Publishing with purpose”, by driving open data efforts towards delivering an impact. However, the strategy of “Publishing with purpose” raised questions about the approaches towards identifying what data were needed, who might use the data, and why (ODI, 2019).

Current research has investigated to a significant degree how governments shaped their OGD initiatives, focusing on their purpose, and the implementation of data openness. However, less attention has been paid to the causal connection between the effectiveness of the government approach to the OGD principles, and the outcomes achieved by governments (as the data providers) and citizens/organisations/communities as (the data users). The study presented in this paper is part of an ongoing research that explores the process of opening and publishing OGD that involves the internal systems of the government agencies and aims to fulfil public needs. More specifically, this paper

investigates how the “Open by default” principle and the “Publishing with purpose” strategy were adopted in various OGD initiatives.

2. Research background and objectives

The nature of the ongoing research study is exploratory as it focuses on current OGD initiatives, rather than on drawing inferences from the findings of prior research. More specifically, the study’s research question is how the “Open by default” and the “Publishing with purpose” strategies were involved in facilitating New Zealand OGD usage and in attracting public participation aligned with social-economic motivation. It investigates New Zealand OGD initiatives through a case study approach. In particular, rather than evaluate in detail the performance of the New Zealand OGD initiatives, it looks into how the current OGD initiatives adopted the open data publishing principles in order to provide best practice guidance. As a result, we aim to propose a new organisational logic model or a modification of the existing organisational logic model related to the OGD initiative.

3. Related work

3.1 Open Government Data initiatives

The Open Data Charter proposed the Open data framework (Charter, 2018a) in figure 1 as a means to underpin government effort in developing OGD programs. The framework highlights two overarching premises: (1) High-quality production and management of data are required for data sharing, and (2) To enhance benefits, the public as users need to be able to process, use and re-use published data.

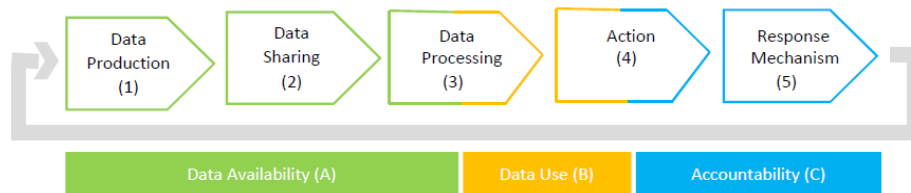


Figure 1. The framework of open data use and impact. Adapted from (Charter, 2018a)

Based on Verhulst and Young (2017), figure 2 presents the six characteristics of open data that are especially relevant in the context of developing economies. Scrutiny, for instance, refers to the provision of details that enhance data quality while flexibility refers to providing a data format that allows repurposing and reusing data in a different context. Another feature, trust, can bring higher levels of accountability and transparency.

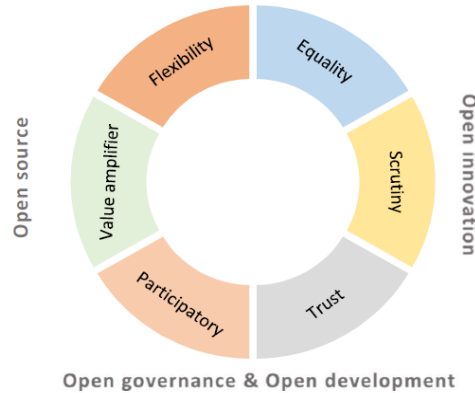


Figure 2. The characteristics of Open Data. Adapted from (Verhulst & Young, 2017)

The implementation of OGD by different government agencies with regards to sharing public data internally and externally presents challenges in terms of work culture transformation and promoting systemic and structural reforms (Matheus & Janssen, 2019). Focusing on the “Open by default “ principle, The Open Data Barometer Leader report (World Wide Web Foundation, 2018) posited that having an open government data initiative and an “open by default” policy was not enough to bring open data up to the point of stimulating creative use. It involves complex shifts to both government culture and systems to adopt the “open data by default” principle. Furthermore, to ensure that the principle can be well adopted, these indicators are needed: sufficient resources, appropriate government policies, and a Right to Information (RTI) and protection framework.

Considerations about applying the “Publishing with purpose” strategy start with the monitoring of how the six Charter principles have been adopted globally (Charter, 2018b). After several decades, governments implemented OGD initiatives; however, organisations advocating the OGD initiatives realised that most of the open data implementations were not driven by user demand, and often ended up with merely opening data up without considering other factors such as data timeliness, accessibility, and comparability.

Taking in all implications, a paper by Crusoe, Simonofski, Clarinval, and Gebka (2019) concluded that most open data published today are hugely underused. Some scholars (Styrin, Luna-Reyes, & Harrison, 2017) compared three country open data ecosystems and found that the potential impact of the OGD initiatives highly depended on the political leadership (W.W.W. Foundation, 2019), on the active OGD initiative promotion, and on the incentives offered by the government. A recently published paper (Wang & Shepherd, 2020) examined in detail information about the United Kingdom Open data - a leader in OGD movement. Sampling the most popular dataset offerings, they found that only 15% were open from the perspective of the ordinary citizen, equating to 0.05% of the population of all datasets available at the UK OGD portal (data.gov.uk). Moreover, approximately 6 out of 10 datasets did not contain granular data, while 4 out of 10 data sets were significantly aged (more than 30 months old). The investigation revealed that the UK OGD initiative did not meet the open data charter principles 2, 3

and 4.

3.2 New Zealand Open Government Data

The data portal data.govt.nz was launched in 2009. The site acts both as a portal and as a citizen engagement platform, to make non-personal government-held information more discoverable, usable and relevant (NZDIA, 2009). The portal is not a data repository rather it is a catalogue of existing government agency websites. Based on interviews, a web survey, literature sources, and comparisons with other government portals, an independent review published in 2011 (Stott, 2011) concluded that although the portal was well designed and was professionally ran, the datasets were still under-used, and were insufficiently well known internally and externally. Responding to the recommendations provided in the review report, the New Zealand government set up a regularly updated open data action plan supported by an implementation plan then was monitored by conducting a quarterly assessment. The main challenges for the New Zealand government in implementing the open data action plan were the shift to a sustainable open data culture and the reluctance to support and use open data, the lack of appropriate government agencies and user capabilities, and the difficulties related to delivering data from different sources and in different formats (StatsNZ, 2018).

To ensure high-quality open data, the principles for managing New Zealand government data and information were approved by the New Zealand cabinet on 8 August 2011 (Cabinet, 2011). It was postulated that data should be open, protected, readily available, trusted, well-managed, reasonably priced (preferably free) and reusable. The commitment was reaffirmed in the National Action Plan 2018-2020 (NZSSC, 2018).

Figure 3 depicts the three themes of the plan (NZSSC, 2018), including government commitment. The plan was developed with the input of engaging citizens and community groups; the comprehensive discussions resulted in 449 ideas which were incorporated into these three themes.

4. Study methodology

The ongoing study follows an exploratory case study approach that allows to present multiple perspectives on OGD actors, activities, policies, and documents. The issues identified are the results of interpreting the data gathered from study participants, in the light of the information gathered from OGD related policies and other documents. The study was designed to include a two-stage data collection process. At the first stage (in 2019), data were collected by semi-structured interviews with participants from 10 government agencies and organisations in New Zealand. The second stage involved collecting data from the New Zealand OGD reports. To address the research question (see section 2), semi-structured interviews employing open-ended questions were used; these interviews were often accompanied by follow-up “why” or “how” questions. The interviews were conducted with one participant at a time for about 40 – 50 minutes at their office premises or using virtual sessions.

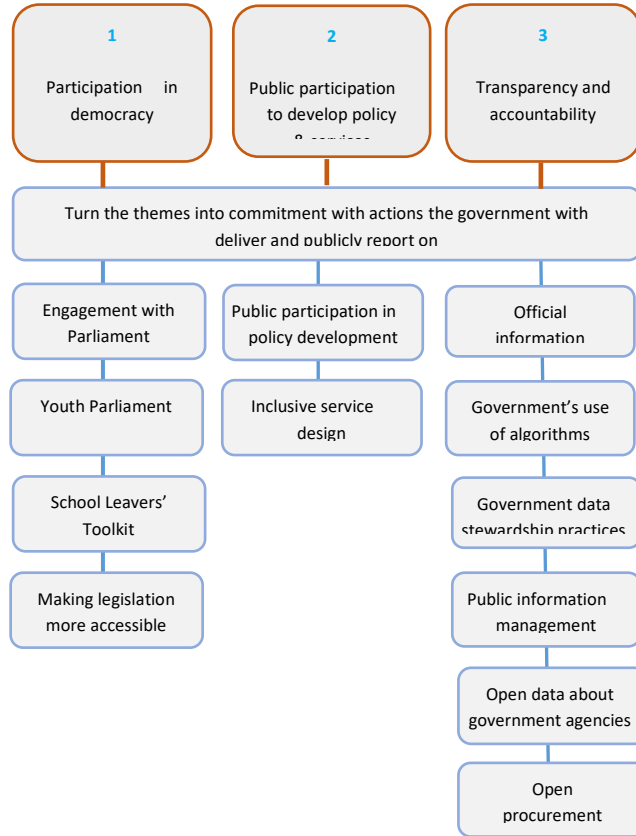


Figure 3. The National Action plans 2018-2020 themes. Adapted from (NZSSC, 2018)

The participants were either government officers or employees in organisations that collaborate in OGD programs. The participants were selected for their expertise and experience about OGD implementation and use in New Zealand. All participants had technical skills related to OGD and were knowledgeable about the ways the data were used within their respective organisations.

Overall, the research design was iterative and began with a review of the literature in order to understand what was previously investigated and currently implemented, followed by the interviews with experts in OGD; the data from those interviews are currently being coded. To increase the accuracy in interpreting the qualitative data, a thematic analysis approach including the inductive coding will be applied (Boyatzis, 1998; Saldaña, 2015).

5. Summary and expected results

In this paper, we review the literature in order to analyse current research in OGD initiatives and the implementation of the New Zealand OGD plan. We expect that the study will contribute essential insights on how OGD initiatives can best move forward, by exploring the case study of the New Zealand OGD initiatives, and proposing a new organisational logic model (or a modification of the existing one).

More specifically, the study will identify and compare the factors influencing the adoption of “Open by default” or “Publishing with purpose” principles, and the expected outcomes of each strategy. Currently, we are analysing the qualitative information gathered from the case study findings and the narrative literature review in order to obtain comprehensive answers to the research questions. The continuing analysis that will lead to the development a business model of organisations using OGD is part of our future work.

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P25: PROBLEMS ASSOCIATED WITH OLDER ADULTS' ADOPTION OF ROBO ADVISORS: AN EMPIRICAL STUDY

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Abstract

In the recent years, Robo Advisor, a digital platform that provides automated, algorithm-driven financial planning services, has increasingly received attention from users of different demographics. Many users have taken advantage of its features to automate their saving and investing activities. However, users in an older age group, specifically, those aged fifty or above, have been seen with low adoption of the robo-advisory services. This empirical study is designed to explore the problems associated with older adults' adoption of robo advisors. Specifically, this study intends to examine whether mental health of aging adults affects their intention to use robo advisors. In addition, I hypothesize that perceived usefulness may mediate the effect of mental health on behavioral intention towards using robo advisors, such that it serves to explain why various levels of mental health would result in differences in intention to use (i.e. approach or avoid robo advisors). To explore solutions for non-adoption, I identify three external variables (i.e. social influences, accessibility, and learning support) that could possibly moderate the main effects of mental health hypothesized in the study, so that when either of these variables is present and strengthened, it will enhance likelihood of using robo advisors.

Keywords: Robo Advisor, Technology Adoption, Mental Health, Older Adult, Financial Service.

1. Introduction

Robo advisor is an artificial intelligence software that automates and assists management of investment (Belanche et al., 2019). In contrast to traditional human advisory services, robo advisory services reduce fees and provide 24/7 access to finance (Park et al., 2016). Comparing to traditional financial services, several functionalities that make robo advisors uniquely attractive to users are: lower minimum balance to maintain the account, automation of money managing and investing activities, trading fractional shares of securities (low barrier of entry), and sometimes automatically minimizing tax on selling or transferring of investment. The top robo advisory services on the market today are registered investment advisors, therefore, are subject to fiduciary standards. In other words, robo advisors must act in the best interest of their users.

While robo advisors are continuously attracting attention from users with various demographic and socioeconomic backgrounds, not much is known about factors that lead to the adoption and the use of robo advisors. Specifically, studies that dig into how robo advisors are adopted and used among older

users do not exist. According to a report released by the Center for Disease Control and Prevention (CDC, 2008), three mental health issues are becoming prevalent among older adults: anxiety, cognitive decline, and depression, and they are influencing older adults' behaviors and decisions in their daily life. In addition, a big challenge faced by older adults today is a financial one, that is, the challenge in personal finance and retirement planning (Stanford Center on Longevity, 2018; Loibl, 2017; Sixsmith et al., 2014). A book recently published in the University of Pennsylvania Wharton School Pension Research Council series (Agnew & Mitchell, 2019), found that older adults' mental health issues affect their abilities to cope with financial stress. A robo advisor, due to its financial expertise and automation, appears to be a viable solution to assist older adults in dealing with this kind of stress. However, the process of getting comfortable with new technology is a steep learning curve for older adults. This is especially true for those who have mental health problems. Therefore, it is possible that having mental problems could result in negative attitudes of older adults towards using robo advisors.

Furthermore, although older adults with mental health problems may refrain from using robo advisors, the reason why is unknown. One possible explanation is that low mental health level contributes to negative beliefs that robo advisors are actually not useful. Prior studies have found that, the perceived usefulness of the technology is one important factor to determine whether older adults would adopt a technology (Zhou et al., 2014; Braun, 2013; Dear et al., 2013). In addition, other external factors that can be considered in affecting older adults' adoption of robo advisors are: social influences, accessibility, and learning support. Social influences mean that elders change their behaviors according to the standards of the society they live in. It has been suggested that older adults will use a new technology just to "keep up with society" (Kuerbis et al., 2017). Therefore, it is interesting to look into whether social influences could make older adults more likely to use robo advisors when they may be unable to see the usefulness of this type of technology due to having lower mental health. Moreover, accessibility simply means that robo advisors are easy to use to the elderly (Czaja, 2006). They should be able to navigate the interface and interact with features without a hassle; learning support is an environment in which necessary help is provided to users so that they can adequately use the technology to complete tasks. It is possible accessibility and learning support can potentially alter the effect of mental health conditions of elders on their perceived usefulness of robo advisors. For instance, when mental health is low, they may still be able to see the usefulness, and therefore become inclined to use the application, if greater accessibility is integrated in the app and help is given.

In summary, this research study is interested in knowing whether older adults' mental health conditions can impact perceived usefulness of robo advisors, and therefore influencing them to approach or avoid this type of technology. One purpose of this study is to examine whether perceived usefulness can explain why different levels of mental health can induce older adults' to adopt or avoid robo advisors. The other purpose is to determine whether the effect of mental health on intention to use robo advisors differs in dependence of social influences, as well as whether higher or lower mental health affects older adults' beliefs of usefulness to be different in dependence of accessibility of the application and learning support resources available to them. Older adults are particularly of interest to the research because, compared to a younger demographic, older adults have a very different attitude and learning culture in connection with the use of technology (Arning & Ziefle, 2007). The results of this research study will

provide insights for financial advisory services, brokerage firms, financial institutions, as well as their technology providers to develop and configure robo advisors that are elder-friendly. Especially, for those with mental health conditions, enabling older adults to overcome the impact of mental problems to utilize new technology and build wealth as they are aging. Meanwhile, the successful introduction of robo advisors to older age groups can bring a competitive advantage for many firms in the finance sector (Park et al., 2016).

2. Theoretical Development and Hypotheses

Studies found that people age 55 years or older experience some type of mental health condition. The most common conditions are anxiety, cognitive decline, and depression (CDC, 2008). Mental health influences older adults' motivation to engage in technology. For example, one study found that among Medicare beneficiaries 65 years or older, "depression and anxiety were negatively related to internet use" (Kuerbis et al., 2017; Choi & DiNitto, 2013). Cognitive change may potentially impact older adults' ability to engage with technology. Research have found that cognitive abilities such as visual-spatial ability, memorizing, and problem solving decline with age, making the technology more difficult to use. (Chevalier et al., 2013; Pak et al., 2009; Juvina & Taatgen, 2009). In Kuerbis et al.'s review of related literature (2017), cognitive decline leading to slower learning processes of the older age groups is found in several empirical studies (Chevalier et al., 2013; Hanson, 2011; Czaja et al., 2006). As evidently shown, when mental health problems are present, learning a new technology becomes less straightforward to older adults. As a result, they are more likely to avoid it. Therefore, when concerning robo advisors, it can be argued that:

H₁: Mental health levels of older adults have a significantly positive effect on their intention to use robo advisors.

In the context of this study, the mental health level is a variable that represents an older adult's perceived mental healthiness of themselves. And, mental health is reduced by three common conditions (i.e. anxiety, depression, and cognitive decline). Not to mention, it is possible that when mental problems prevent older adults from properly operating robo advisors, they will unlikely be able to complete the intended task. As a result, they will unlikely view the technology to be useful (Agnew & Mitchell, 2019). It can be further argued that, lower mental health level leads to lower perceived usefulness of robo advisors.

H₂: Mental health levels of older adults have a significantly positive effect on perceived usefulness of robo advisors.

Perceived usefulness can also be seen as a fundamental determinant of the adoption of various types of technology (Davis, 1989). Studies also found that, among older users, when benefits of utilization are not clear, they are more likely to choose not to engage in that technology (Chen & Chan 2013; Mitzner et al., 2010; Czaja et al., 2006). This could also be true when older adults evaluate the usefulness of robo advisors.

H₃: Perceived usefulness has a significantly positive effect on older adults' intention to use robo advisors.

Social influences refer to situations in which people change their behaviors to agree with others in society. A number of studies have reported that older adults see using technology as a "basic skill" and a way of "keeping up with society" (Kuerbis et al., 2017; Damodaran et al., 2014; Chen & Chan, 2013). For that reason, it is possible to argue that when social influences are strong, older adults with lower levels of mental health may still be willing to use robo advisors. Consequently, it can be hypothesized that:

H₄: Social influences moderates the effect of mental health levels of older adults on their intention to use robo advisors.

Accessibility is the robo advisor's quality of being able to be used by an older age group. This factor is especially important to older adults during the time of retirement because retirement planning is a very complicated process and can hardly be automated by machine (Agnew & Mitchell, 2019). Therefore, it is critical that robo advisors are designed in keeping with financial needs associated with aging.

Accessibility could potentially moderate the effect of perceived mental health on perceived usefulness such that when higher accessibility is integrated in the robo advisor, an older adult with a lower level of mental health may still be able to realize its usefulness (Kuerbis et al., 2017). Therefore, it can be argued that:

H₅: Accessibility moderates the effect of mental health levels of older adults on perceived usefulness of robo advisors.

The context of learning is important to older adults who want to learn to use technology. For them, there are primarily three ways of learning regarding utilization of technology: reading a manual, receiving instruction from other people who have the know-how, and "trial and error" (Barnard et al., 2013). In a supportive environment, older adults are able to quickly learn to perform basic tasks (Barnard et al., 2013; Broady et al., 2010; McLeod, 2009). In the adoption of robo advisors, when substantial learning support is provided, elders with mental health conditions may be able to overcome the impact of the mental condition and understand how to use robo advisors properly, resulting in believing "robots" to be useful.

H₆: Learning support moderates the effect of mental health levels of older adults on perceived usefulness of robo advisors.

Finally, considering that whether mental health level is high or low may affect perceived usefulness of a robo advisor, which in turn may influence an older adult's intention to use it. It can be hypothesized that:

H₇: The effect of mental health levels of older adults on their intention to use robo advisors is mediated through perceived usefulness.

Figure 1 illustrates the research model:

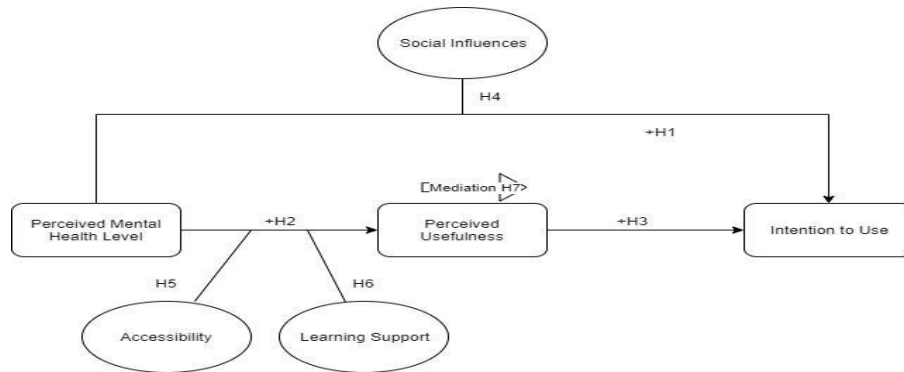


Figure 1: Research Model

3. Research Methodology Overview

3.1 Research Design

Based on findings from related research studies, a conceptual research model (Figure 1) is developed to describe relationships hypothesized in the section above. Surveys will be developed and distributed to participants to measure each construct specified in the model. Measuring items will be selected from prior related studies, but will be redefined to fit the current context. This study focuses on the individual older adult as the unit of analysis. 7-point Likert scales will be provided for participants to respond to each question (from “1” – “Strongly Disagree” to “7” – “Strongly Agree”). “Older adult” refers to persons who are 50 or above in age because cognitive changes begin to take place at the age of fifty, interfering with technology engagement (Hanson, 2011). These participants will be assessed for their mental health state, and data will be collected from a balanced mix of mentally healthy individuals and those with some signs of mental conditions (i.e. anxiety, depression, and cognitive decline). For each participant, an average score will be computed to represent their overall mental health level. An additional assessment will be conducted prior to the study, to ensure that participants have similar levels of knowledge and experience about technology. Those who have substantial experiences of using robo advisors will not be selected for this study. The assessment also ensures that participants have similar levels of financial experience and knowledge. An introductory video will be sent to inform participants what a robo advisor is, its basic functions, and how to use it. Each survey will be accompanied with a questionnaire to collect demographic and socioeconomic information about participants.

3.2 Data Collection and Analysis

The survey will be conducted in the United States, and responses will be collected from a sample of 300

adults aged 50 or above. The participation is limited to this age group as they are of interest in this study. To ensure that the sample represents a diverse population and an even split in terms of demographic and socioeconomic variables (i.e. gender, marital status, education, and income), the study will administer data collection online using Qualtrics survey software. Before distributing surveys, to check content validity, faculty at the author's institution who have expertise in the topic of interest will be invited to evaluate the appropriateness of language and content of each measuring item. Pilot tests will be conducted with smaller samples and exploratory/confirmatory factor analysis and reliability analysis will be used to ensure construct validity and reliability of measuring items (Straub, 1989). Data analysis will be conducted in SPSS. All hypotheses except H₇ will be tested using multiple regression while controlling participants' gender, marital status, education, and income. The testing of H₇ will be conducted by using PROCESS Macro, which facilitates mediation analysis. Preferably, bootstrapping will be used as it is a robust analysis in testing the significance of indirect effects (Hayes, 2018).

4. Contribution

This research intends to validate a research model that can effectively provide explanation to some key issues associated with the technology adoption of an older age demographic. First, the research finds that various mental health conditions may prevent older adults from using robo advisors. Second, the research identifies external variables that may aid in the development of solutions to mitigate older adults' non-adoption of robo advisors. Financial planning for older adults need to be thought carefully through as they are a vulnerable group that hardly recovers if significant financial loss occurs due to poor planning strategies. Therefore, their mental process of adopting robo advisors should be understood for development and improvement of financial services technology to minimize risk of financial loss and maximize benefit of planning. Theoretically, this research sheds additional light on the process of technology adoption by focusing on a unique age group and a novel technology for a specific purpose. Practically, financial services firms and their technology providers can consider the insights provided in this study when developing and implementing robo advisory services to better serve the needs of older clients. This will create a win-win situation that both firms and clients can benefit from cutting-edge technology.

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P26: SELF-SERVING BIAS IN INTELLIGENT SYSTEMS: A CASE OF PHISHING WEBSITE DETECTION SYSTEM

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Abstract

Intelligent systems built on machine learning (ML) and artificial intelligence (AI) have enabled a wide range of applications with capabilities and functions far exceeding those of human beings. When human beings and intelligent systems jointly make decisions and complete tasks, human beings make a cognitive assessment on the capability of the intelligent system. A biased assessment could lead to devastating consequences in system use. In this study, we develop a research model to examine the self-serving bias toward intelligent systems and the sources of the bias in the context of intelligent phishing website detection system. Our model suggests that the capability of the intelligent system in terms of detection accuracy is one key factor contributing to the self-serving bias in personal capability. The task difficulty, outcome value of decision, and social loafing are other factors influencing the bias. On the other hand, personal traits and illusion of control are two major sources for self-serving bias toward the intelligent system.

Keywords: Machine Learning, Artificial Intelligence, Intelligent System, Phishing Website Detection System, Security, Self-Serving Bias, Task Difficulty, Social Loafing, Illusion of Control, Big Five Personal Traits

1. Introduction

Machine learning (ML) and artificial intelligence (AI) are now pervasive and become an integral part of everyday life. They have enabled a wide range of applications with capabilities and functions far exceeding those of the human beings. Experts foresee a future society in which people live and work alongside with ML and AI systems and devices (collectively we call them intelligent systems) such as household AI gadgets and robots, data analytics systems and AI machinery (Rai et al. 2019). Literature suggests that humans socially react to an intelligent system (e.g., a robot) and make their cognitive assessment on its capability. Biased assessment could lead to devastating consequences in the use of the system. The automation literature reports many of such cases (e.g., aircraft accidents and incidents due to a biased assessment and consequent mistrust) (Parasuraman and Miller 2004).

In this study, we examine the self-serving bias toward intelligent systems and its sources. We focus on the self-serving bias in personal capability and the self-serving bias in system capability in terms of failure (blame attribution). The former refers to an individual's bias toward his/her own capability over

that of the intelligent system, and the latter is defined as one's bias toward the responsibility of intelligent system for failure or error. Following the attribution theory and literature (Monson and Snyder 1977), we develop a research model to investigate the self-serving bias and its consequence in the context of ML and AI. The specific intelligent system we examine in this study is a phishing website detection system. Our model suggests that the capability of the intelligent system in terms of detection accuracy is one key factor contributing to the self-serving bias in personal capability. The task difficulty, outcome value of decision, and social loafing are other factors influencing the bias. On the other hand, personal traits and illusion of control are two major sources for self-serving bias toward the intelligent system.

2. Self-serving Bias and Intelligent System

The concept of self-serving bias comes from the attribution theory that describes the attribution process by which individuals explain the causality of behaviors and outcomes (Kelley and Michela 1980; Monson and Snyder 1977). Self-serving bias is a bias that people attribute socially desirable behavior and success to internal factors such as intelligence, skills, and personal traits, and socially undesirable behavior and failures to external factors such as others' acts, luck and social fairness (Monson and Snyder 1977). For example, students tend to attribute a good grade to their effort and intelligence, and a bad grade to a lousy teacher or bad luck. The biased attribution is due to people's strong tendency to protect and maintain self-esteem and likable image. Self-serving bias has been used to explain the attribution of the causality of behaviors and outcomes in many interpersonal relationships (e.g., workplace relationships) (Harvey et al. 2014).

Prior research also found effects of self-serving bias in situations of human-machine and human-computer interactions. People tend overestimate their own abilities and take credit for a successful joint task, but more or less blame the machine/computer for the error or failure (Gogoll and Uhl 2018; Moon 2003). As intelligent systems are getting more sophisticated and widely deployed, researchers have shown a growing interest in human relationship and interactions with such systems (e.g., human-robot interactions). They found the evidence of self-serving bias in the context of human-intelligent system interaction. People tend to disregard the criticism coming from the robot (You et al. 2011), credit themselves for winning a computer game while attributing the AI for losing a game (Vilaza et al. 2014), and show less trust in the robot if it blames users for the error (Kaniarasu and Steinfeld 2014).

Although the self-serving bias was observed in the context of human-intelligent system interaction, little research has examined the causes of self-serving bias. This study combines users' psychological traits with their perceptions of the intelligent system to examine the sources of self-serving bias and the consequences of self-serving bias in system performance. More specifically, we investigate the antecedents of self-serving bias in the context of human-intelligent system coordination in detection phishing websites. We chose this context because to the best of our knowledge, self-servings bias has not been studied in the domain of intelligent security systems, while the consequence of the bias may have a direct effect on system security and detection performance.

3. Hypothesis Development and Research Model

Attribution theory suggests that the self-serving bias occurs when people attribute desirable outcomes to internal causes and undesirable outcomes to external causes. The theory does not systematically explain the reasons behind the self-serving bias, but attribution literature shows there are motivational reasons, cognitive reasons, and personal differences that cause the self-serving bias (Mezulis et al. 2004; Shepperd et al. 2008).

3.1 Motivational Reasons

The psychological assumption for self-serving bias is that people have strong intention to maintain self-image and self-worth. When the outcome is important and valuable to self-image and self-worth, individuals have strong motivations to defend self-image and self-worth, and display the self-serving bias (Shepperd et al. 2008). When facing phishing websites, users perceive differently of the consequences of detection outcomes (success or failure). They are more motivated to defend their self-image and show a self-serving bias when they perceive a high value of detection outcome because a success in avoiding a phishing website is important for their self-esteem. When the intelligent phishing detection system fails, users tend to be more frustrated if they perceive the loss from the failure is high, and thus tend to have the blame attribution to the system.

H1: outcome value is positively associated with the self-serving bias in blame attribution of the detection system.

Another motivational factor related to the self-serving bias is controllability (Shepperd et al. 2008). To protect self-image and self-worth, individuals have strong desires to control the outcomes and demonstrate self-enhancement. Controllability is a hard-wired human need, but, in many circumstances, controllability is an illusion and for the self-serving purpose. Illusion of control—a false perception of ability to control the environment for the disable outcomes—leads to an overestimation of the system ability (Miller and Ross 1975). In human-automation interactions, when operators overestimate their control capability, they tend to overestimate their performance (Parasuraman and Miller 2004). In line with this reasoning, we argue that users tend to show self-serving bias when they perceive that they determine the outcome of the joint-task of detecting phishing website.

H2: illusion of control is positively associated with the self-serving bias in self-capability.

Social loafing has been observed in many social settings (e.g., technology-supported teamwork setting) (Alnuaimi et al. 2010). It is defined as “the reduction in motivation and effort when individuals work collectively compared with when they work individually” (Karau and Williams 1993, p. 681). Similar behaviors were found in human-automation settings in which human operators reduced their efforts and took less responsibility when they worked alongside with the automation for a joint-task or decision making (Skitka et al. 2000). By the same token, we argue that when using an intelligent detection system

to detect phishing websites, users who show more signs of social loafing tend to attribute the blame to the system for detection failure.

H3: social loafing is positively associated with the self-serving bias in blame attribution of the detection system.

3.2 Cognitive Reasons

Attribution literature suggests when people make self-serving attributions, they believe their attributions are based on an objective evaluation of the evidence, though sometimes the objectivity is a false perception (Shepperd et al. 2008). For example, people make performance assessment and form their performance expectations prior to making self-serving attributions. Therefore we argue that during human-intelligent system interactions, users examine the system's overall preformation before making self-serving attributions.

H4: Perceived overall accuracy of the detection system is associated with (a) the self-serving bias in self-capability and (b) the self-serving bias in blame attribution of the detection system.

People have cognitive constraints when handling a complex task. Thus, when people judge that the unexpected outcome (e.g., failure) arises not from the stupidity of the people or the machine, but from the complexity/difficulty of the task, they are less likely to make self-serving attributions (Dzindolet et al. 2002; Shepperd et al. 2008). In line with this reasoning, we posit that a user's perception of the task difficulty of detecting phishing websites demines how likely he/she is to make self-serving attributions.

H5: task difficulty is negatively associated with (a) the self-serving bias in self-capability and (b) the self-serving bias in blame attribution of the detection system.

3.3 Personal Differences

The literature review on attribution theory suggests there are personal difference factors influencing the magnitude of the self-serving bias (Mezulis et al. 2004). For example, individuals with anxiety and depression show greater self-serving bias than those without. Individuals who have developed stable traits and personalities exhibit a consistent level of self-serving bias (Mezulis et al. 2004). Particularly, Big Five personal traits (neuroticism, openness, conscientiousness, agreeableness and neuroticism) were found to influence the biases in self and others in interpersonal relationships at workplace (Judge et al. 2006). Thus, we argue that in the context of human-intelligent system interaction, users' personal traits determine their self-serving bias.

H6. Big Five personal traits are associated with (a) the self-serving bias in self-capability and (b) the self-serving bias in blame attribution of the detection system.

3.4 Consequence of Self-serving Bias

Biases in automation can have significant consequences such as performance (Parasuraman and Manzey 2010). With a biased perception of the automation, a user tends to change his/her way of using the automation, resulting in its varying performance. When the capability of the automation far exceeds the user, the bias leads to low performance. The accuracy of a state-of-the-art intelligent phishing detection system is much higher than that of the users (Abbasi et al. 2015). Thus, their self-serving bias in self-capability could negatively impact their performance since they tend not to heed warnings from the system.

Moreover, when individuals show the self-serving bias in blame attribution, they tend to be less diligent in performing the joint-task, because they believe they have co-targets for the blame of failure. Reduced effort and increased complacency lead to errors and failures. By the same token, when users have the intelligent system to take the blame for detection errors, users tend to reduce their effort and attention to warning signs on websites and the warnings issued by the detection system, resulting in low performance.

H7. the self-serving bias in self-capability is negatively associated with the system performance.

H8. the self-serving bias in blame attribution is negatively associated with the system performance.

Together, the above hypotheses form the research model for this study.

4. Research Design

We will conduct a Web-based experiment to test the hypotheses. We use a $2 \times 3 \times 2$ between-subject design. The first factor, screen control, varies at two conditions—with choice and without choice. Screen control may give users an illusion of control since in the with-choice group, users are only given a choice of selecting the warning message styles for the detection system, while in the without-choice group, users will see a standard warning message from the system. The warning message style has no impact on the ML algorithm of the detection system and detection outcomes. The second factor, detection accuracy, is administered at three levels: 95%, 90%, and 85%, representing high, medium and low accuracy. This factor influences users' perceptions of detection accuracy. The third factor, detection domain, varies in two domains: online banking vs. social media. The factor affects users' perceptions of outcome values because in comparison with social media, online banking directly ties to users' finance and the consequence of detection failure is more severe. The participants will be randomly assigned to one of the 12 conditions during the experiment. They will be asked to determine if a set of websites are phishing or not when the intelligent detection system provide them the detection outcomes. But they can choose not to follow the detection system. A pre-experiment survey and post-experiment survey will be conducted. Participants will answer the questions related to their personal traits, past experience and demographic information in pre-experiment survey, and the questions related to the experiment in the post-experiment survey. We plan to recruit about 300 subjects to participate in the experiment. We will recruit them via various social media and control for age, gender, education, and

security knowledge when analyzing the data.

5. Discussion and Conclusion

Human beings now have to interact with AI and ML systems at work, in school and at home. In the near future, such systems may become “intellect beings” to coexist with us and we rely on them to make critical decisions and jointly complete work (Parkes and Wellman 2015). There is a need to understand how our biases are formed and influence our decisions and tasks when “intellect beings” participate in. The understanding may help us build an ideal relationship between human beings and intelligent systems and achieve desirable outcomes. In this study, we examine the formation of self-serving bias and its impact on detection performance in the context of human-intelligent phishing detection system interaction, based on the attribution theory and literature. The study has theoretical and practical implications. Theoretically, this study presents a research model to examine the formation of self-serving bias in human-intelligent system interactions and the impact of the bias on joint-task performance. The study contributes to the attribution literature by providing a theoretical model to explain the attribution of the causality of behaviors and outcomes in an emerging context: human-intelligent system interaction. The study also contributes to the human-computer interaction literature by examining the blame attribution in the emerging context. Additionally, this study contributes to the behavioral security research by introducing the concept of self-serving bias.

Moreover, the findings from this study can help practitioners to address the self-serving bias through system design and prevent the negative effects of the bias before system implementation. Our research model shows that even in a context where the interaction is minimal and the task is secondary to users (security is a secondary task to most users), there are dispositional, motivational and cognitive reasons for the self-serving bias. This indicates a need of customization for detection systems to address the self-serving bias issue due to personal, motivational and cognitive differences.

In conclusion, this study examines the self-serving bias in an emerging context of human-intelligent systems interaction. The study not only enhances our knowledge toward human biases toward automation, but also points out the importance of future research to investigating different biases in such context since human-intelligent systems interactions will become more and more ubiquitous and complex in the near future.

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P27: SOLUTIONS TO INCREASE MOBILE MERCHANT PAYMENT APPLICATIONS VALUE, CUSTOMERS' CONTINUED INTENTION TO USE, AND LOYALTY

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Abstract

The use of mobile payment applications is on the rise. There are a variety of mobile payment applications that attempt to offer value to increase the market share of merchants that provide them. However, many users are likely to stop using apps if optimal utility and customized services are not correctly delivered. This study proposes that offering context-based services that indicate customization and personalization of services will improve the perceived utility of mobile merchant payment applications and in turn, increase continued intention to use it and customer loyalty to the merchant. Our results also show that the reputation of mobile vendors significantly enhances the perceived utility of mobile merchant payment applications. The findings of this study can be valuable to researcher, merchants and mobile application developers.

Keywords: Context Awareness, Calculus Theory, Mobile Application, Mobile Payment, Utility, Personalization, Privacy, Technology Adoption.

1. Introduction

Technology has long been recognized as an enabler of competitive advantage. In fact, competing brands often gain a competitive advantage by using technology to connect to customers to offer products and services, build loyalty and retention, lock in customers, and increase switching costs (Faulds et al., 2018). However, it is difficult to understand how customers choose to use one information system (IS) over the other to procure products and services. In the IS research community, system use is often predicted by measures of perceived ease of use and perceived usefulness. However, these IS theoretical models are commonly used to predict system use by employees within organizations. One possible way of increasing our understanding of customer behavior as they interact with IS in hyper-competitive environments, is to include the perceived value construct in IS theoretical models. The marketing literature recognizes the perceived value construct as one of the most critical measures for gaining competitive advantage (Petrick, 2002). Particularly when IS is used by external customers, in-depth learning about what customers value about IS may help guide managers on how to respond. Further,

because a customer finds an IS useful or easy to use, it does not necessarily mean that the IS provides excellent value. It is quite possible that a customer who finds an IS easy to use or useful may consider it poor value if the costs of using the IS outweigh the benefits (Manis & Choi, 2019). One case of note is that of mobile payments. Mobile payments service providers in the United States face significant challenges in motivating consumers to adopt mobile payments in a retail environment. In the U.S., the mobile payments market space is highly fragmented and filled with many competitors such as Apple Pay, Samsung Pay, and PayPal. With only 37.2% of the U.S. population reporting the adoption of a mobile payment solution of some kind (Wester, 2014). To increase adoption, mobile payments must achieve higher penetration into the consumer base, for instance, providing value-added services like purchase-tracking or loyalty program integration that creates added incentives for consumers to part with old payment habits (Wester, 2014). Essentially, mobile payments providers need to offer products that add value beyond the payment and to integrate mobile payments into the overall consumer experience.

Unlike consumers in developing countries such as Kenya, proving mobile payments' value propositions to consumers has been challenging, and it has been difficult to show how mobile payments are a more valuable payment mechanism than cash and credit cards. Little is still known about what factors will make consumers in the U.S. choose mobile payments over other payment mechanisms and other competing mobile payment providers. Traditional IS constructs, such as perceived ease of use and perceived usefulness, are just a small part of the value proposition for consumers. Thus, a greater understanding of customer's use of IS in a retail environment is needed than what popular IS constructs, such as perceived ease of use and perceived usefulness, can provide. Since perceived value has been found to be an essential indicator of repurchase intentions in the marketing literature (Petrick, 2002), it could be applied to the IS field to determine consumers' intentions to reuse IS. Valid and reliable measures of perceived value would allow for comparison of value between competing IS applications such as mobile apps. It would allow individual apps providers to identify the dimensions of perceived value in which they perform well or poorly. Though research has focused on the business value of IS, a multi-dimensional scale for the perceived value of IS services and applications from the consumer perspective still does not exist.

Therefore, the purpose of the current study is to develop a multi-dimensional scale for the perceived value of a customer information system. We will illustrate the scale's usefulness by applying it to the mobile payments retail environment. By doing so, we will gain insight as to which factors make a mobile payment app valuable and competitive.

2. Literature Review

Although the popularity of mobile payment systems has increased in recent years, so has privacy and security concerns associated with them. Privacy has been a central issue in the adoption and use of technology-enabled products or services. Several studies have shown that greater concerns regarding information privacy, will lower the individual intentions to use online services (Belanger & Crossler,

2011). Privacy concerns also lead to less voluntary sharing of personal information via the Internet (Belanger & Crossler, 2011). However, among the stream of research on privacy, there are contradictory results. Some researchers found that unauthorized use of secondary data does not have an impact on users' perception of privacy. Therefore, it does not affect their intention to use online services (Chen & Li, 2009; Drennan et al., 2006; Brown & Muchira, 2004). This paradox has not been explained in prior privacy studies. Further, an increasing number of customers who use mobile devices to shop and pay online share their personal and account information frequently. It can be expected that they will continue to be exposed to data security issues such as identity theft, hacking, account infiltration, and other security violations in their online transactions (Warkentin & Willison, 2009). Thus, privacy and security concerns should be prioritized when selecting and designing mobile payment systems.

Before receiving any E-service from vendors, potential customers usually need to give consent for their personal data to be disclosed to vendors. This information disclosure usually ensures services to be personalized to meet customers' preferences. However, the need to collect more personal data for personalization increases the risk that privacy will be violated (Dinev et al., 2006). According to the privacy calculus theory, individuals are willing to disclose personal data if benefits associated with such behaviors exceed costs (Laufer & Wolfe, 1977). Since information disclosure is inevitable in doing business via the Internet, the theory provides some insights that researchers and practitioners can maneuver to encourage customers' share of information to create higher value in return, meanwhile enforcing security procedures to ensure privacy be protected. Prior related studies have employed the privacy calculus theory to analyze drivers for information disclosure (Zhu et al., 2017; Wang et al., 2016). These researchers found that whether customers disclose personal data depends on the utility of the personalization of online services. In another study where researchers integrated the privacy calculus theory to develop a model to predict customer loyalty of mobile hotel booking services (Ozturk et al., 2017), personalization influenced privacy concern, trust, and perceived risk, in turn, influencing customer loyalty. Being able to personalize online services to meet customers' needs with privacy and security in mind has indeed increased mobile users' willingness to exchange their personal information for receiving services. Although these studies enabled our initial understanding of the application of the privacy calculus theory in a mobile device context, little is known about key drivers for personalization and its relationship with privacy and security when evaluating a mobile payment system. Further, it is not clear that what contributes to the perceived value of the system that leads to use and generates loyal customers. In the next section, we conducted an exploratory qualitative analysis to identify factors that are critical as part of an ideal mobile payment system from customers' perspectives.

3. Concept, Construct, and Hypotheses Development

To inform the construct conceptualization, we carried out a qualitative analysis of feedback on the mobile order and payment application on the Starbucks Idea site at mystarbucksidea.com. In December 2014, Starbucks launched an updated version of the Starbucks Mobile app, which gave customers the capability to order and pay outside the store and pick up the order by skipping the line and moving straight to the counter. The site administrators asked existing users to give feedback about their

experience in using the Mobile Order and Pay application and requested suggestions to improve it. To systematically review and code users' comments, we posed the following two questions:

1. What are the advantages and disadvantages of using the application?
2. What are the essential features that should be included in the application?

We used Straus and Corbin's (1990) open and axial coding procedures to identify conceptually similar themes. To develop the initial items, we analyzed these comments for the period between December 2014 and November 2016. We used NVIVO 11 to code the data. As shown in Table 1, we clustered the open codes into subcategories that were conceptually similar to form the axial codes. We used these axial codes as a basis for construct development and associated them with the extant IS literature. In most cases, the axial codes matched existing constructs in the literature. Table 1 illustrates the process of comparing the initial conceptualization derived from our data analysis to the existing literature. In total, our analysis revealed nineteen constructs that represented the essential concepts in the present context.

Construct	Examples of Open Codes From Analysis of Starbucks Ideas Forum Data and Email Interviews	Prior Literature
Fulfillment	<ul style="list-style-type: none"> • My drinks are always on time when I use this. However, they're also the wrong drink at least half of the time. 	Parasuraman et al., 2005
Privacy	<ul style="list-style-type: none"> • How will my personal and banking information be handled? 	Liu et al., 2005
Security	<ul style="list-style-type: none"> • On Christmas day someone hacked into my account, reloaded a total of \$300 (in \$100 increments) from the bankcard listed on my account to one of my Starbucks cards, uploaded their own Starbucks card to my account, transferred the \$300 from my cards to their own, then deleted their Starbucks card from my account, effectively absconding with my \$300. Merry Christmas to me. 	Liu et al., 2005; Suh & Han, 2003
Trust	<ul style="list-style-type: none"> • You would have to trust this app and this company in ensuring your security and information will be safe. 	Gefen et al., 2003
Time Awareness	<ul style="list-style-type: none"> • Can you adjust the app so I can have a morning, afternoon & evening drink [offer] for us frequent users 	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Personalization	<ul style="list-style-type: none"> • Based on my order history and saved favorites, you should be able to analyze my taste - what ingredients make up my favorite beverage and food - then suggest what I may like as and when you introduce something new - makes it easier for me to choose from a variety of things - and I can trust you! 	Sheng et al., 2008; Sherrie et al., 2006; Arora et al., 2008
Customization	<ul style="list-style-type: none"> • Everything is super customizable down to how many pumps of syrup you want. 	Sherrie et al., 2006; Arora et al., 2008
Activity-Based Adaptation	<ul style="list-style-type: none"> • It would be great to get an alert on my phone that my drink or food is ready. I can imagine walking into the store and not knowing how long it is until it is ready. 	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Availability	<ul style="list-style-type: none"> • Some drinks "aren't available at this location" comes up as an error for simple items such as a Skinny Carmel Macchiato. 	Dabholkar et al., 1996; Yang et al., 2002.

Environment	<ul style="list-style-type: none"> in Houston, multiple locations had to close for weather issue. The mobile app still let me place an order and charged my card. I only found out that the store was closed when I arrived to pick up my drink. 	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Location Awareness	<ul style="list-style-type: none"> Imagine a world where you can order your morning coffee based on your location. -- Once the Starbucks app is installed and a user is within 500 feet of the set location, a verbal / visual notification pops up. "Would you like to order "xyz" with no whip and half fat as per usual? "Yes" says customer and verifies with a fingerprint or the voice recognition that is standard on most newer phones. 	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Navigation	<ul style="list-style-type: none"> The app provided a map to the closest Starbucks where our order would be waiting (downstairs in my office building) with an estimated wait time of 4-8 minutes. 	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Usefulness	<ul style="list-style-type: none"> Starbucks was very crowded with high school students. I simply walked up to pick up area, said the magic words and voila! My drink was ready. That alone was enough to sell me on this feature. 	Davis, 1989
Information Quality	<ul style="list-style-type: none"> You used to put the nutrition information for all your food and drinks, but I can't find it on the new app. Could you bring it back so I can make an informed choice of food/beverage that I want to consume. 	Ahn et al., 2007
Functionality	<ul style="list-style-type: none"> Since the latest app update, I am unable to tip using my iPhone app. Will you be adding that feature back into the app? Also, would you consider allowing us to tip a percentage rather than a random amount? 	Goodwin, 1987
Perceived Value	<ul style="list-style-type: none"> I like to get my Starbucks first thing on my lunch break, and this makes it easy to order before I even get out of work. 	Hoehle & Venkatesh, 2015
Ease of Use	<ul style="list-style-type: none"> Ordering the coffee was easy enough, everything is super customizable down to how many pumps of syrup you want. You even get the calorie count of your drink. 	Davis, 1989
Technical Compatibility	<ul style="list-style-type: none"> I am unable to use my phone to order. I received this invitation from Starbucks today. "3 BONUS STARS WHEN YOU MOBILE ORDER & PAY March 21, 2 p.m. – close" But I cannot order as no Mobile app exists for windows based phones. I feel I am being discriminated against and may consider using other vendors for my coffee in the future. 	Premkumar et al., 1994
Universal Access	<ul style="list-style-type: none"> I love using the mobile order feature. It works in the U.S. but it won't work in Canada even though mobile ordering is available in Canada now...What's up with that? 	Janda et al., 2002; Stephanidis & Savidis, 2001

Table 1: Interplay between Constructs, Codes, and Literature

Based on the codes represented in Table 1, we defined the first-order constructs in Table 2 as follows:

Construct Name	Entity (E) to which the construct applies and General Property (GP)	Construct Definition	Source/ Reference
Fulfillment	E = Person, GP = perception about the ability of the mobile application merchant to fulfill its promises to the user.	The degree to which the mobile application merchant fulfills its promises to the user about order delivery.	Parasuraman et al., 2005

Privacy	E = Person, GP = perception about the ability of mobile application to protect the user's privacy.	The degree to which a user perceives that his/her personal information stored in the mobile application can be accessed or viewed by unauthorized entities.	Liu et al., 2005
Security	E = Person, GP = perception about the ability of the mobile application to safeguard the user's information from criminal use or abuse.	The degree to which a user perceives that the mobile application has safeguards and policies in place to protect his/her information.	Liu et al., 2005; Suh & Han, 2003
Trust	E = Person, GP = perception about the trustworthiness of the mobile application merchant.	The degree to which a user perceives that the mobile application merchant is trustworthy.	Gefen et al., 2003
Time Awareness	E = Person, GP = perception about the ability of the application to deliver the right product/service to the right use at the right time.	The degree to which a user perceives that the mobile application delivers the right product/service to the right user at the right time.	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Personalization	E = Person, GP = perception about the ability of the application to personalize contents and services.	The degree to which a user perceives that the mobile application has the ability to provide content and services that are tailored to individuals based on knowledge about their preferences and behaviors.	Sheng et al., 2008
Customization	E = Person, GP = perception about the ability of the mobile application to allow users to customize the product/service they are purchasing.	The degree to which a user perceives that he/she is able to use the mobile application to specify and modify elements of a product/service.	Arora et al., 2008
Activity-Based Adaptation	E = Person, GP = perception about the ability of mobile the application to adapt the product /service according to the user's preferences and activities.	The degree to which a user perceives that the mobile application monitors the user's activity and adapts the product/service according to the user's preferences and activities.	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Availability	E = Person, GP = perception about the mobile payment service's availability.	The degree to which the product/service and the mobile payment service are available when and where the customer wants it.	Dabholkar et al., 1996; Yang et al., 2002

Environment Awareness	E = Person, GP = perception about the ability of the application to adapt the products/services according to the user's environment.	The degree to which a user perceives that the mobile application adapts the products/services according to the user's environment.	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Location Awareness	E = Person, GP = perception about the ability of the application to adapt the products/services according to the user's location.	The degree to which a user perceives that the mobile application is able to locate the user and adapt the product/services according to the user's location.	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Navigation Services	E = Person, GP = perception about the ability of the application to support the user's navigation according to the user's purchases.	The degree to which a user perceives that the mobile application supports the user's navigation according to the user's purchases.	Abowd et al., 1999; C. Emmanouilidis et al., 2013
Usefulness	E = Person, GP = perception about the usefulness of the mobile application in accomplishing the user's tasks.	The degree to which a person believes that using the mobile application would be useful in accomplishing his/her tasks.	Davis, 1989
Information quality	E = Person, GP = perception about the ability of the mobile application to provide relevant, timely, and accurate information.	The degree to which a user perceives that the mobile application provides relevant, timely and accurate information.	Ahn et al., 2007
Functionality	E = Person, GP = perception about whether the mobile application includes the functions needed to carry out the user's task.	The degree to which a user perceives that the mobile application includes the functions needed to carry out his/her task.	Goodwin, 1987
Perceived Value	E = Person, GP = perception about how the net value of the benefits of adopting the mobile application exceeds the costs associated with its adoption.	The degree to which a user perceives that the net value of the benefits of adopting the mobile application exceeds the costs associated with its adoption.	Nielsen et al., 2006; Nah et al., 2005; Johnson et al., 2006; Hoehle & Venkatesh, 2015
Ease of use	E = Person, GP = perception about the extent to which mobile application use is free of effort.	The degree to which a person believes that using the mobile application would be free of effort.	Davis, 1989

Technical compatibility	E = Person, GP = perception about the extent to which the mobile application is compatible with various existing mobile platforms/systems.	The degree to which a user perceives that the mobile application is compatible with various existing mobile platforms/systems.	Premkumar et al., 1994
Universal Access	E = Person, GP = perception about the accessibility of the mobile application from any location.	The degree to which a user perceives that the mobile application is globally accessible.	Janda et al., 2002

Table 2: First Order Constructs, Construct Entities and Definitions

According to the first-order variables, Table 3 displays the definitions of the three second-order constructs as follows:

Construct Name	Entity (E) to which the construct applies and General Property (GP)	Construct Definition	Source/ Reference
Reputation	E = Person, GP = overall perception of the ability of the mobile application merchant's reputation.	The degree to which the user perceives that the mobile application's merchant is fair and honest.	Anderson & Weitz, 1992; Hoxmeier, 2015
Context-based Services	E = Person, GP = overall perception about the ability of the mobile application to dynamically adapt its behavior according to the user's and application's context.	The degree to which the user perceives that the mobile application dynamically changes or adapts its behavior based on the context of the application and the user.	Abowd et al., 1997; Brown et al., 1997; Davis et al., 1998; Dey et al., 1997; Korteum et al., 1998; Schilit et al., 1994; Ward et al., 1997
Application Utility	E = Person, GP = overall perception about the utility of the mobile application	The degree to which a user perceives that the mobile app generally serves its purpose well.	Hoehle & Venkatesh, 2015

Table 3: Second-Order Constructs, Construct Entities and Construct Definitions

Table 4 shows that three constructs (i.e., utility, reputation, and context-based services) are conceptualized and measured as second-order formative constructs, and two dependent variables (continued intention to use and loyalty) are conceptualized and modeled as first-order reflective

constructs.

Construct	Type of construct	Dimensions
App utility	Formative	Time-saving
		Convenience
		Control
		Value
		Information quality
Vendor reputation	Formative	Security
		Privacy
		Fulfillment
		Trust
Context-based services	Formative	Identity awareness
		Environment awareness
		Time awareness
		Location awareness
Continued intention to use	Reflective	5 items
Loyalty	Reflective	5 items

Table 4: Constructs and Dimensions

Using the identified constructs, we defined four hypotheses as follows:

Hypothesis 1 (H₁): There is a positive relationship between the reputation of vendors and context-based services.

Hypothesis 2 (H₂): There is a positive relationship between context-based services and perceived utility.

Hypothesis 3 (H₃): There is a positive relationship between perceived utility and continued intention to use the mobile application.

Hypothesis 4 (H₄): There is a positive relationship between perceived utility and customer loyalty.

Figure 1 shows the proposed conceptual model.

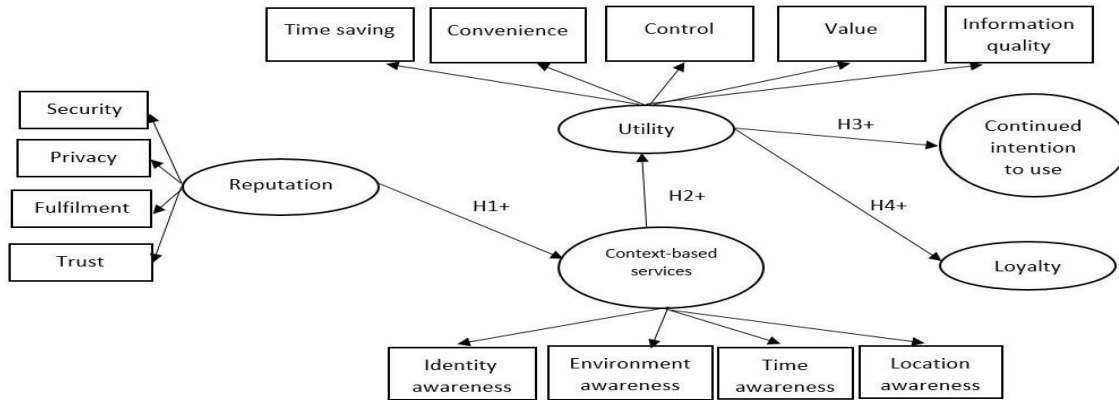


Figure 1: Conceptual Model

4. Methodology

Using Qualtrics software, we emailed the survey to 500 randomly chosen students enrolled in the evening MBA and BBA programs at a large university in the southeastern United States. After excluding responses that failed the response quality questions, the final set of useable and valid responses contained 450 samples.

5. Analysis

To validate the survey instrument, we performed a Confirmatory Factor Analysis (CFA) on all the constructs to assess the measurement model. To do so, AMOS (Version 20) was used to test convergent validity and discriminant validity. All AVEs are greater than 0.50 demonstrating convergent validity, and all values of Cronbach's Alpha and composite reliabilities are higher than the threshold value of 0.7 (Table 5), which highlights that the reliability of constructs is adequate (Segars, 1997).

We also tested the discriminant validity of the constructs (Table 6). All the diagonal values (the square roots of the AVEs) were greater than 0.7 and exceeded the correlations between any pair of constructs (Fornell, Tellis, & Zinkhan, 1982). Therefore, the results indicate that the model fulfills the requirements of discriminant validity and it is assumed that the model also has adequate discriminant validity.

Constructs	Average Variance Extracted (AVE)	Cronbach's Alpha	Composite Reliability
Reputation	0.763	0.923	0.927
Utility	0.785	0.948	0.948
Context-based services	0.637	0.872	0.870
Loyalty	0.866	0.97	0.97
Intention to use	0.866	0.97	0.97

Table 5: Convergent Validity Summary and Construct Reliabilities

Constructs	Reputation	Utility	Context-based services
Reputation	0.873		
Utility	0.755	0.886	
Context-based services	0.433	0.609	0.798

Table 6: Correlations among Latent Constructs

The indices values for CFI= 0.922, NFI=0.90, RFI= 0.90, IFI= 0.912 and TLI=0.912 are above 0.9 and the RMR= 0.058 and RMSEA= 0.067 are below 0.08 (Byrne, 2001). The fit indices support that there is a good fit between the hypothesized model and the observed data.

The path analysis result significantly supports all proposed causal relationships (Table 7). The reputation of vendors significantly influences users' perceptions of the merchant's context-awareness offerings, supporting H₁ ($\beta = 0.651$, $p < 0.001$). Offering context-based services significantly influences the levels of utility perceived from the application, validating H₂ ($\beta = 0.806$, $p < 0.001$). Perceived utility significantly increases the continued intention to use the application supporting H₃ ($\beta = 0.462$, $p < 0.001$). Utility perceptions also enhance customer loyalty to the application, validating H₄ ($\beta = 0.432$, $p < 0.001$). Figure 2 displays the standardized path coefficients of the structural model under investigation.

	Path		Estimate	S.E.	C.R.	p-value
Reputation	→	Context-based services	.651	.039	12.179	***
Context-based services	→	Utility	.806	.054	15.985	***
Utility	→	Intention to Use	.462	.101	8.445	***
Utility	→	Loyalty	.432	.092	7.752	***

*** p < 0.001

Table 7: Path Analysis

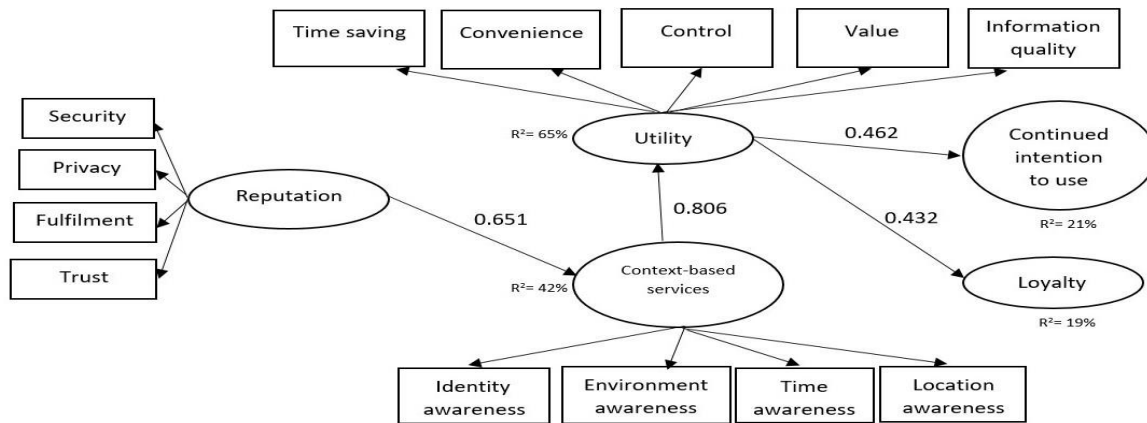


Figure 2: Path Coefficients

Overall, the proposed model can explain 65% of the variance in utility, 42% of the variance in context-based services, 21% of the total variance in users' continued intention to use a mobile application. Moreover, the model is able to predict 19% of the variance in users' loyalty to the application. These R square values show that future studies can extend this work by adding more relevant variables to enhance the explanatory power proposed by this model.

6. Discussion

The model showed that customers are more receptive to context-based services that are provided by a reputable mobile application. The context-based services (such as services offered based on time and location awareness) can lead to more perceived utility (such as time-saving and convenience). The more utility seen by users, the more willing they are to continue using the application in the future. Moreover, the perceived utility can make users loyal to the mobile app. This study demonstrated the significance of

perceived security, privacy, fulfillment, and trust in vendors. Vendors should have a robust privacy policy statement, which clearly states the purposes of collecting, processing, and using customers' data. If users are aware of security safeguards, which used to protect personal data from unauthorized access and third parties, users are more likely to trust the vendor. If the measures to protect data security are robust, users will be more likely to use context-based services because they realize that their personal information is stored and processed by a reputable vendor to offer more personalized and customized services based on their context.

These customized services can bring about more convenience, value, time-saving, and perceived control. The more utility a mobile application generates, the more likely that users will continue using the application in the future. Users will also be more inclined to say positive things about the mobile app to others. This study showed that the levels of utility offered by an application could increase switching costs, enhance the functionality of the application, and finally increase the levels of customer loyalty. More importantly, our study confirmed the usefulness of the privacy calculus theory in a way that highlighted that customers would choose to continue to use mobile payment systems when the perceived utility is high.

Additionally, we expanded the theory to include other vital variables that significantly contribute to the benefits and risks of using mobile payments, such as reputation and context awareness. Path analyses yielded new insights to enrich the theory that reputation and context awareness can affect utility (for cost-benefit analysis), thus influencing customers' continued intention to use mobile payment systems and their loyalty. Our finding also filled the gap in prior related studies and found that both privacy and security have greater priorities than personalization when customers consider using mobile payment services. Moreover, we have validated and utilized multi-dimensional scales for measuring constructs and have demonstrated the usefulness of the scales in the mobile payment environment. With an increasing number of electronic hand-held gadgets and devices introduced to the market and utilized by people, future research can apply our model in other contexts to seek further validation.

7. Conclusion

Through the development of a model and an empirical study, this paper suggests that providing customization and personalization of mobile services based on customer contexts is the main competitive advantage of mobile application vendors. Context-based services can improve the utility offered by the apps, and in turn, encourage current users to continue using the apps in the future. Moreover, they will become more prone to recommend apps to other prospective customers. However, these positive use behaviors will not take place if the app vendors are not reputable in the market. Therefore, the findings demonstrate that the reputation of app vendors is the essential building block of this equation. If a reliable app vendor offers context-based services with high levels of personalization, users may see more utility. Consequently, they are more likely to use the app in the future and also encourage others to switch to it. The results of this study can contribute to both theory and practice.

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P28: TAILORING THE CYBER SECURITY FRAMEWORK: HOW TO OVERCOME THE COMPLEXITIES OF SECURE LIVE VIRTUAL MACHINE MIGRATION IN CLOUD COMPUTING

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Abstract

This paper proposes a novel secure live virtual machine migration framework by using a virtual trusted platform module instance to improve the integrity of the migration process from one virtual machine to another on the same platform. The proposed framework, called Kororā, is designed and developed on a public infrastructure-as-a-service cloud-computing environment and runs concurrently on the same hardware components (Input/Output, Central Processing Unit, Memory) and the same hypervisor (Xen); however, a combination of parameters needs to be evaluated before implementing Kororā. The implementation of Kororā is not practically feasible in traditional distributed computing environments. It requires fixed resources with high-performance capabilities, connected through a high-speed, reliable network. The following research objectives were determined to identify the integrity features of live virtual machine migration in the cloud system:

- *To understand the security issues associated with cloud computing, virtual trusted platform modules, virtualization, live virtual machine migration, and hypervisors;*
- *To identify the requirements for the proposed framework, including those related to live VM migration among different hypervisors;*
- *To design and validate the model, processes, and architectural features of the proposed framework;*
- *To propose and implement an end-to-end security architectural blueprint for cloud environments, providing an integrated view of protection mechanisms, and then to validate the proposed framework to improve the integrity of live VM migration.*

This is followed by a comprehensive review of the evaluation system architecture and the proposed framework state machine. The overarching aim of this paper, therefore, is to present a detailed analysis of the cloud computing security problem, from the perspective of cloud architectures and the cloud service delivery models. Based on this analysis, this study derives a detailed specification of the cloud live

virtual machine migration integrity problem and key features that should be covered by the proposed framework.

Keywords: Cloud Computing Infrastructure, Computational Modeling, Virtualization and Security, Live Migration, Integrity, Organizations.

1. Introduction

The word “Cloud” is a metaphor describing the web as space where computing has been preinstalled and exists as a service. Many companies, both large and small, are contemplating a migration to cloud computing (CC) to leverage the significant potential of this new paradigm [1-3]. Government agencies, small and medium-sized enterprises, and large organizations already make significant use of CC and they are spending considerable amounts of money, resources, and time on delivering secure services using information and communication technologies [4]. Security is crucial and it is one of the main challenges for CC adoption, as many surveys show [5]. Systems become significantly more susceptible to several cyber attacks when they move to cloud platforms, especially when this move is based on a lack of adoption of cloud-native models and the required adjustment in organizational processes to align with the features and capabilities of the chosen cloud platforms [2].

Virtualization is a technology that provides the ability to automate and orchestrate multiple, tightly isolated IT processes related to on-demand provisioning on a single piece of server hardware to create a virtual computer system or “Virtual Machine” (VM). With respect to virtualization technologies, a physical server can be divided into several isolated execution environments by developing a layer (i.e., VM monitor or hypervisor) on top of the hardware resources or operating systems (OSs); thus, a physical database can be divided into several separate execution environments with the help of virtualization technologies. The server’s execution environments (i.e., VMs) run in parallel without interruption. A VM, also called a guest machine, is a virtual representation, or software emulation of a hardware platform that provides a virtual operating environment for guest OSs. The task of moving a VM from one physical hardware environment to another is called migration. If the migration is carried out in such a way that the connected clients perceive no service interruption, it is considered a “live” migration. For example, database consolidation is made easier if VMs do not have to be shut down before they are transferred. The method is also used for administrative purposes; for instance, if a server needs to be taken off-line for some reason, live transferring of VMs to other hosts can be used to pass running VMs between cloud sites over wide-area communication networks.

A VM migration can occur in two ways: live and offline. In a live VM migration, the VMs are transferred from a source host to a destination host while they are running. After a successful VM migration, the source host removes the memory pages of the migrated VM. During a live VM job migration, there is considerable potential for compromise through malicious activities while information such as memory pages is copied from the host and transferred to the destination, presenting security risk(s) with regard to data integrity and confidentiality. The owner of the VM must have a framework to ensure live VM migration data integrity at both ends of the migration process. In other words, there is a

need to ensure a clear memory portion is assigned to an incoming VM on the destination host, separated from previous VM data or malicious codes, and to secure the removal of the memory data of the outgoing VM. This situation might make organizations and businesses reluctant to switch to using the cloud because of the potential attacks on their assets.

This paper investigates the possibility of misuse of migrating VM's data either in transit or present at source and destination during the live VM migration process. It then proposes a novel framework for a secure live VM migration by using a Virtual Trust Platform Model (vTPM) agent and four other agents: input/output, data plane, integrity analyzer, and data organization. While existing studies [6-9] have established a live VM migration framework for cloud systems integrity, an examination of the different types of research has identified a lack of empirical evidence and knowledge regarding which issues are the most important for these areas. In this paper, the relative significance of the identified issues is determined first, to address the two related research questions listed below, and then the importance of the identified issues is discussed in the rest of the paper. *Research Question 1*: What are the opportunities and challenges for live VM migration in CC, with respect to the essential system attributes and essential system characteristics?, and *Research Question 2*: What are the characteristics of the proposed framework that is on the public cloud instead of in a traditional on-premises data center? According to Kitchenham et al. [10], a systematic literature review method is one of the best ways to identify and prioritize issues for decision making and to sort large volumes of references. This method assists in identifying the research questions and issues associated with the research topic. The overarching aim of this paper is to develop and design a secure live VM migration framework to help cloud service providers (CSPs) improve integrity protection in live VM migration from one VM to another in the same platform (with the same hardware features and the same hypervisor [Xen hypervisor]).

The remainder of this paper is structured as follows. Section 2 discusses the related work and motivation for this research. Section 3 explains the design of the framework system architecture and its agents. Section 4 presents the evaluation system architecture: that is, the state machine. Finally, Section 5 summarizes the paper and discusses future work.

2. Related Work and Motivation

Critical concerns for cloud users involve protecting workloads and data in the cloud and from the cloud, and ensuring trust and integrity for VM images launched on a service provider's cloud [11]. For live VM and workload data protection, cloud-user organizations need a framework to securely place and use their workloads and data in the cloud. Current provisioning and deployment frameworks include either storing the VM and application images and data in the clear (i.e., unencrypted) or having these images and data encrypted using keys controlled by the service provider, which are likely applied uniformly to all the tenants.

Live VM migration [12] in the inter-cloud is a new way of looking at VM migration. It allows the migration of VMs not only between data centers of the same cloud but also between servers on different clouds. The driving force behind live VM migration between clouds is to decrease the workload on a particular cloud and reduce the congestion of its network. The key point of a planned migration is to take snapshots that preserve the state and data of a VM at any given time. With these snapshots of a

VM, an image of the VM in each state is copied and stored. The snapshot is then migrated to the destination cloud, where the hypervisor creates a new VM with the same configuration as the snapshot. The source cloud redirects the incoming traffic of its VM to the destination VM soon after the target VM is up and running.

Data deduplication [6] is a live VM migration technique that prevents large chunks of data from migrating, thereby reducing migration time. This operates on the concept of only selected memory material that has been altered on the source server being transferred. Thus, the phase of migration involves only those parts of the VM that were updated at the source end. A Dirty Block Tracking (DBT) mechanism and a new diff format are the two major components of data deduplication. The role of DBT is to record all the operations that cause changes in the picture of the VM disk, while the diff format is used to store the reported data. DBT monitors and labels each changed disk page as a dirty file. Only the pages identified by the DBT are migrated to the storage; the rest is left behind. Data deduplication is beneficial for VMs undergoing multiple migrations, resulting in multiple destination servers. As it reduces the migration time by a factor of 10, it is one of the most effective techniques for live VM migration.

Yang et al. [7] suggest an Input/Output (I/O) Outsourcing scheme for Workload-Aware, (WAIO) to improve the efficiency of live processing for VM migration. During the migration, WAIO effectively outsources the working set of the VM to a surrogate device and creates a separate I/O path to serve VM I/O requests. The VM live storage migration process can be performed on the original storage by outsourcing VM I/O requests from the original storage to the surrogate device, without interfering with them, while the outsourced VM I/O requests are serviced separately and thus, much faster. This lightweight WAIO prototype implementation and extensive trace-driven experiments show that WAIO significantly improves the I/O performance of the VM during the migration process compared with the existing DBT migration approach. In addition, WAIO allows the hypervisor to migrate a VM at a higher speed of migration without sacrificing the I/O performance of the VM.

Riteau et al. [8] propose a live VM migration system, called Shrinker, which allows VM clusters to migrate between data centers linked via a network. Through integrating data duplication and cryptography hash functions, Shrinker reduces the data to be migrated. This operates on the principles of handling distributed information, and of allowing chunks of VMs to be migrated in multiple data centers across different servers. Shrinker is different from traditional live VM migration methods as it allows source and destination server hypervisors to interact with each other during migration.

Work on opportunistic replay [13] aims to reduce the amount of data in low bandwidth environments that are migrated. This approach keeps a record of all types of user events that occur during the execution of the VM. This information is then transferred to an identical manufactured VM and put into effect to produce almost the same state as the VM source.

Zheng et al. [9] present a novel scheduling algorithm for storage migration that can significantly improve the performance of I/O storage during wide-area migration. This algorithm is unique in that it considers the storage I/O workload of individual VMs, such as temporal location, spatial location, and popularity characteristics, to calculate efficient schedule data transfers.

Berger et al. [17] discuss a vTPM that provides trusted computing for multiple VMs running on a single platform. The key to this process is finding a way to store vTPM data encrypted in the source platform and restoring them safely in the in-destination platform, as well as a way to protect the integrity of the transferred data in the process of live vTPM-VM migration, where it is vulnerable to all the threats of data exchange over a public network. These include leakage, falsification, and loss of sensitive information contained in the VM and vTPM instances.

This paper proposes a better alternative live VM migration framework, which assigns valid but conspicuous values in the new system as “flags” for problem data. This means that when users find a flag in a certain record, they know that the migrated record contains information that could not be loaded immediately. The original data from the legacy system persist in a standard format and are connected to the new record for each such example. The user can quickly check the original source to interpret the data in a meaningful manner.

In addition, the proposed framework collects the target VM working set data over the migration period to the Kororā platform. This helps the framework process to access the data set during migration, while the I/O migration process is accessing the original disk most of the time. Consequently, it is possible to significantly reduce the traffic between I/O processes and the Kororā platform, and the overall integrity of the live VM migration can be improved.

3. System Architecture

The use of the IT security framework is supported by tools that enable service providers to bridge the gap between control requirements, technical issues, and business risks. Kororā is capable of measuring and preserving the integrity of live VMs migration in the cloud system. The expected benefits of using this framework include increasing the level of integrity among different physical hosts. Kororā allows users to check malicious files against three different malware providers’ engines and it can check indicators of comparison details of hashes, URLs, IP addresses, and domains from different resources.

This section aims to explain the system requirements (representing the problem from a design point of view) through an intermediate model of logical architecture, to allocate the elements of the logical architecture model to the system elements of the Kororā physical architecture models. The proposed framework system requirements and the exact approach taken in the synthesis of solutions often depends on whether the system is an evolution of an already-understood product. The Kororā system architecture aims to meet the following system elements and system architecture requirements:

- *System Element 1 – Integrity of configuration files:* In this case, the VM image structure is such that it can represent a complete file system for a given platform integrity: for example, ‘vbox’ files in virtual box or ‘.vmx’ files in VMware. Both these files can be edited by a third party to make changes in the configuration of VMs.
- *System Element 2 – Virtual hard disk integrity:* The life cycle of the VM image consists of different states. For instance, a VM image can be created, started, suspended, stopped, migrated, or destroyed. Essentially, VM images are loaded from a storage location such as a hard disk drive and run directly from a VM manager with a low level of integrity: for example, ‘.vmdk’, ‘.vdi’, ‘.ova’ files. A third party can make changes to these files after

running them in their own environment since it is the actual OS holding file; it would be easy to place a Trojan or malicious codes inside the files.

- *System Element 3 – The integrity of the data files on the VM, including all confidential files, and the integrity of the system files:* The VM is loaded from the storage location and the VM image may not comply with the intended settings and configurations needed for proper implementation in each environment. The VM image itself could be distorted (perhaps by an insider) or even maliciously modified. This work proposes two ways to analyze these files – “*supply the data files*” and “*system files hashsum*” – on the framework before migration and checking of the files after migration.

3.1. System Architecture Requirements

To apply the system design agents in the Kororā framework, the following requirements must be considered in the Xen hypervisor environment:

- 64-bit x86 computer with at least 1 GB of RAM (this can be a server, desktop, or laptop) and trusted platform module chipset on the motherboard. The TPM hardware must be activated through the BIOS.
- Intel virtualization technology or AMD-V support (optional for paravirtualization [PV], required for hardware VM and some PV optimisation).
- Sufficient storage space for the Kororā framework dom0 installation.
- Extensible firmware interface – this helps the hardware layer to select the OS and get clear of the boot loader. In addition, it helps the CSP to protect the created drivers from a reverse-engineering (back-engineering) attack.
- Software requirement cmake – this is the main additional product necessary for compiling a vTPM. To manage domains with vTPM, libxl should be used rather than ‘xm’ which does not support vTPM.
- Linux host (Ubuntu 12.4) must be installed on the machine.

The Kororā system architecture focuses on a hypervisor that preserves metadata using cryptography and hashing algorithms. The protected live VM migration framework based on this hypervisor was designed to identify the different attacks possible and perform an independent secure migration process. The approaches of live VM migration are generally divided into three different classes: 1) *Migration of the process*; 2) *Migration of memory*; 3) *Suspend/resume migration*. In this research, the process of live VM migration means the process of migrating a VM from a source host to a destination host without suffering any attacks. These requirements must be incorporated into the process of the secure live VM migration platform.

Before the migration starts, it is important to ensure that source hosts and destination hosts and VMs meet the requirements for migration that Kororā is trying to match and to verify whether the target is correct, and to create a cryptography rule. Effective access control policies must be provided to protect the process of live VM migration. If an unauthorized user/role begins the live VM process and initiates the migration, the use of access control lists in the hypervisor will avoid the occurrence of

unauthorized activities (authorization). Using route hijacking or Address Resolution Protocol (ARP) poisoning techniques in the migration process, an attacker may initiate Man-in-the-Middle (MiTM) attacks. During live VM migration, the source and destination platforms need to perform mutual authentication in order to avoid MiTM attacks (authentication). An encrypted network must be set up so that no data can be accessed from the VM content by an intruder and any software alteration can be detected properly. This will help to prevent active attacks on live migration, such as memory manipulation, and passive attacks, such as sensitive information leakage (confidentiality and integrity). An intruder may intercept traffic and later replay it for authentication in the process of the VM migration. Therefore, the method of live VM migration should be immune to replay. For example, nonces in java applications help with the password for the migration authorization, as well as the public key of the machine where the user is sitting at, to provide the correct command that is transmitted to the server in migration to prevent playback attack (reply resistance). The source host cannot deny the VM migration activity. Using public key certificates can achieve this feature (source non-repudiation).

This framework is orthogonal to existing live migration approaches – including the Zehang et al. [9] and Mashtizadeh et al. [15] live migration patents, and the Fan Peiru [16] vTPM-VM live migration protocol – and it is a secure boost layer for most, if not all, VM live migration schemes. In addition, this framework can be used to improve the security of other VM tasks, such as those associated with the virtualization and the virtual networking layers, which may experience the same problem of data integrity as VM live storage migration. This research framework, as well as the three frameworks named above, exploit the secure live migration characteristics, but they improve the VM migration security in different ways. For example, the scheme of Zheng et al. [9] aims to significantly reduce the total amount of data transferred by exploiting the workload of the VM's locality. Rarely updated data blocks are differentiated from frequently updated data blocks in virtual disk images by analyzing the workload position. The rarely updated data blocks are transferred in the migration before the frequently updated data blocks, so that the re-transmissions of data blocks are minimized, thus reducing the total amount of data transmissions. While this current research framework secures the live VM migration, its methodology is completely different from that of Zehang [9].

Five agents of the design framework system architecture must be clarified. The responsibilities of these agents are as follows:

- *Virtual Trust Platform Model Agent*: The vTPM agent provides trusted computing for multiple VMs migration on a single platform [17]. With multiple VMs operating on a single platform, vTPM offers trusted computing. It is important to move the vTPM instance data along with its corresponding VM data to keep the VM security status synched before and after the live vTPM-VM migration process. Current live VM migration schemes only check the hosts' reliability and integrity. This poses a huge security risk for vTPM-VM migration. To solve this problem, the proposed framework uses vTPM to secure boot VM(s) over the Xen hypervisor (see Figure 1, Label 1).
- *I/O Agent*: The I/O agent redirects the necessary I/O requests to the replacement device from the operating VM itself. To minimize I/O traffic to the original replacement device, it redirects all write requests on the replacement device [18]. Meanwhile, the I/O redirects all the popular read requests identified by the Data Plane module to the replacement device. If the replacement device has only partial data for a request, the I/O issues read requests to the original replacement device and merge the data from the original device into the replacement device. Either the original storage device

[18] or the replacement device can be redirected to the read requests from the migration module. While the original storage device generates most of the virtual disk images, the replacement device provides the modified chunks (units of information that contain either control information or user data) of data. Because of the VM workload locality, most of the requests will be routed to the original storage device (see Figure 1, Label 2).

- *Data Plane Agent*: Different memory contents are moved from one host to another host in this module (e.g., kernel states and application data). The transmission channel must, therefore, be secured and protected from any attack. All migrated data are transferred as clear data without encryption in the live VM migration protocol. An attacker may, therefore, use one of the following techniques to position himself in the transmission channel to execute a MiTM attack: ARP spoofing, DNS poisoning, or route hijacking [19, 20]. These attacks are not theoretical. Tools such as Xensploit work against Xen and VMware migration [21] (see Figure 1, Label 3).
- *Integrity Analyzer Agent*: Protection of information systems is concerned with three key information properties: availability, integrity, and confidentiality. These three critical characteristics of information are major concerns throughout the commercial and military sectors. Traditionally, confidentiality has received the most attention, probably because of its importance in the military. Unlike the military security systems, the main concern of commercial security is to ensure the integrity of data is protected from unauthorized users. Availability and confidentiality are equally significant within the commercial environment, where a secure working environment is required; however, Clark and Wilson (CW) [22] propose a security model that focuses on integrity in recognized mathematical terms by a set of constraints, or a valid state when it satisfies these. Since much of the attention in the security arena has been devoted to developing sophisticated models (e.g., Bell-LaPadula model [23, 24]) and mechanisms for confidentiality, capabilities to provide confidentiality in information systems are considerably more advanced than those providing integrity.

The integrity analyzer agent uses CW as a basic theory for specifying and analyzing an integrity policy for Kororā. Moreover, it adopts the CW model to live VM migration focusing on the subjects, objects (see Section 4), and their data exchange of users' applications to enhance the security of the live VM migration mechanism, as well as providing user convenience (see Figure 1, Label 4).

- *Data Organization Agent*: In the virtual disk images, the data organization agent monitors the popularity of reading requests from the live VM itself. Only the popular data blocks that will be read are outsourced to the replacement device. Since the replacement device serves all write requests, monitoring the popularity of write requests is not required. Each virtual disk image of the running VM is divided into chunks of fixed size and the data organization agent records each chunk's access frequency. If the access frequency exceeds a predefined threshold for a particular chunk, the entire chunk will be outsourced to the replacement device. All the subsequent accesses to this chunk will be served by the replacement device, which removes their I/O involvement with the migration process. By submitting read-only requests, the migration module usually scans the entire virtual disk files. Most of these

requests will only be issued once, except for requests that read dirty blocks of data (see Figure 1, Label 5).

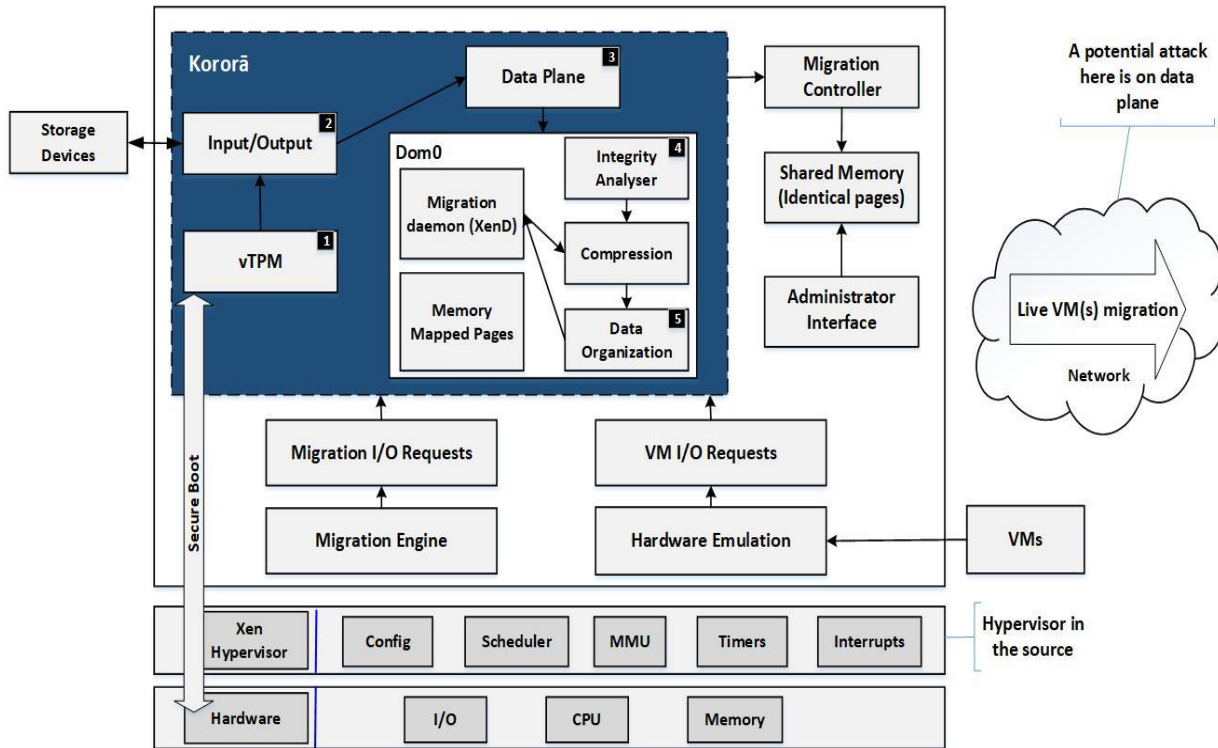


Figure 1. System Design Architecture of the Kororā

This paper focuses on adopting evaluation theory to define the research system machine and consequently identify a way to apply the integrity model in the design research framework, as discussed in the next section.

4. Evaluation of the System Architecture: State Machine

One of the primary aims of the proposed integrity framework is to consider the full cloud integrity environment and to capture all potential integrity attributes and elements as evidence, including functional and non-functional elements. Evaluation is a key analytical process for all intellectual disciplines and it is possible to apply different types of evaluation methods to provide knowledge regarding the complexity and ubiquity of the CSPs [25]. This paper aims to obtain a set of essential evaluation components. In particular, the evaluation of the system architecture method has been applied to review the secure establishment framework using the identification of these evaluation components and an analysis of their weaknesses and strengths. Evaluation theory [26] is considered a theoretical foundation for developing a secure live VM migration framework. Its processes are shown in Figure 2, which represents an overview of the components of evaluation and their interrelations, helping to establish a clear pathway for this study. Reaching a comprehensive and reliable integrity level in live VM migration processes is the main reason for using the evaluation theory. Further, this theory

offers a clear, formal description of the evaluation concepts, as listed below:

- Target: Integrity between CSPs and cloud service users (CSUs).
- Criteria: Integrity elements of the CSPs and CSUs that are to be evaluated.
- Yardstick/standard: The ideal secure live VM migration framework measured against the current secure live VM migration framework.
- Data-gathering techniques: Critical or systematic literature review needed to obtain data to analyze each criterion.
- Synthesis techniques: Techniques used to access each criterion and therefore, to access the target, obtaining the result of the evaluation.
- Evaluation process: A series of tasks and activities that are used to perform the evaluation.

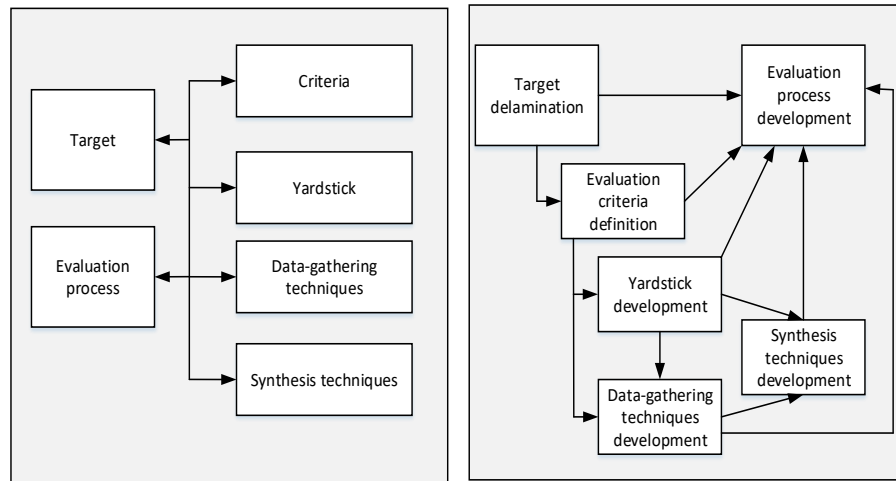


Figure 2. Components of an Evaluation and the Interrelationships between them [26].

4.1 System Architecture State Machine

The proposed framework in this research is a state machine framework. It consists of subjects, objects, access attributes, access matrix, subject functions, and object functions. Access attributes are defined as follows: Read, Write, Read and Write, and Execute (depicted in Figure 3).

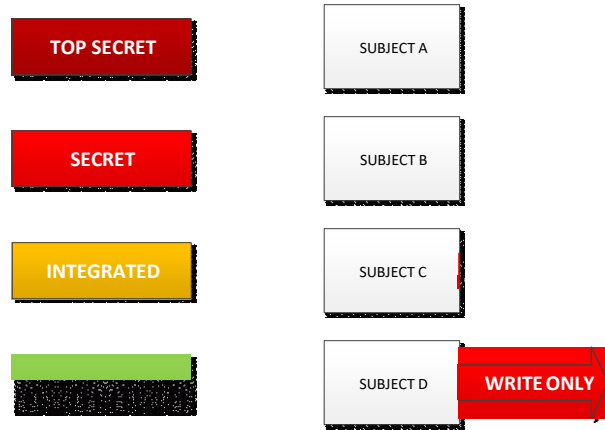


Figure 3. The Relationship Between Objects and Subjects

The proposed model state machine is as follows:

- 1) $t \in T$, where T is sorted Quaternion, each member of T is t
- 2) $T = (a, B, c, D)$, where,
- 3) $a \subseteq (S \times O \times A)$,
- 4) B is an access matrix, where $B_{ij} \subseteq A$ signifies the access authority of s_i to o_i ,
- 5) $c \in C$ is the access class function, denoted as $c = (c_s, c_o)$,
- 6) D signifies the existing hierarchy on the proposed framework,
- 7) S is a set of Subjects,
- 8) O is a set of Objects,
- 9) $A = [r, w, a, e]$ is the set of access attributes,
- 10) $ee: R \times T \rightarrow I \times T$ shows all the roles in the proposed framework, in which e is the system response and the next state, R is the requests set, and I is the arbitrary set of requests, which is [yes, no, error, question]. In this study, the question is important because if the response is equal to the question, it means that the current rule cannot deal with this request.
- 11) $\omega = [e_1, e_2, \dots, e_s]$, ω is the list exchange data between objects.
 $W(\omega) \subseteq R \times I \times T \times T$
 $(R_k, I_m, T^*, T) \in W(\omega)$
 if $I_m \neq \text{Question}$ and exit a unique J , $1 \leq j \leq s$, it means that the current rule is valid, subject and object also are valid because the object verifies the vTPM of the other object (attestee) by request (challenge) for integrity checking. Consequently, the result is,
 $(I_m, t^*) = e_i(R_k, t)$, which shows for all the requests in the t there is a unique response, which is valid.
 Where, $a \subseteq (S \times O \times A)$ where S is a set of Subjects, O is a set of Objects, and $A = [r, w, a, e]$ is the set of access attributes,
- 12) c_s is the security level of the subject (includes the integrity level $c_1(S)$ and category level

$c_4(S)$). Figure 3 shows the security level in the proposed framework and the relationships between the subjects and objects. c_o signifies the security function of objects. Figures 3 show the relationship between the entire subjects, objects, security functions, and security level of the proposed framework.

- 13) The integrity of the vTPM is highest in the state machine and lowest in the user agent. Therefore, the integrity level is $c_1(TPM)$, $c_2(TA)$, $c_3(IDP)$, $c_4(RP)$, and level $c_5(UA)$; this study should prove that each state of the proposed framework is secure. It has been assumed that each state is secure except for state three (Data Plane), as shown in Figure 1. Therefore, if state three is secure, all the states are secure.
- 14) $\Sigma (R, I, W, z_0) \subset X \times Y \times Z$
- 15) $(x, y, z) \in \Sigma (R, I, W, z_0)$, if $(z_t, y_t, z_t, z_{t-1}) \in W$ for each $t \in T$, where z_0 is the initial state. Based on the above definition, $\Sigma (R, I, W, z_0)$ is secure in all states of the system; for example, (z_0, z_1, \dots, z_n) is a secure state.
- 16) CW model has several axioms (properties) that can be used to limit and restrict the state transformation. If the arbitrary state of the system is secure, then the system is secure. In this study, the simple-security property (SSP) [27] is adopted. This property states that an object at one level of integrity is not permitted to read an object of lower integrity.
- 17) $t = (a, B, c, D)$
- 18) Satisfies SSP if,
 - For all $s \in S, o \in S \Rightarrow [(o \in a (s: r, w)) \Rightarrow (c_s(s), > c_o(o))]$,
 - i.e., $c_1(s) \geq c_2(o), c_3(s) \geq c_4(o)$.
 - $c_1(G) \geq c_2(vTPM), c_1(IEU) \geq c_2(RP)$.

Based on Figures 1, 3, and the SSP axiom, all the objects of the proposed framework use two primary concepts to ensure the security policy is enforced: well-informed transactions and separation of duties. The integrity axiom is “no read down” and “no write up”, which means a subject at a specific classification level cannot read and write to data at a lower or higher classification respectively. Star property, Discretionary security, and Compatibility property are other models that can be used to limit and restrict the state transformation, and they will be used in future work.

5. Conclusions and Future Work

The proposed framework, called Kororā, is designed based on five agents running on the Xen privileged dom0 and communicating solely with the hypervisor. The cloud scenario for this paper is a public cloud environment, which means the tenants have the most responsibility and control over their systems; therefore, the risks are higher. Consequently, as a response to the research problem, this paper has represented a design system architecture of a secure live VM migration. For further study, two more agents, called Go Agent and Libvirt Agent will be added to the Kororā in order to support the proposed framework being run in VMs and Xen hypervisor, respectively. A prototype will be developed to prove the effectiveness of the Kororā.

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P30: USE OF NETWORK ANALYSIS TECHNIQUE FOR PRIORITIZING PROJECT PORTFOLIO: A CASE STUDY

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Abstract

Network analysis is widely used in the context of exploring social phenomena that involve disciplines such as economics, marketing and psychology. This work proposes the use of network analysis from an optics perspective as a strategic analytical intelligence tool, where it discusses its use as a support tool when prioritizing project portfolios. The research was defined through a case study carried out in a Brazilian bank, in which a specific scenario of the need to prioritize demands within the existing portfolio was considered, covering the period from 2018 to the first quarter of 2019. To study these scenarios, 2-mode networks were analyzed to visualize the context and measures of centrality degree, proximity and intermediation were also used to provide analytical intelligence in identifying the best options for negotiation and prioritization. It was concluded, through the information provided by the use of network analysis, that complex scenarios and difficulties for prioritization can be predictively diagnosed, as well as the centrality measures allow the identification of the best options for prioritization and selection and the view of the impacted areas to be involved in the negotiation. The use of network analysis technique as a support tool for decision making in the prioritization of projects portfolio is very promising and becomes potential as a new efficient option to be considered, evaluating its ability to provide analytical intelligence and insights predictive of the prioritization scenarios.

Keywords: Analytics; Network Analysis; Portfolio Prioritization; 2-mode network; Centrality Measures.

1. Introduction

New business models and startups are changing the pattern of competition, causing consolidated companies to “disrupt historical operators and reformulate production, consumption, transport and delivery systems” (Schwab, 2016). Therefore, a resource adopted for the transformation of the company is the use of information technology, whose benefits obtained in projects were considered as a basic condition for the survival and competition of companies (Albertin & Albertin, 2016). Another important factor is the need for analytical intelligence – Kugler (2013) considers that “raising the level of intelligence in organizations is not optional; it is a question of survival”. Davenport, Harris & Morison

(2010) observe that the application of tools and analytical intelligence make it possible for the company to identify new insights and serve as a knowledge support providing of information for action and decision making. Companies in the Brazilian banking sector that have historically been recognized for their technology adoption invested R\$ 19.5 billion in the sector in 2018 (around US\$ 5.34 billion, at the time). 80% of banks identified investment in analytics as one of the most recent innovation technologies (Federação Brasileira de Bancos [FEBRABAN] & Deloitte, 2018), representing 32% of the expenditures for new technologies.

Considering then the need for organizations to have information in a faster way in order to prioritize projects that meet strategic objectives, this work presents the use of an analytics technique called network analysis as an instrument when prioritizing projects in portfolio, providing analytical intelligence and views of predictive scenarios. This analysis is given through a case study in a Brazilian bank, which occupies a position among the four largest in Brazil considering shares listed on the stock exchange and total assets in 2018. It was developed through the exercise of technique in the project portfolio, using the RStudio statistical software and R programming language, with the demonstration of the results evaluated through network graphics and centrality measures. The network analysis technique, based on the mathematical graph theory, allows the study of the interdependence and connection properties between elements, called nodes or actors. It is a non-parametric technique, as well as decision trees, whose principle of utility lies in modeling the problem. This analytics technology, also known as graph analytics, will have significant disruptive potential over the next three to five years (Moore, 2019).

In a solid process like portfolio management, the current proposals for the evolution of the theme are based on new frameworks or adaptation of methodologies, and this proposal is based simply on providing existing information in a structured way when prioritizing projects, adding the analytical intelligence that makes it possible to exercise and explore scenarios to support decision making at the moment of prioritization, thus reflecting on an evolution from qualitative decision methods to more quantitative and therefore more objective methods.

The use of network analysis is largely related to social network analysis (SNA), which is commonly represented by studies with themes referenced to people or organizations. Considering that this type of analysis assesses the relationship between structures with the same or different characteristics, this model can be applied to other themes, generating value through the exercise of the relationship between structures, enabling the presentation of information that can assist in the performing predictive analyzes. Pondering this concept, the present work conducts an analysis of networks with the theme of project portfolio aiming to demonstrate how the application of the network analysis technique can contribute to the prioritization of projects in portfolio, providing the vision of the relationship of projects with competing areas for a predictive analysis of the impacts for the prioritization decision.

2. Theoretical Reference

2.1 Portfolio Management

The term portfolio is defined by the Project Management Institute [PMI] (2018) as a collection of “projects, programs, subsidiary portfolios and group-managed operations to achieve strategic objectives”. Portfolio management is a dynamic decision process, marked by uncertain and variable information, containing projects that are selected and prioritized, with the need to periodically review the projects contained in the portfolio (Cooper, Edgett & Kleinschmidt, 1999). Cooper, Edgett & Kleinschmidt (2000) argues the main difficulties for project portfolio management reflect on four issues: balancing resources (balancing the need for projects with the amount of available resources), prioritizing projects (obstacles begin to appear during execution), decisions in the absence of solid information (Go/No Go - investment decisions based on little or unreliable information) and many smaller projects in the portfolio (absence of more significant revenue generators). These authors also indicate that for an efficient project portfolio management, the quality of information must be improved, establishment of gates already creating a barrier for lower quality projects and a process that directly activates the executives, bringing a better understanding when prioritizing.

2.2 Analytics concept

In the references of the analytics theme, most of the literature is related to the extraction of perceptions and information of value through Business Intelligence (BI) and the analysis of Big Data. Analytics is one of the tools that allows the extraction of information through structured bases for generating reports and that is referenced by Chen, Chiang & Storey (2012) within the different fields of Text Analysis, Network Analysis, Web Analysis, Mobile Analytics and Big Data Analytics as an emerging opportunity in analytical research. For Davenport and Harris (2017) analytics is defined as the extensive use of data, statistical and qualitative analysis, explanatory and predictive models and fact-based management for actions and decision making. The analytics techniques are categorized by Davenport & Harris (2017) as descriptive, predictive, prescriptive and autonomous, where Gartner presents questions to identify these divisions (Hagerty, 2016), according to the definitions below:

- Descriptive Analysis: access to historical or current information, which can provide alerts, exploration or reports and which answer the question: "What happened?";
- Predictive Analysis: use of quantitative techniques (network analysis, segmentation, propensity and econometric analysis) in data from the past that can result in prediction of the future and that answer the question: "What will happen?";
- Prescriptive Analysis: use of various quantitative techniques and technologies to identify ideal behaviors and actions that answer the question: "What should I do?";
- Autonomous Analysis: use of artificial intelligence or cognitive technologies to create and improve models and learn the data that in this case was identified by Gartner through the term diagnosis, and that answer the question: "Why did it happen?".

2.3 Network Analysis

The computational representation of objects and their relationships is usually performed through a mathematical structure called graphs (Goldschmidt, Passos & Bezerra, 2015), which refers to mathematical abstractions that can represent a network. Networks are collections of nodes or vertices (nodes) joined by edges (edge), which capture the pattern of interactions between parts of a system (Newman, 2018) as well as the notion of elements in a system and their interconnection (Kolaczyk; Csárdi, 2014). The network demonstrated through the presentation of a graph structure allows us to acquire important information about its elements and their relationships, then dealing with the role of network analysis. In the analysis of a network, we can observe the situation in which an entity (node or vertex) can have a greater influence than others, and this identification can be evaluated through measures of centrality, which measure the importance of a vertex. The best-known measures of centrality are:

- Degree centrality (degree): represents the number of connections (edges) that affect the node; the greater the number of neighboring vertices a given vertex has, the greater its importance in the network (Goldschmidt et al., 2015), which allows identification to focus attention on the most influential elements (Newman, 2010);
- Proximity centrality (closeness): measures the cumulative (smallest) distance from each node to all others in the network; they are vertices where from it is the easiest way to reach other vertices (Goldschmidt et al., 2015), presenting the measure of the average distance from one vertex to other vertices (Newman, 2010);
- Centrality of intermediation (betweenness): measures how much a vertex intermediates the relationship between two other vertices being on the shortest path between them (Goldschmidt et al., 2015) and that they have power through their position within the network, which can be a guide to the influence that a vertex has on the flow of information among other vertices (Newman, 2010).

2.4 2-Mode Networks

In network analysis, when the behavior of vertices with common characteristics is observed, the graph designed for this network is called 1-mode (a mode). When comparisons are generated between two types of vertices with different characteristics, the network is called 2-mode (two modes), which is also known as bimodal or bipartite, representing relationships between two different types (Tsvetovat & Kouznetsov, 2011). The 2-mode networks, according to Tomaél & Marteleto (2013 apud Brusco, 2011) are characterized by the establishment of close relations between the two different sets of objects, where data are collected and the relationships between these structures are identified. These links "are considered as conductors of information and it is through them that one entity receives influence from the others".

According to Tomaél & Marteleto (2013), the 2-mode network can be represented by means of a matrix that registers the affiliation between the different entities (nodes) and also by means of a bipartite graph. The matrix is formed through the relationship between the two distinct nodes, where the

existence of a connection between the nodes is identified. In the bipartite graph, the nodes are in two different sets, with their connections being made from one node in one set to the node in another set.3.
Case Study Scenario

3.1 Bank A: Brief history of the company

The company in this study is a large national private bank, which due to the confidentiality agreement for the performance of this analysis will be called Bank A, where the period from 2018 to the first quarter of 2019 was considered for analysis, with a portfolio of 7.096 demands. In 2015, Bank A began a transformation in the organizational structure of the Information Technology area, focused on efficiency in serving projects. Firstly, it defined the organization of a functional model, with the creation of technology boards specialized in the subjects of Architecture, Development, Engineering, Quality, Sustainability and centralized project portfolio management through the creation of the Portfolio Management, adopting the agile methodology as incremental process model for carrying out the projects. In 2017, Bank A redefined the project service model by creating 28 Delivery Business Tribes (DBT), which represented a grouping of subjects with synergy within the same distinct business and who would be responsible for the development and delivery of the projects. Each DBT was formed matrix by the technology teams of the specialized functional structures organized in a collection of squads, having as inspiration model the structure of service of projects of the company Spotify.

3.2 Bank A: Portfolio Composition Process

Following the strategies of organizational restructuring of the Information Technology area, Bank A organized all project demands in a Unified List of Demands Portfolio (ULDP), following an order of attendance following the prioritization based on strategic planning which is defined in the executive committee and reviewed quarterly. The Bank A categorizes demands into 3 main groups: Service to Regulatory Bodies, Risk for Operation and Financial Return, where this order also follows the characteristic of importance for the institution. In the service queue, there are exceptions that may occur in demands for Service to Regulatory Bodies or Risk for the Operation, being received at different periods of the quarterly calendar of the executive committee, going so far as to change the sequence of the ULDP, reflecting in a repriorization in the defined service order previously. After the conclusion of the ULDP for that quarter, the Portfolio Management, following the order of prioritization, sends the demands to the DBT, and they receive only the demands that have their business scope, becoming responsible for delivering the demand. The DBT responsible for a demand is called “Centralizer”, and if there is a need to involve more DBT due to the shared scope, they are called “Associate” in that demand.

3.3 Bank A: Service of projects by the technology team

When a DBT is defined as Demand Centralizer, it then performs the service assessment and identifies whether other DBT need to participate to fulfill deliveries of this demand, then sending a service request

to the Associates, who in turn perform the scope assessment, the capacity of available resources and DBT current service backlog. In this process of meeting demands, the same DBT can go through the following scenarios in parallel:

- Receive demands in which it will be called Centralizer;
- Be involved as an Associate, sharing a demand with other DBT(s);
- Receive priority demands outside the quarterly planning (such as demands for Service to Regulatory Bodies or Risk for Operation);
- Receive late involvement as an Associate, due to a deficiency in scope verification (superficial analysis) or scope change (incremental model process of agile methodology).
- To suffer changes in the scope of the ongoing project that impact the cost and deadline.

During this period, several meetings are held to evaluate attendance (which can take up to two weeks), holding impact assessment meetings, several decentralized negotiations in situations of competition in prioritization, the need for the involvement of several teams and a lack of depth in the visibility of risk, where this set of situations makes the process time consuming and exhausting.

4. Methodology

4.1 Research Type

The present work consists of presenting a panorama of analysis of portfolio prioritization with the identification of the existing scenarios in the competition of demands between the respective Delivery Business Tribe (DBT). Such scenarios are observed using network analysis, seeking to demonstrate how this analytics technique can contribute as predictive support, providing a visualization of the favorable or unfortunate possibilities available at the moment of prioritization decision. We opted for a methodological approach of case study, which investigates a contemporary and non-historical phenomenon, with quantitative evidence and can be a useful method for making an assessment (YIN, 2015). An applied research with qualitative characteristics was carried out through the collection of data from the projects of the Portfolio Management in the period from 2018 to the first quarter of 2019, carrying out a confidentiality agreement between the researchers and the company.

4.2 Data collection

The first step of the analysis was the selection of sources for data collection: base 1, of demand information originating from the market tool, base 2, which was an electronic spreadsheet handled by the Portfolio Management, adding information that was not included in the market tool and the base 3 with requests for involvement of DBT from a market tool.

Information on the demands present in base 1 (tool) and base 2 (spreadsheet) were consolidated, resulting in base 4 with a total of 7.096 demands in the portfolio. Following, a selection was made only of demands with status in execution, excluding canceled and completed ones to generate the necessary scenario of the current demands, which resulted in an amount of 4.490 demands in the study. To identify the demand in the study, a code masking was used, resulting in a reference like DEM associated with a sequential number, according to the order of demand in the portfolio, and for the name of DBT,

the same concept was used, with the DBT associated with a sequential number, following the alphabetical order of the area names. After selecting the demands, it was time to verify the base 3 that has all the requests for involvement. First, all approved requests were discarded as they would be attended by DBT, using only rejected requests for study, which for this reason leave the demands pending, without being able to complete their final delivery. For a demand to be executed and completed, all involvement must be approved for execution, otherwise, the demand will never be able to be completed, as it will have part of its scope pending execution.

4.3 Selection of DBT

To make more focused observations, it was defined to focus the study on the vision of a single DBT, and to simulate the options in this area for the prioritization scenarios. In order to select the best DBT for the study, the following criteria were considered: DBT having demands with characteristics of Centralizer and Associate, having demands shared with other DBTs and having pending requests for involvement. Considering these premises, DBT01 was selected, which in the Centralizer situation contained a portfolio of 66 demands in execution that had a shared scope with 21 DBT in total and, as an Associate, a portfolio of 162 demands in execution that had a shared scope with 27 DBT.

4.4 R and RStudio Statistical Software

For the analysis of networks and generation of network graphics, an open source tool called RStudio was used, which allows statistical analysis and has “software resources for data manipulation, calculation and graphical display” (The R Foundation). It is an integrated development environment (IDE - Integrated Development Environment) that has a console and a window that supports the execution of direct code and uses the R programming language to perform data and statistics analysis. R is a computer language and a tool for data analysis aimed at solving statistical problems. According to the IEEE Spectrum classification of the main programming languages, the R language occupies the seventh place in the ranking, being a specialized language for manipulating statistics and big data (Cass, 2018). The packages made available by R are free and publicly accessible, and information on their use as well as the main packages can be found on the CRAN website (Comprehensive R Archive Network).

5. Presentation and Analysis of Results

5.1 2-mode network: Pending engagement requests

The 2-mode network represents the comparison between nodes with different characteristics, and the first situation analyzed refers to the pending approval of the involvement as a Member of the DBT to carry out a demand. To demonstrate this situation between the competing demands in requests with the number of orders and the DBT that were related, a 2-mode network was generated, using R's visNetwork package, which allows interactive network visualization. For the design of this 2-mode

network, two types of nodes were considered, the first node referring to demand (represented by the gray diamond) and the second node referring to DBT (represented by the circles in blue and red).

The DBT nodes were identified differently, where the blue circle identifies the DBT that accepted the involvement as Associates, and the nodes with red circles those that refused. The same demand may have accepted and refused involvement requests with the same DBT, as the scope of each request may belong to squads different from this DBT, which have different service capacity plans. The functions of the visNetwork package allow a series of implementations that assist in visualization, and in this analysis a grouping was applied to define areas, identifying the demands classified as Financial Return with a blue line and the demands of Service to Regulatory Bodies in yellow. Another function of the visNetwork package is demonstrated in the representation of the number of involvement refused, in which the thickness of the red line varies between thinner or thicker, following the value of the number of involvements. In the example in figure 1, a single involvement refused is shown by a thin red line, while the increase in the number of involvement refused shows a thicker line, as can be seen in the demonstration of the number of five involvements refused.

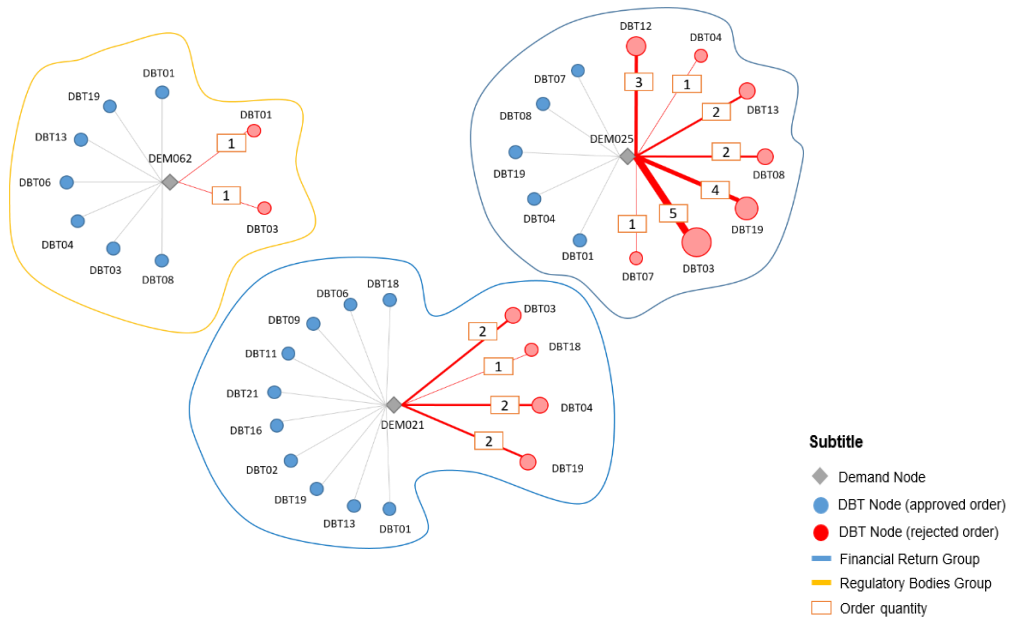


Figure 1: Representation of the 2-mode network: requests for involvement (DEM and DBT)

(Source: Developed by the Authors)

For the generation of this model, two files edited in the excel electronic spreadsheet with extension .csv (comma-separated variable) were used, one with the identification of the demands and DBT and the other with the relationship matrix between them. Simply evaluating the scenario, DEM062 has two

pending approval related to two DBT (DBT01 and DBT03) to negotiate, while DEM021 demand has seven order pending with four DBT. DEM025 represents the most complex, with eighteen pending orders related to seven DBT, 50% of which are concentrated in two specific DBT (DBT03 and DBT19). DEM062 has priority classification for being Service to Regulatory Bodies (area highlighted in yellow), which in this case, according to the order of importance of this classification in Bank A, needs to prioritize service more than the others evaluated. Having the knowledge that the DEM062 demand will need to be met, now the process will be to use the 2-mode network to evaluate the portfolio in progress, and to identify the best selection for the prioritization evaluation of the portfolio in execution.

5.2 2-mode network: Eligible Demands for Repriorization

After defining the priority of the DEM062 demand for service, the next step was to check the portfolio in progress, analyzing the other demands contained therein and their relationships with the respective DBTs involved. In the data source, only the demands in execution that involved DBT01 and DBT03 were selected simultaneously, considering that the negotiation for reprioritization within the portfolio would be more effective. With the selection defined, a relationship matrix was generated between the demands and the DBT, indicating the existence or not of a connection between them. Through this matrix, a 2-mode network was generated using the GPlot function, which produces a two-dimensional graph, where the “twomode” argument was included, which represents that the data must be interpreted as two modes.

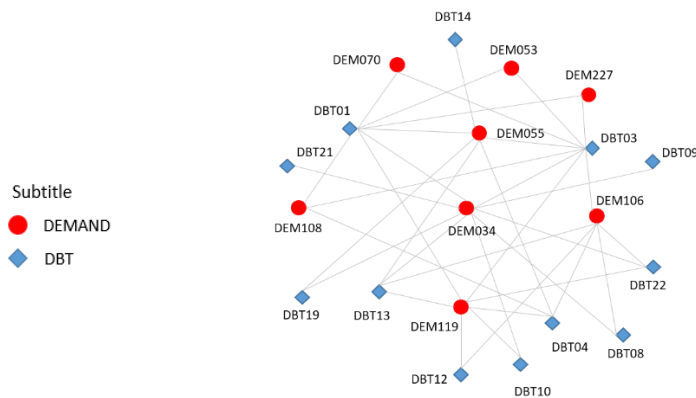


Figure 2: Representation of the 2-mode network: demands eligible for reprioritization (Source: Developed by the Authors)

The network was represented in figure 2, where the relationship in two ways is demonstrated through the connection between the demands and DBT, where the nodes in the shape of red circles are the demands, and the nodes represented by blue diamonds are the DBT.

With a view of the demands and their relationships with DBT, it is possible to quickly identify that certain demands have a greater amount of involvement with some DBT than others. For the definition

of the best option for the repriorization negotiation, centrality measures will be used, using the techniques of centrality degree, proximity centrality and intermediation centrality.

5.3 2-mode network: Centrality of Degree (degree)

To measure the centrality of degree, the “degree” function was used, with the graph visualized through the “gplot” function with the “twomode” arguments representing the network in two ways, the nodes being represented by the red circles the demands and the nodes represented by blue diamonds the DBT, and the “indegree” argument, which returns the number of connections received at each node.

Just to demonstrate a better view of the connections of the centrality of degree, two representations were separated in figure 3, with the left side showing the demands only, while the right one highlights the DBT view.

Below each figure, there is information on the number of connections identified through the “degree” function.

Visually considering the node size and the connection information provided by the “degree” function just below the image of each network, it is possible to identify two possible candidate demands for the repriorization negotiation, these being the DEM053 and DEM070 demands. Both have the least number of relationships (two connections) with NETs and are also related only to DBT01 and DBT03. Likewise, the DEM106, DEM119, DEM108 and DEM034 demands have higher grade centralities, thus reflecting as less indicated options because they have the largest number of connections, resulting in a more complex prioritization negotiation, due to the number of links with DBT.

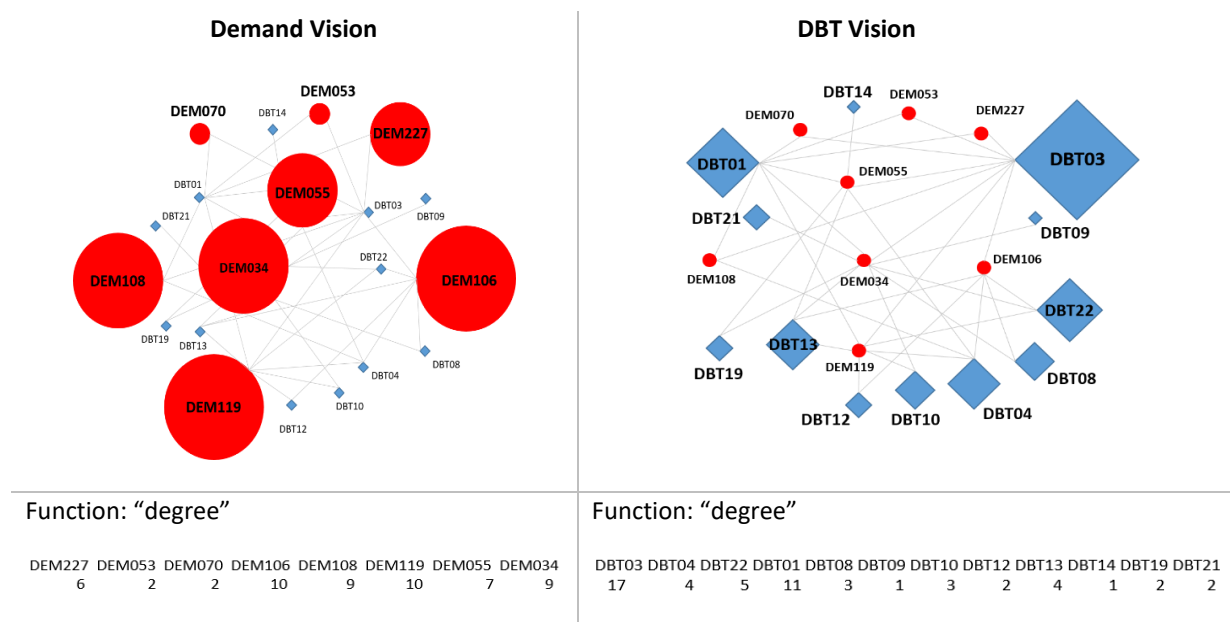


Figure 3: Representation of the 2-mode network: centrality of degree (degree)

(Source: Developed by the Authors).

5.4.2-mode network: Proximity Centrality (closeness)

To visualize the closeness centrality (closeness) the function “closeness” was used, with the visualization of the graph through the function “gplot” with the arguments “twomode” representing the network in two modes. The nodes represented by the red circles are the demands and the nodes represented by blue diamonds the DBT, and the formatting of the number that represents the proximity value was defined with a limit of two tenths in the visualization. Figure 4 shows the values of the centrality of proximity to the demands and DBT, where the demands and DBT that have greater communication with the others were highlighted with blue boxes.

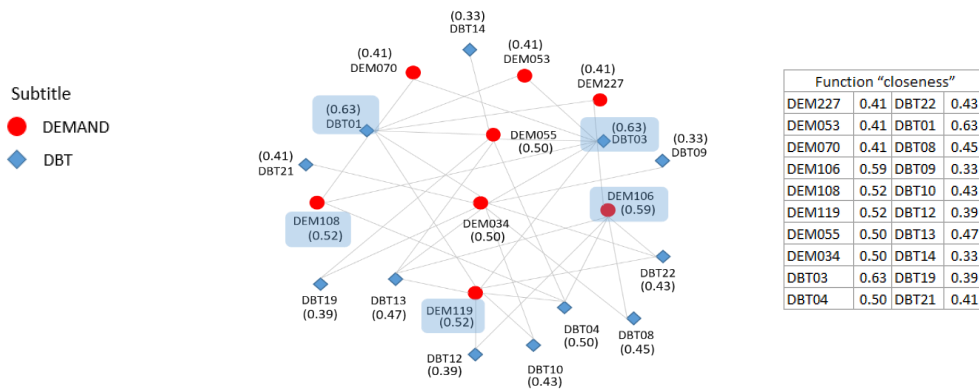


Figure 4: Representation of the 2-mode network: centrality of proximity (closeness)

(Source: Developed by the Authors)

In the observation, the demands that have a greater degree of proximity are DEM106, DEM108 and DEM119, which represents for the study the demands with greater complexity at the time of prioritization assessment, as they are the ones that are most related to a high number of DBT. The demands that showed the lowest degree of proximity to the DBT, including the same value calculated at the centrality of proximity were the DEM053, DEM070 and DEM227 demands, being those that would cause less complexity for the negotiation scenario for the reprioritization with the DBT involved, looking at the proximity to the low number of DBT.

5.5.2-mode network: Intermediation centrality (betweenness)

In the calculation of the centrality of intermediation (betweenness), the function “betweenness” was used, with the visualization of the graph through the function “gplot” with the arguments “twomode” representing the network in two modes. The “vertex.cex” argument was indicated with division by three, where it receives the measurement of each node staggered according to its intermediation centrality, where this division was used so that the nodes can be visualized, otherwise they would cause overlap in the visualization of the nodes.

The number representing the intermediation centrality value was defined with a limit of three tenths in the visualization. The measure of intermediation centrality in figure 5 demonstrates first assessing DBT, that DBT09 and DBT14 do not influence the communication path with other vertices, being exclusively related to each demand. DBT03 and DBT01, as described in the proximity assessment, in which the participation of both was a mandatory premise for selection, reflected in the greater result of the degree of intermediation, which are then the most influential vertices.

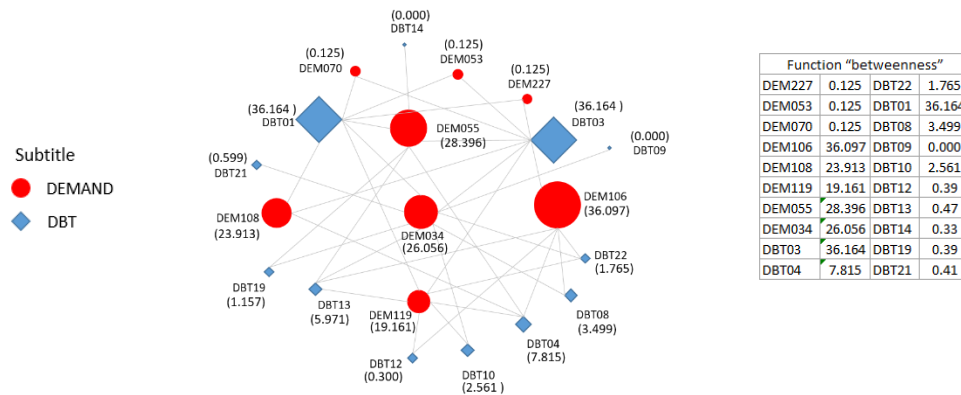


Figure 5: Representation of the 2-mode network: centralization of intermediation

(Source: Developed by the Authors)

Assessing the demand nodes, DEM106 is the one with the highest degree of intermediation, which identifies in the study that this would not be a good candidate for repriorization, since it has a strong influence with the other DBT nodes. This would result in greater negotiation complexity due to the greater amount of relationship between DBT that would be involved in the reprioritization discussion. Likewise, the demands DEM034 and DEM055 follow, which occupy the sequence of second and third places with the highest degree of intermediation, resulting in the same scenario as DEM106. For the case studied, the best scenario for selecting demands for reprioritization using this measure would be the one with the lowest degree of demand intermediation, and with this consideration the best options result in demands DEM053, DEM070 and DEM227.

6. Conclusion

To start the discussion of the conclusion, we begin by evaluating the results provided by the graphs and measures of centrality, where in the graphical representation of the demand map related to the respective DBT, it is already possible to have a broad view of this portfolio in a simple way. Using the first measure of centrality of the study, the degree centrality (degree), the best options were identified from the perspective of this measure, being then the demands DEM053 and DEM070, having the least number of connections with DBT. In contrast to the demands DEM106, DEM119 and DEM034, with high

degrees of centrality, they would reflect in more complex prioritization negotiations as they have a greater number of links with DBT.

Observing the measure of closeness degree (closeness), the best selection scenarios were indicated by the demands DEM053, DEM070 and DEM227. These showed the lowest degree of proximity to DBT, unlike the demands DEM106, DEM108 and DEM119, which have the highest proximity values, impacting most DBT for the prioritization negotiation scenario. Finally, the measure of intermediation (betweenness) presented DEM053, DEM070 and DEM227 as the best options, and DEM034, DEM055 and DEM106 were less indicated.

For the representation of the results of the centrality measures, the analysis of the results of the measures were concentrated only in the most representative ones to indicate the best and worst options, and unanimously, the demands DEM053 and DEM070 presented the best selection scenarios for reprioritization, according to with the amount of relationships and connections with DBT. The worst view was identified in the DEM106 demand, with the presentation of results of the measures indicating that this demand would bring the most complex scenario for the discussion of reprioritization with DBT. Thus, decision making for the prioritization negotiation would be considering a more assertive scenario, already segregating the demands that would present more complex negotiation scenarios due to its relationship with DBT, and containing the visualization of the most promising scenarios, increasing the analytical capacity. decision makers, providing the necessary information for the evaluation.

But, this work demonstrates that it is not just a matter of considering which demands with more DBT involved are the most complex to be prioritized, but which are the demands to be negotiated and which DBT in which these negotiations can occur, already indicating what the impact on the portfolio on both sides. A DBT can have several squads to attend to, having a considerable number of demands executed in parallel, and exploring demands and other related areas, being able to set up an impact analysis and understand who should be involved in the prioritization negotiation, and what is advisable or not to be negotiated.

The work concludes that the results obtained in the study can contribute as a technical option to be used when prioritizing the project portfolio, in addition to presenting another perspective for the use of network analysis considering the relationship structure between projects and impacted areas, bringing analytical intelligence to the business. For this, it considers data capture by structuring information without the support of people, the need for tools or frameworks, and allowing simulation of scenarios with a predictive view of the situations to be considered. This context supports decision making with fewer dependencies, bringing speed in obtaining information, together with assertiveness, given the possibility of exercising the scenarios proposed for the assessment.

This work focused on the prioritization stage of the project portfolio, but we understand that it can be expanded within other themes of portfolio management such as the evaluation, categorization and selection process, as well as other insights within the broad theme can also be explored of SNA, with comprehensive potential for interesting assessments on the use of this analytical technique. Despite the

limitations intrinsic to the experiment scenario, the technique was successfully used and the results demonstrate that it can be applied in project portfolio prioritization scenarios, thus representing a performance gain for this process.

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P31: THE EFFECT OF E-FILING ON TAX COMPLIANCE AMONG MICRO ENTERPRISES IN JAMAICA

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Abstract

Over the past decades government revenue authorities, especially in developing countries have implemented a series of reforms towards strengthening their revenue collection capabilities. Electronic filing (e-Filing) of taxes was introduced in Jamaica to improve tax compliance. However, the adoption of this initiative remains low which results in loss of tax revenue. This condition ultimately limits the government's ability to finance needed projects and address critical needs of citizens. This study seeks to investigate the effect of e-Filing on tax compliance among micro enterprises in Jamaica. Tax-compliant firms found the e-Filing system easy to use and cost effective, while the non-compliant firms did not adopt this initiative because it was felt that paying taxes was not a priority at this stage of the firm. It is hoped that the insights gained from this study can guide government policy makers regarding the introduction of information and communication technology (ICT) in tax administration.

Keywords: e-Filing, information and communication technology, tax compliance, micro enterprises

1. Introduction

For years government revenue authorities especially in developing countries have been implementing a series of reforms towards strengthening their revenue collection capabilities (Bruhn & McKenzie, 2014; Salami, 2011). These reforms include but not limited to the introduction of ICT with the principal objective to improve tax collection. In an effort to make it easier to pay company income tax (CIT), Electronic filing of taxes was introduced in Jamaica in 2016. It was believed that this initiative would improve tax compliance. However, the adoption of this initiative remains low. The low adoption results in loss of tax revenue, which ultimately limits the government's ability to finance needed projects and address critical needs of citizens (Frazoni, 2000; Wenzel, 2005). One of the critical functions of any tax system is to collect resources to fund government's recurrent expenses and expenditure to facilitate

growth and development (Phillips, 2012). However, many enterprises willingly perform tax evasion (Abiola & Asiweh, 2012; Jacobs, Crawford, Murdoch, Hodges, & Lethbridge, 2013; Tax Administration of Jamaica, 2018). However, there are firms who are desirous of being compliant in paying tax but view the tax system and processes as cumbersome and thus become non-compliant.

This low adoption rate was regrettably mainly among micro enterprises (Powell, 2019). In this study, micro enterprises are defined as firms that employ five employees or less with annual sales of J\$15 million. Micro enterprises have been important drivers of economic growth and sustained development in Jamaica (Aremu & Adeyemi, 2011). These enterprises create wealth and generate employment. It is estimated that 97.6% of all classified commercial taxpayers are micro enterprises (Ministry of Industry, 2017). Furthermore, over 413,000 Jamaicans are classified as self-employed. It is estimated that 80% of the jobs in Jamaica are from micro enterprises (Ministry of Industry, 2017).

It is interesting to note that micro enterprises in Jamaica are highly informal, hard to regulate, and contribute the lowest to tax revenue (Ministry of Industry, 2017). Table 1 shows the tax compliance statistics with respect to company income tax in Jamaica in financial year 2015/16. The compliance management philosophy by the Tax Administration Jamaica are:

- Simplify interactions, maximize automation and reduce compliance costs by providing and integrated online experience
- Improve online services to small and micro enterprises and reduce paper transactions

Company Size	Payment Compliance in 2015/16
Large	95.3%
Medium	40.3%
Small	26.6%
Micro	17.4%

Table 1: Comparative Filing of Company Income Taxes in Jamaica

Source: (Powell, 2019)

It is believed that compliance by micro enterprises can be challenging due to cost and other operational factors. However, Nisar (2013) argued that recent trends in tax avoidance emphasizes the need to develop an easier system of tax payment/collection that involves the Internet. The deployed ICTs are expected to assist taxpayers in accessing accurate financial balances and provide a greater user friendly approach in filing returns. It is hoped that these benefits will enhance compliance.

Jamaica is regarded as one of those countries in which the payment of taxes is difficult and is perceived to be a major hindrance to doing business (Phillips, 2012). As a result, the Jamaican government introduced a series of reforms with the last reform in 2014. This gave autonomy to both the revenue

administrators and taxpayers by increasing the ability to manage internal affairs regarding tax payment in a timely manner and improve taxpayers' experience. Hence, the research question, "What is the effect of e-Filing on tax compliance among micro enterprises in Jamaica"? The contribution of this study is to provide useful insights which can guide government policy makers regarding the best approach to introduce information and communication technology (ICT) in the management of tax collection.

2. Literature Review

Micro enterprises have been considered globally as the driving force behind many economies (Aremu & Adeyemi, 2011). In 2015 approximately 83% of all classified taxpayers in Jamaica fall within the category of micro enterprises (Ministry of Industry, 2017). According to the International Council for Small Businesses, formal and informal micro, small and medium size enterprises make up over 90% of all firms globally. It is estimated that 80% of jobs in Jamaica are from micro enterprises (Ministry of Industry, 2017). This sector is characterized by a high degree of informality (Bruhn & McKenzie, 2014). It is stated that Jamaica has a very active informal economy which represents about 40% of total economic activity with small entrepreneurs representing the majority in the sector (Ministry of Industry, 2017). This sector is also characterized by low tax compliant rate (Ministry of Industry, 2017).

One of the main challenges when trying to measure and ensure compliance is the informality of a large share of economic activity in Jamaica - businesses which operate without being registered. In Jamaica, there is a high incidence of unregistered companies. These companies do not report their income to the relevant authorities and do not file or pay taxes. Previous estimates of the scale of informality in the Jamaica economy have put it between 40% - 80% of the official economy (Torero et al., 2006; Witter and Kirton, 1990). Significant levels of informality among enterprises have implications for revenue collection and enforcement costs by the government (Abiola & Asiwah, 2012). Importantly, businesses classified as wholesale and retail comprise the largest grouping among micro enterprises and the highest contributor of GDP at 16% but only contributed to only 9.8% of tax revenue (Ministry of Industry, 2017).

Another factor that prevents micro businesses from utilizing the Tax e-Filing application is the lack of the proper infrastructure (Dowe, 2008). It is felt that the basic prerequisites for implementing successful e-payment systems are: (1) a reliable and accessible Internet service; (2) cooperative and trustworthy financial institutions; (3) an IT oriented atmosphere; and (4) access to adequate financing to set up the appropriate infrastructure in tax offices. Ideally, the setting of an e-payment system should form part of a comprehensive IT design, development and implementation strategy. The infrastructural requirements becomes challenging for some micro enterprises and entrepreneurs because of the lack of access to reliable Internet services, especially in some rural areas. In 2017, 56% of Jamaicans were using the Internet. However, this percentage was highly skewed towards prepaid cell phone Internet users.

These factors result in tax administrations attempting to control the situation through encouraging compliance. However, these compliance measures are generally ineffective given the minimal resources the tax administrators contribute to the compliance effort. Electronic-filing (e-filing) is the transmission

of tax information directly to the tax administration using the Internet. E-filing may take place anywhere. Nisar (2013) argued that recent trends in public taxation stress the need of developing a system of tax assessment and collection that involves internet services. E-filing is enhanced with the ability to conduct electronic-payment (E-payment). E-payment is the transfer of money from a person's bank account to the tax administration's bank account using an electronic banking platform over Internet at any time (during and after banking hours), and from any place (Caribbean Regional Technical Assistance Centre, 2008, 6).

E-tax filing minimises the cost of preparation and submission of tax returns due to the fact that these transactions are executed in a paperless environment (Azmi and Kamarulzaman, 2010). Similar findings were discovered in Muturi and Kiarie (2015) study. According to Muturi and Kiarie (2015), e-Filing improves on convenience to the clients, as well, as it ensures accuracy and timely reconciliations of the captured data. Prior research also confirmed that e-Filing improves efficiency, reducing errors and avoiding mis-postings.

Tax compliance can be defined generally, as adhering to all the laws of the country as it pertains to the paying of taxes. More specifically, it involves "taxpayers' willingness to comply with tax laws, declare correct income, claim the correct deductions, relief and rebates and pay all taxes on time" (Palil and Mustapha 2011, 558). Inherent in tax compliance, is the willingness on the part of the taxpayer to declare truthfully and file his/her taxes based on all income earned for the period.

A survey conducted in South Africa, Ukraine and Nepal revealed that the lack in infrastructure and the cost to procure and implement e-Filing systems is a major deterrent among micro operators. Another factor that affects micro enterprises is the lack of knowledge and awareness of the e-Filing option, and some who are aware of the facility, do not understand how to navigate through the software application. According to CAPRI (2016) only 31% of micro businesses filed their taxes online. Further, there is low business registration among this group, and lack of awareness as to Tax Administration Jamaica (TAJ) software. Tax evasion and avoidance in developing countries are difficult to address (Fuest and Riedel, 2010).

It is the taxpayers' responsibility to make sure that they are aware of all their obligations. However, it is in the tax authority's interest to ensure that taxpayers (owners of firms) are educated about all their tax responsibilities with the hope that they comply. It is posited that the Government of Jamaica must create a simple framework, as well as provide infrastructure and support services to support economic growth and sustainable development (Ministry of Industry, 2017).

A study found that perceived usefulness, perceived ease of use and perceived risk were shown to be an important construct to influence taxpayer's perceptions on electronic tax filing given the fact that the adoption of the electronic tax filing system is voluntary in Malaysia (Azmi and Bee, 2010). The findings suggest that a system that is useful and easy to use are important for taxpayers to voluntarily e-file their tax returns. In addition, the adoption of e-Filing requires a huge initial investment by the business in capital assets and also in the time and effort required to climb the learning curve (Yilmaz and Coolidge, 2013). Also, the perceived risk construct defined by privacy and performance risk was found to have a

negative influence on behavioural intentions, this means that if taxpayers perceive that the electronic tax filing system is risky their perceptions of usefulness of the system will decrease.

The results of another study in Malaysia revealed that three skills were necessary for a taxpayer to interact with technology-based tax system, these were knowledge of spreadsheets, Microsoft word and email (Ling and Nawawi, 2010). The Malaysian Internal Revenue Board encountered public readiness challenges in adopting systems. Although the benefits were communicated, the adoption rate was only 5%. There is also the access reliable Internet and the required technological skills required to adequately utilize the software application (Maisibal and Atambo, 2016). It was found that Internet experience and manual tax filing experience are significant determinants to the adoption of e-Filing systems (Mas'ud, 2019). It was also found that e-Filing adoption are low with older business owners (Pippin and Tosun, 2014).

3. Methodology

This is a quantitative study in which data was collected from the owners of micro enterprises. The owners were believed to be the best persons to represent the views of the companies. The survey instrument was pre-tested by eleven executives of micro enterprises in Kingston, Jamaica. The main focus of the pre-test was face validity and the relevant adjustments made.

The resulting survey instrument contained twenty close ended questions and seven open ended questions. The size of the micro enterprises in Kingston, Jamaica was estimated over 100,000. The target sample size was 384 based on Yamane (1967) sample size formula at 95% confidence and 5% margin of error. A self-administered approach was taken to collect the data. The targeted respondents were assured that the information given is confidential and their participation in the study was voluntary. In the final analysis, only 42 questionnaires were completed and analyzed.

4. Findings and Discussion

The profile of the forty two respondents were 55% male and 45% female (n = 42). In terms of age distribution, the age range 26-35 years old accounted for the majority of the respondents at 40.5%, while 36-50 years old accounted for 35.7%. 51-64, 19-25 and 65 years and older accounted for 16.7%, 4.8% and 2.4% respectively. With regards to the highest level of education attained, the majority of the respondents (33%) possessed an undergraduate degree. 29% had a trade/skill certification, 17% had CXC subjects and 14% had master's degrees. The majority of the respondents were fully self-employed amounting to 61.9%, while the remainder 38.1% were employed to some other organization along with having their own enterprise.

With respect to respondents who were employed to other organizations, 26% were working full time with another company, 11.9% were working on a contractual basis while 7.1% stated that they were

employed on a part time basis. Respondents were asked to state how long they have been business. 38.1% of the respondents had been in business for 1-5 years, this is followed closely by respondents who were in business for 6-10 years which accounted for 33.3% of the respondents, while 19% of the businesses were in existence for 11 years and over, and the remaining 9.5% were in business for less than one year.

In an attempt to establish the level of formality among the surveyed micro enterprises, they were asked to state whether or not the business was registered with the Companies office of Jamaica. 74% of the businesses were registered with the Companies Office of Jamaica, and 26% were not registered. Table 2 provides a summary of the businesses that have Internet access and are registered e-Filing users.

The respondents were asked whether or not the business had access to Internet. The cross tabulation in Table 2 shows the majority of the businesses had access to the Internet at 83.3% (n=35) while only 16.7% stated that they have no access to internet. The results revealed that the majority of the business even though they had access to Internet, most of them are not registered to use the Tax Administration of Jamaica e-Filing system, only 34.3% were registered to the system. Pertaining to the micro enterprises use of the e-Filing system, the majority (69%) were not users of the system while 31% of the respondents stated that they were registered to use the system.

In terms of industry type, the majority (57.1%) of the micro enterprises were from the Wholesale and Retail sector. Food and hospitality accounted for 14.3%, Professional services accounted for 11.9%, with transport, manufacturing and motor vehicle and appliances accounting for 7.1%, 4.8% and 4.8% respectively.

			Business have Internet Access		Total
			yes	no	
Is the business registered as an e-Filing User	Yes	Count	12	1	13
		% within Is the business registered as an e-Filing User	92.3%	7.7%	100.0%
		% within Business have Internet Access	34.3%	14.3%	31.0%
	No	Count	23	6	29

		% within Is the business registered as an e-Filing User	79.3%	20.7%	100.0%
		% within Business have Internet Access	65.7%	85.7%	69.0%
Total		Count	35	7	42
		% within Is the business registered as an e-Filing User	83.3%	16.7%	100.0%
		% within Business have Internet Access	100.0%	100.0%	100.0%

Table 2. Cross tabulation showing summary of businesses that have internet access and are registered e-Filing user

The results of the study revealed that the majority (83%) of the micro enterprises maintained proper books and records, while 17% stated that they did not maintain proper books and records for the businesses. Cash book was the main record been kept. The types of books and records that were kept are as follows:

- Cash book = 29.3%
- Sales and Income = 26.8%
- Purchases journal = 13.4%
- Bank statement = 18.3%
- Bank reconciliation = 7.3%
- Other records = 4.9%

The majority of the respondents, 88.1% have a positive perception towards paying and filing taxes while 9.5% did not believe in filing taxes and only 2.4% stated that they wanted to file taxes but don't know how to do so. Of the majority who believed in filing and paying taxes 75.7% of them were currently paying some form of taxes.

The results of the cross tabulation regarding the relationship between the enterprises that are aware of the e-Filing system and are registered as an e-Filing user, shows that 61.9% were aware of the e-Filing system. However, of those who were aware 50% are actually registered to use the system while the other 50% are not registered to use the system.

In addition, the results of the cross tabulation between size of enterprises and registration of the e-Filing system, shows that enterprises with more employees tend to be registered as e-Filing user, while those with fewer employees tend not to use the system. Another interesting finding is the discovery that micro enterprises with higher annual revenues are more incline to use the e-Filing system. The analysis also shows that micro enterprises are registered to pay payroll tax, income tax and general consumption tax (GCT) at 57.1%, 50% and 50% respectively.

Number of Sample Points	Pearson Correlation	Significance
42	0.525**	0.000

** Correlation is significant at the 0.01 level (2-tailed)

Table 3: Correlation between e-Filing system and awareness of the system

Table 3 shows the results of the Pearson correlation between awareness and registration of the e-Filing system. The test revealed a moderate positive relationship between awareness of the e-Filing system and the registration of the system. The result implies that as the awareness of the system increases, so does the registration of the system, but at a moderate pace. This is statistically significant at $p < 0.01$.

Number of Sample Points	Pearson Correlation	Significance
42	-0.351*	0.023

** Correlation is significant at the 0.05 level (2-tailed)

Table 4. Correlation between e-Filing and Annual revenues

The results of the Pearson correlation revealed a weak negative relationship between annual revenues and the registration of the e-Filing system. The result as shown in Table 4 indicates that as the revenues of the enterprises decreases, so does the registration of businesses for the system at a moderate rate. This is statistically significant as $p < 0.05$.

The respondents were asked why they were not registered as an online user, and 71% stated that the e-Filing system was not a priority for the business. 16.1% indicated that they did not possess the computer related skills to currently use the system, while 9.7% felt that the e-Filing system was too costly to implement (as shown in Table 5).

Reasons micro enterprises do not use the e-Filing system	Number	Percent
Not a priority for the business	22	71.0%
Do not possess computer related skills for e-Filing	5	16.1%
e-Filing system will be too costly	3	9.7%
The firm's information is not secure	1	3.2%

Table 5: Reasons why micro enterprises do not use the e-Filing system

Of the micro enterprises who use the e-Filing system, 53% of the respondents stated that they experienced challenges with the system while 47% of the respondents did not encounter any challenges with the system.

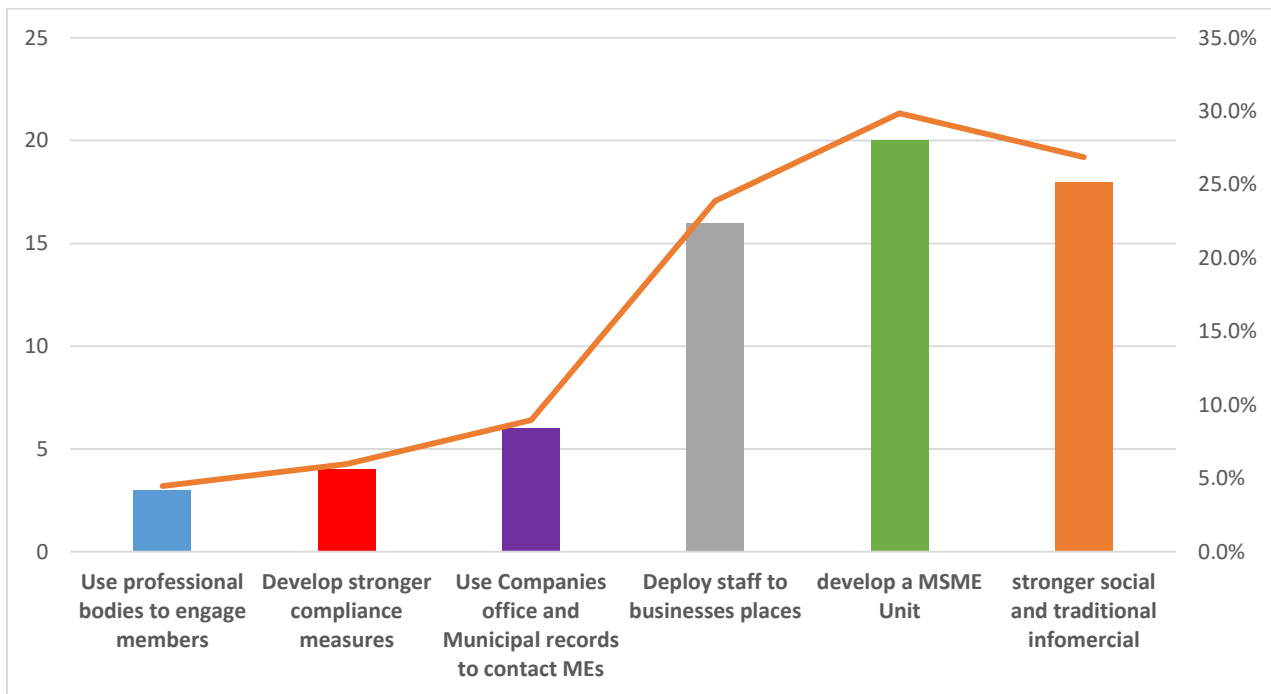


Table 6: Bar graph showing ways micro enterprises can engage in tax compliance

Respondents were asked how the Tax Administration of Jamaica (TAJ) can engage micro enterprises

about tax compliance, the majority of respondents (30%) revealed that the TAJ should develop a MSME unit to deal with them specifically, they also were of the view that deploying TAJ staff to their enterprises would be an effective way of engaging them, and stronger social and traditional media infomercials would be an effective way to encourage micro enterprises to comply (as shown in Table 6).

5. Discussion

The research confirmed the notion that most micro entrepreneurs are self-employed. The majority of the respondents (74%) reported that their business was registered with the Companies' Office of Jamaica. This finding was contrary to Naidoo and Smulders (2013) study that discovered that many micro enterprises choose to remain in the informal sector. To some extent many of these enterprises have made the first step to become a formalized enterprise, but after a few years they become delinquent and renege on their tax obligations. The results of the study revealed that only a small percent (31%) of the micro enterprises file their taxes online. This finding is consistent with the study conducted by CAPRI (2016) which posits that 31% of the micro businesses in Jamaica file taxes online.

According to Coolidge and Yilmaz (2014) "The reliable availability of Internet access and electricity, capability in computer usage, awareness of or being informed about the process are essential to the process to "; however, the study revealed that despite the majority (83%) of the enterprises reporting that they had access to the Internet, and were aware of the system the results showed that these factors did not have a positive impact of ME's adoption of the system.

The e-Filing system was not short of its challenges as respondents were asked if they experienced any challenges with the system, and 53% stated that they experienced some form of challenges. Some of the challenges expressed were problems relating login difficulties and system delays caused by slow Internet. These problems are consistent with Kumar (2017) study which revealed that taxpayers experienced difficulties with network problems and problems associated with registration and passwords. As a result, the responsibility must reside with the Tax Administration to ensure that the online systems are always operating effectively.

In an examination of micro enterprises reluctance to use the e-Filing system, it was discovered that it was not a priority for these enterprises. This finding is consistent with CAPRI (2016, 25) study, which found that most enterprises that do not file tax online was due to inertia. This is compounded with the fact that a considerable amount of the micro enterprises were in businesses before the system was introduced.

In a survey conducted in Malaysia, the Malaysian Inland Revenue Board encountered challenges with public readiness because there was lack of dialogue between the private sector and the government in the development of the project, this later led to a decrease in the use of the system two years later (Ling and Nawawi, 2014). In an attempt to achieve high usage of the system, there must be buy-in by the

recipient of the system (users) and the benefits must be clearly stated at the beginning of the project.

The micro enterprises that use the e-Filing system had good experiences with the system. The majority revealed that the e-Filing system made the process of tax compliance much easier, cheaper and time efficient. These findings are consistent with Suharyono (2018) study in which it was found that the benefits that taxpayers can realize in using any e-Filing system are a quicker, safer, convenient and cheaper way of filing taxes. Prior research also confirms this notion (Osebe, 2013).

6. Conclusion

The study found that persons who filed their tax electronically had a positive attitude towards tax compliance. This positive attitude could be attributed to the benefits being derived from using the system. The e-Filing system has resulted in improvements as it relates to submitting tax information but challenges has been associated with its utilization. The system has also reduced the related tax compliance costs, hence is a positive step towards tax compliance as it relates to the submission of tax information.

As a result, the system can be used to increase the rate at which micro enterprises comply in providing tax information and paying taxes. The study revealed that the major reasons for not using the Efiling system is that they felt that the system was *“not a priority for the business”*. Coolidge and Yilmaz (2014) purports that micro enterprises should not be forced to use the e-Filing systems until the majority of them have had the chance to become familiar with the system on a voluntary basis.

It was also felt that the TAJ should develop a unit that deals with specifically with micro enterprises. This view was shared by the World Bank (2014) who posited that just as how there are tailored services provided to large taxpayers by the government there also needs to be such establishments for micro enterprises seeing that they are more skewed towards entrepreneurship.

The TAJ can engage micro enterprises by conceptualising stronger social and traditional infomercials. It appears that businesses prefer information from a push standpoint rather than having to go search for information from the website of TAJ or from workshops and seminars (CAPRI 2016, 29).

It is recommended that the TAJ offer incentives to micro enterprises, according to OECD (2008, 31) countries such as Australia have offered non-monetary incentives such as extended filing periods for businesses that file electronically. In Ireland the revenue authority provides an additional two weeks to file returns where this is done using the online systems.

Further studies could expand the scope to other parishes in Jamaica in an attempt to make the findings more generalizable.

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P32: WHO SHOULD I APPROACH? KNOWLEDGE SOURCING IN ENTERPRISE SYSTEM IMPLEMENTATION

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Abstract

During enterprise system implementation, organizations transfer system-related knowledge to end users through training sessions and by having them involved in the system design and implementation processes. However, during actual use of the system, end users acquire informal knowledge from co-workers through their social networks. Existing research has focused on the structural features of social networks and their impact on regulating knowledge flow between end users and across the network. The personal attributes and preferences of end users that could impact their knowledge acquisition and processing capabilities have not been considered. This paper examines the expertise level of end users, their gender, and the complexity of their job tasks in influencing system-related knowledge acquisition and its impact on performance outcomes. Data for this study was collected from active users of a new Enterprise Resource Planning (ERP) system that had been implemented across multiple business units of diversified business conglomerate in the United States.

Keywords: Social Networks, Enterprise Resource Planning, Advice Networks, Expertise Networks, Gender.

1. Introduction

Enterprise systems integrate data across business units within organizations for the purpose of enhancing efficiency and effectiveness (Ranjan et al., 2016). They usually are replacing legacy systems which typically manage data and business processes of a single department. Transitioning from a legacy environment to an integrated environment requires end-users to be more collaborative and have a cross-organizational perspective. As a result, end-users need to master the tools and procedures of the new system, understand how upstream and downstream processes are affected by their actions, understand how the newly restructured data flows across multiple processes, and how the resulting information will be used (Garg & Agarwal, 2014; Kini & Basaviah, 2013; Tarhini et al., 2015). Researchers and practitioners have emphasized the need to disseminate system-related knowledge during and after enterprise system implementation. The vehicles to deliver knowledge can be in the form of training, end-user involvement during implementation, and the use of experts and technology champions within organizational departments (Arasanmi, 2019; Bano & Zowghi, 2015; Bhattacharya et al., 2019; Ma'arif & Satar, 2018).

Despite these measures, end users often reach out to their social networks to learn about system use in the context of a specific role, share best practices, address on-the-job technical issues, and to address business challenges (Freeze et al., 2012; Sasidharan et al., 2012; Sasidharan et al., 2017; Sykes et al., 2009; Sykes et al., 2014).

2. Social Learning Theory and Social Networks

The social learning theory argues that learning is a social activity facilitated primarily through observation. Their environment impacts how people learn new things and acquire new behaviors (Bandura, 1977). This concept of environment-driven learning forms the basis of social networks: the study of how and why people or groups interact with one another (Hanneman & Riddle, 2005). In a work environment, employees may acquire knowledge from co-workers to solve job-related problems. A co-worker who might not an answer to a question may in turn reach out to another co-worker for help, leading to the development of an informal knowledge acquisition network. Social network techniques help codify these knowledge networking patterns to identify network players and network structures that can influence knowledge flows across the organization (Borgatti & Cross, 2003; Brass, 1984, 1985, 2011; Hanneman & Riddle, 2005).

3. Social Advice Networks and Enterprise System Implementation

Workplace social networks are composed of informal, context-relevant employee interactions, formed in real-time based on shared beliefs, preferences, goals, and objectives (Borgatti & Cross, 2003; Brass, 1984, 1985, 2011; Hanneman & Riddle, 2005). Research on social networks in the context of enterprise systems has found that system-related knowledge gained through such informal network structures facilitates an improved understanding of the system, in addition to improving job performance. Such knowledge transfer social networks are referred to as advice networks. As opposed to the more formalized “text-book” knowledge acquired during training sessions, advice networks have been found capable of providing direct fixes to unanticipated and context-dependent problems. In addition, it reduces the amount of time required for problem resolution (Freeze et al., 2012; Sasidharan et al., 2012; Sasidharan et al., 2017; Sykes et al., 2009; Sykes et al., 2014).

Network researchers have primarily focused on the structural features of advice networks that calibrate the amount of knowledge flowing through the network. The unit of analysis could be the network or the individual user (Hanneman & Riddle, 2005). Network level measures include knowledge tie density which can be indicative of the speed of knowledge transmission across the network. Other approaches include identifying closely connected sub-networks or cliques within the overall network based on commonalities such as demographics. At the level of the individual user, the primary focus has been on the immediate network surrounding the user – the user is called the “ego”, and the network of those users that ego approaches to acquire knowledge is called the ego network. The ego network often forms the most immediate and primary knowledge acquisition source for a user (Hanneman & Riddle, 2005).

The effective use of enterprise systems requires end users to constantly acquire knowledge and integrate its features into their work, so a large ego network provides individuals with increased access to others' knowledge (Brass 1984, 1985; Brass & Burkhardt, 1993; Ibarra & Andrews, 1993). The centrality measure reflects the positioning of a user within an advice network in relation to his or her knowledge acquisition and knowledge transmission potential. This could be in terms of closeness (the number of direct knowledge ties of a user with other users) or betweenness (the extent a user is between otherwise unconnected users, such users transmit knowledge between unconnected users gaining knowledge and institutional power in the process). Increasing centrality provides exposure to a variety of experiences, information, challenges, and solutions which would not have occurred in isolation (Hanneman & Riddle, 2005). Central users possess influence, power, and control within the network (Borgatti & Cross, 2003; Brass, 1984; Ibarra & Andrews, 1993).

While this body of research has provided a better understanding of how users access and process informal knowledge in the workplace, the focus essentially has been on a numerical count of the knowledge ties between end users, and not on the end users themselves. The implicit assumption has been that the higher the number of knowledge ties, greater the amount of knowledge acquisition, leading to improved performance outcomes. We argue that while the number of knowledge ties do matter, for a more holistic appreciation of the knowledge dynamics at play within the network, the end user too must be taken into account, as his or her personal attributes, preferences, and perspectives can impact the quantity and quality of knowledge flows and their subsequent utilization (Aubert et al., 2013; Shih, 2006; Sun et al., 2009).

4. Research Framework

We now examine the expertise level of end users, their gender, and the nature of their job tasks in influencing knowledge flows and subsequent performance outcomes.

4.1 Expertise Level of Knowledge Sources

The expertise level of knowledge sources can impact the quality of knowledge flows across the advice network. While all end users would likely have undergone formal organizationally mandated training, the extent to which this knowledge would have been internalized by recipients can depend on a variety of factors, including prior experience with similar technologies, technical self-efficacy, and learning capabilities. Some end users would have participated in the system design and implementation processes, and would arguably possess more procedural or know-how expertise than others who did not have that experience. Knowledge flows emanating from those with authentic system related expertise would have a greater positive impact on recipients than that sourced from those lacking such expertise.

Hoffman's expertise model (Hoffman, 1998) conceptualizes expertise as a continuum, ranging from those with little or no domain knowledge (the naïve and the novice) to those with foundational and higher than foundational domain knowledge (the apprentice, the initiate, and the journeyman), and finally to those with competence and experience in both domain and related subdomains (the expert and the master). In the context of this study, the expert and the master are viewed as possessing system-related knowledge to the extent that they can function as reliable sources of high quality knowledge flows. The subnetwork within the overall advice network connecting these system-related experts is referred to as the expertise network.

The quality of knowledge accessible to an end user can have an impact on performance outcomes, hence greater the overlap between the end user ego network and the expertise network, higher would be the performance outcomes.

P1: The extent of overlap between the end user ego network and the expertise network would be positively related to end user performance outcomes.

4.2 Gender

Social networks capture human interactions and gender can play a role in the manner in which relationships are initiated, nurtured, and expanded. Prior research on workplace social networks have concluded that they have by and large been disadvantageous to women (Forret & Dougherty, 2004; McGuire, 2002; Ibarra, 1995, 1997; Loscocco et al., 2009; McPherson et al., 2001). Women view workplace interpersonal relationships as a means of gaining reciprocal trust, developing intimacy, and fostering closeness. On the other hand, men are more goal-oriented with their workplace relationships being a tool for achieving job success, acquiring power, and establishing dominance (Basow & Rubenfield, 2003; Mason, 1995; Mulac et al., 2001; Tannen, 1990). A new enterprise system would be replacing an existing system which would have an associated advice network. Women would be more likely than men to call upon their existing advice network to acquire knowledge regarding the new system as it would further nurture and cement their existing relationships. However, use of the newly implemented system may require access to knowledge flows different from what is available from within their current advice network. Men being goal-oriented would be more likely to deliberately venture outside of their existing advice network and acquire knowledge from those perceived as system-related experts. Hence, men are expected to have higher performance outcomes than women.

P2: The extent of overlap between the end user ego network and the expertise network would be higher for men than women.

P3: Men will have higher performance outcomes than women.

4.3 Job Tasks

The nature of the job task performed by end users can vary in and structure and complexity. At one extreme, tasks may be well-defined and structured. The steps involved for executing structured tasks are usually documented and require minimal cognitive input (e.g., generating routine expense reports). At the other extreme job tasks may be unstructured and may require creative thinking and analytical reasoning (e.g., modeling a supply chain). The execution of such tasks through an enterprise system may demand higher levels of cognitive input on the part of the end user and familiarity with more complex system functionalities (Chang et al., 2014; Giachetti, 2016). End users executing such unstructured tasks would benefit more from high-quality knowledge flows than those end users involved in more routine structured tasks. A greater overlap between the end user ego network and the expertise network would provide the end user with the high-quality knowledge flows required for such tasks. Hence, we propose an interaction effect between the nature of the job task (unstructured versus structured) and accessibility to high quality knowledge flows.

P4: The joint effects of end user task structure and the extent of overlap between the end user ego network and the expertise network will be positively related to end user performance outcomes.

5. Research Methodology

Our study context was an agribusiness company located in midwestern United States having interests in grain storage and distribution, commodity trading, and plant nutrients. They implemented an Enterprise Resource Planning (ERP) system with the intent of improving efficiency and maximizing productivity through streamlining operations across their various business units.

An online questionnaire was used to collect data from heavy users of the ERP system belonging to the three business units that were most impacted by the implementation. These users were shortlisted based on transaction logs that included both the frequency and complexity of system-related interactions. Networking data was collected using the “roster” method – each end user was provided with a roster of other users within their business unit and asked to identify those that they had approached for acquiring system-related knowledge. Those identified in this manner constituted the ego network for that user. This data was used for generating the advice networks for end users. End users also self-reported their level of expertise with the system. This was used in conjunction with data provided by the company regarding expertise levels of end users to create the expertise network.

In addition to networking data, demographic details of participants such as age, gender, experience, and educational qualifications was also collected. Data regarding the extent of structuredness and complexity of job tasks was also collected. Performance outcomes of end users was measured using the individual impact component of the DeLone and McLean Information Systems Success (DMISS) model (DeLone & McLean, 1992). The individual impact component spans performance indicators such as time savings, innovative idea generation, client satisfaction, and productivity improvements.

5. Current Status

We have completed data collection and the data is being tabularized for analysis. Two of the three operational groups had 27 end users each (representing an 80% response rate), and the third unit had 25 end users (representing an 75% response rate). The UCINET and NetDraw (Borgatti et al., 2002) is being used for mapping the ego networks and generating networking parameters. We expect to present our preliminary findings at the conference.

6. Concluding Remarks

Current research on knowledge sourcing through advice networks has focused on structural influences impacting the amount of knowledge acquired by end users. We expand on this narrowly defined research paradigm to encompass attributes and characteristics pertaining to the end user and their impact on knowledge acquisition. The expertise level of end users, their gender, and the complexity of their job tasks in influencing system-related knowledge acquisition and its impact on performance outcomes is considered.

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P33: USING KNOWLEDGE MANAGEMENT TO STRENGTHEN INFORMATION SECURITY POLICY DEVELOPMENT IN DEVELOPING COUNTRIES: CASE - JAMAICA

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Abstract

Information security incidents continue to grow exponentially amidst the development of advanced technological solutions aimed at protecting information system resources. Today, the growth in information systems' breaches remains at an alarming rate. The strategies developed by malicious users are becoming more sophisticated in nature and are introduced unabated across various networks. However, security experts and developers are lagging behind in their response to the information security phenomenon. Today, developing countries continue struggling to effectively address information security issues and are becoming the main avenue for cyber criminals who capitalize on the weaknesses that exist in these regions. An effective response to information security requires a significant amount of resources. In developing countries there are limited human, financial and technological resources and weak legislative frameworks and these are fundamental requirements for combating cyber-crime. One major cyber-crime incident could be catastrophic for businesses and governments in these small, fragile economies and could have far reaching effects on their citizens. Knowledge management can be employed to assist in strengthening the capability of organizations and governments in the development of context-sensitive information security policies in developing regions. In this paper we present a knowledge acquisition model that brings together the two most widely adopted standards COBIT, ISO/IEC 27005 and tacit knowledge that exists in repositories (human) within the information security domain to support the development of context-sensitive information security policies. A quantitative methodology was used in the development of an artifact, preliminary evaluation was done using the informed argument approach and results and recommendations for future research are presented. This study can add to the limited literature on the use of knowledge management in the information security domain and the artifact presented can assist information security practitioners in small/medium-sized organizations.

Keywords: information security, knowledge management, information security policy, cyber security.

1. Introduction

Managing information security knowledge aimed at developing and implementing context sensitive security policies for developing countries as they increasingly participate in the digital economy. Improving Knowledge Management (KM) capabilities in organizations can strengthen their policy development capabilities in an environment where the Internet is becoming the medium of choice for communication. However, parallel to the benefits offered by the use of the internet are drawbacks. Presently, new and more diverse information security vulnerabilities created daily and information security breaches continue to occur unabatedly (Alshaikh, Maynard, Ahmad, & Chang, 2018; Jalali, Siegel, & Madnick, 2019). There is rapid development of new, evolving and sophisticated cyber weapons and Developing Countries (DC) are still at the very early stage of developing cyber-defense (Caldwell, 2013; de Barros & Lazarek, 2019; Gercke, 2011). In the developing regions there are inadequate cyber-security controls and a scarcity of the knowledge and skills that are required to develop effective cyber-security strategies (Jenkins, Grimes, Proudfoot, & Lowry, 2014; Khan, Moon, Rhee, & Rho, 2010; Muller, 2015).

The implementation of KM to assist with policy development could result in a more effective and efficient policy development process. Information security safe-guards are much weaker in developing regions when compared to developed countries; this makes them the avenue of choice for cyber criminals who exploit the weaknesses that are present in these systems (Kshetri, 2010; Schia, 2018). According to Jenkins et al. (2014) users of the Internet in developing countries are targeted by hackers because of the perception that there are limited programs to secure cyberspace and there are inadequate laws to enforce cyber security. Jamaica like other developing countries has limited information security resources (human and financial) and is lagging behind in enacting the necessary legislations which are required for the full protection of data and systems. Therefore, KM can bring together the distributed information security knowledge repositories and the limited information security expertise that exist in developing countries.

This study makes both theoretical and practical contribution. From a theoretical perspective it examines how knowledge management processes can assist developing countries with the management of information security, thus adding to the paucity of knowledge that exists in literature regarding knowledge management and information security. From a practical perspective, the proposed knowledge acquisition model facilitates knowledge sharing in the domain. The knowledge acquired during this exercise can result in improved information security decision making processes, increased efficiency and strengthen policy development capabilities. In this study we will look at how knowledge management can be used in developing countries to develop context-sensitive information security policies. This study uses a design science research (DSR) approach for the creation and evaluation of the proposed Knowledge Acquisition Model along with an initial Knowledge Management Model. Preliminary evaluations of the models are presented with subsequent evaluation to be done in future research. The rest of this paper is organized as follows: a background to this research that looks at the state-of-the-art of information security and knowledge management, the design science methodology used to conduct the study, a Knowledge Acquisition Model (KAM) that has been developed and preliminary evaluation of the proposed KAM and results of the initial evaluation are presented in the

Knowledge Management Model (KMM).

2. Background

Success in today's technologically driven world is partially dependent on effective information security and the ability to control information (Caldwell, 2013). Effective information security begins with the development of effective information security policies which includes guidelines for protecting technical and information resources as well as monitoring human behavior (Khan et al., 2010; Peltier, 2016). However, the complexity and dynamic nature of these interconnected systems makes developing information security policies a challenging task because there are no simple solutions, neither does one size fit all (Alberts & Dorofee, 2002; Alshaikh et al., 2018; Syamsuddin & Hwang, 2009). Researchers Jalali et al. (2019) in their study point out that only 19% of chief information security officers believe that information security incidents are addressed adequately in organizations. Knowledge in the information security domain is distributed, fragmented and resides in various repositories. The main sources of information security knowledge reside in explicit (codified) format in systems and frameworks. However, additional knowledge sources that are very important to the success of information security are implicit (human) knowledge that resides in domain experts. Bringing distributed and fragmented knowledge together is challenging and very costly. No single developing country or organization in these countries can effectively manage information security because managing information security requires large amounts of financial and human resources (Ellefsen & Von Solms, 2010; Tu & Yuan, 2014).

2.1 Knowledge Management

Knowledge Management can be described as achieving the best results through maximizing the use of the organizations knowledge resources within the organization. According to Alshaikh et al. (2018) knowledge management encourages the "creation and sharing" of knowledge within an organization to maximize the use of its knowledge resources. Knowledge management processes can be employed to assist with the development of context-sensitive information security policies. Knowledge management Systems (KMS) can be described as flexible technologies that provide a platform for the creation, sharing and application of related knowledge in organizations (Maier & Hädrich, 2011; Mansingh, Osei-Bryson, & Reichgelt, 2009). By its very nature a KMS is designed to be a collaborative tool that supports knowledge management. Knowledge management can result in more effective and efficient knowledge management processes and improved productivity of "knowledge work" (Maier & Hädrich, 2011). Knowledge management provides a conduit for codifying knowledge that is associated with a process. This knowledge is broken down into rules or related courses of action resulting in a more accurate direction as it relates to procedures or processes (Turner & Makhija, 2006). Process-related knowledge can be proactively delivered in its most correct form to the process performer and can be found in things such as documents, experts and help files just to name a few (Jung, Choi, & Song, 2007). The present research looks at addressing information security management by applying explicit/codified knowledge that resides in established frameworks. However, very few researchers have looked at how knowledge management (KM) processes can be used to assist with the management of information security (Belsis, Kokolakis, & Kiountouzis, 2005). In this study we will investigate how knowledge

management can assist in the development of effective information security policies in developing countries.

2.2 Information security

Several information security (InfoSec) standards have been developed to assist with designing information security policies including security governance guidelines such as Control Objectives for Information and Related Technology (COBIT), the Capacity Model for security (CMM-SEC), Guidelines for Management of IT security GMITS International Organization of Standards (ISO) and the International Electro-technical Commission (IEC), Integration Solution Framework (ISF) : ISO/IEC 27001/2, BS7799, PCIDSS, COSO, ITIL, OPM3, PRINCE2, PMMM, (Blum, 2006; Njenga & Brown, 2008; Palilingan & Batmetan, 2018; Susanto12, Almunawar, & Tuan, 2012; Susanto & Almunawar, 2015). There is also the Communication and Information System (CIS) Security Capability Breakdown/ Framework designed to assist practitioners manage information security across the organizations communication platform (Bernier & Perrett, 2014). However they are not widely adopted, with the highest adoption rates ranging between 6% - 26% for COBIT and ISO/IEC 27002 (Susanto12, Almunawar, & Tuan, 2011; Susanto12 et al., 2012). The low adoption rate is attributed to multiple factors including complexity, certification requirements, lack of resources, difficulty in understanding and implementing the guidelines, culture and the lack of trained personnel (Susanto12 et al., 2011, 2012; Tunçalp, 2014; Von Solms, 2005). Despite the continuous increase in security breaches many security tools / guidelines remain underutilized by practitioners (Witschey et al., 2015). Making decisions regarding the security of an organization's information resource is a very important issue and could be the difference between secured and vulnerable systems.

In May, 2019 the General Data Protection Regulation (GDPR) implemented its new regulation. While some of these requirements are not entirely new it however, in the new implementation processing personal data without consent is unlawful. Therefore, it is imperative that governments and organizations align their information security policies aimed at preventing these types of breaches. These new legislation has far reaching implications because they are applicable worldwide and applies to any jurisdiction that does business directly with countries within the European Union or its uses its citizens personal data. The GDPR implementation of May, 2019 makes it even more important that organizations in developing countries like Jamaica implement policies aimed at meeting these information security requirements.

2.3 Knowledge Management and Information Security

Effective management of information security depends on knowledge (past and present) from an organizational context along with trends in technology (Belsis et al., 2005). Managing various types of knowledge in organizations has been investigated, however not much attention is given to knowledge management from an information security knowledge perspective (Belsis et al., 2005). There is a limited and an incomplete representation of systematic documentation of information security knowledge at

the management level that outlines how this knowledge contributes to the information security experts' work (Belsis et al., 2005; Fenz & Ekelhart, 2009). A few researchers have looked at knowledge and information security; however, there is paucity of study that investigates how knowledge management can strengthen information security in organizations that are constrained because of their lack of or limited resources.

Researchers (Kesh & Ratnasingam, 2007) proposed an information system knowledge architecture (ISKA) that is aimed at capturing "time-invariant" knowledge at the high level and provides a framework for organizational knowledge to be dynamically captured. The proposed ISKA is the first step in the acquisition of information security knowledge and provides a medium for organizations to capture initial knowledge and incrementally update this knowledge based on the needs of the organization. The ISKA applies the knowledge management principles and uses primary and secondary interfaces to connect all the components of KM. The primary interfaces are concerned with the relationship between components such as knowledge dimensions, knowledge characteristics, knowledge resources and the relevant stakeholders. The secondary interfaces are only concerned with the knowledge components. The study proposed that implementation of their proposed architecture would require that knowledge architecture be developed for each group of stakeholders.

Researchers (Fenz & Ekelhart, 2009) proposed an information security ontology that models the information security knowledge that is encoded in the German IT Grundschutz Manual and the ISO/IEC 27001 standard. This ontology uses the OWL-DW W3Web ontology language standard to model the relationships between the organization's information resources (assets) and their vulnerabilities. The aim of this study was to propose a structure that could support the information security risk management but provide a general model that could support the information security domain including the infrastructure. The researchers pointed out that previously proposed information security ontologies were very limited in their scope and suggested that future studies could look at expanding the scope.

A study of knowledge management for information security done by (Belsis et al., 2005) sought to identify the primary sources of information security knowledge. This study conducted field research aimed at identifying the main sources of information security knowledge. The three core areas relating to information security knowledge that were identified are the strategic, tactical and operational levels. The researchers suggested that the operational level is considered to be the greatest source of information security knowledge. In the study the researchers identified that the most relative sources of information security knowledge within an organization are at the strategic, tactical and operations levels.

A structural framework was developed that comprised three layers namely: policy, guidelines and measures. This framework was used develop a model that represents the logical flow of information security knowledge in organizations. This knowledge can be used to develop context-sensitive information security policies. The researchers point out that capturing and documenting knowledge relating to information security remains an "ad hoc" process and controlling information security knowledge remains "unobtrusive" in most organizations. Researchers suggested that there is a need for

research that looks at the use of knowledge management and information security as presently, information security scholarships are limited mainly to documents / framework (Belsis et al., 2005). Information security policies can be describes as a “means to an end” therefore, it should be viewed beyond the protection of data on a device, and policies should incorporate the organizations assets both internally and externally (Peltier, 2016).

In this study we extend / build on the study presented by (Belsis et al., 2005) and we propose a knowledge acquisition architecture/ model that uses the knowledge management principles. We distill the two most widely adopted information security standards namely: COBIT and ISO/IEC 2005 with the Value Focused Thinking (VFT) technique that facilitates the input of the decision maker. The proposed Knowledge Acquisition Model (KAM) provides a medium for the combination and codification of explicit/ codified knowledge that exist in the information security frameworks and implicit/tacit knowledge of domain experts. Information security experts / practitioners posse tacit knowledge (“cognitive and technical elements”) acquired through previous problem solving methods and practical experience. Explicit information security knowledge exists in various forms of documents (frameworks, manuals and handbooks etc.). The amalgamation of tacit of information security knowledge that resides in human repositories and explicit (“articulated, codified and communicated”) could yield more efficient and effective output. Using knowledge management technologies, “Codifiable” process-oriented knowledge can be broken down into rules or related courses of action and can result in accurate procedures being followed (Turner & Makhija, 2006). Process-oriented knowledge if proactively delivered in its most correct form to the process performer can result in increased efficiency therefore improves the usability of the organization’s knowledge assets (Jung et al., 2007).

The proposed KAM brings together tacit knowledge of domain experts and process - related knowledge taken from the ISO 27005 and the COBIT standards. The explicit knowledge from the COBIT and ISO /IEC 27005 will be distilled along with the VFT approach that facilitates the decision maker and domain experts input. Design Science is ideal for this study because it provides a framework for the utilization of existing knowledge and the addition of proven knowledge management concepts extending the literature while providing a model aimed at solving a real world problem. In this study we present a model that applies the knowledge management concepts to the information security domain. The results suggest that implementation of knowledge management techniques in the information security domain could strengthen information security policy development capabilities in cases where there are limited resources such as developing countries. The KAM presented can assist in the development of context-sensitive information security policies. Design science research contribution can be significant and publishable if what is presented is “new” because although the artifact presented may be incremental the practicality of its application can complement the contribution to knowledge (Gregor & Hevner, 2013).

3. Research Methodology

A qualitative approach was used to conduct this study. Design science is a technology-oriented paradigm

which has its foundation in the sciences and engineering and is central to what information system practitioners and researchers do (Hevner & Chatterjee, 2010a). According to (Nugrahanto & Morrison, 2008; von Alan, March, Park, & Ram, 2004) the generally accepted activities in design science are to build and evaluate, where building looks at the development of an artifact to meet specific requirements and; evaluating is concerned with how well they achieve the intended purpose and contribute to knowledge. Design science brings together technology-based artifacts that can be classified as instantiations, constructs, methods or models (Golding & Donaldson, 2009). Design science (DS) aims to simplify a problem and build artifacts that are referred to as human-machine with the intent of “supporting operations, management, analysis, and decision-making activities” in organizations (Hevner & Chatterjee, 2010b). DS research aims to build/develop improved or new solutions in a problem domain when the application’s context is unclear, unknown or where solutions are not optimal (Gregor & Hevner, 2013).

3.1 Design Science Research Guidelines

Researchers (Hevner & Chatterjee, 2010b; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007) point out that design science research (DSR) aims to develop useful technological solutions based on business requirements aimed at: (a) Producing artifacts that are “implementable” and which provide solutions for unsolved problems. (b) Applying rigorous methods both in the construction and evaluation of the artifact. (c) Facilitating the search process, for unearthing a solution for a problem. Therefore, producing “effective design” will depend on knowledge of both the application and the solution domains. (d) Constructing an artifact that can be evaluated as the output. (e) Evaluating the design of the artifact. An artifact is “complete and effective” if it meets the requirements and produces the intended solution to the relevant problem. (f) Communication of research results.

Guideline	Activity of this Research Project
Identification and clear description of a relevant organizational, IT problem	Information security is a growing problem worldwide and organizations in developing countries are struggling to address the problem because of the lack of the required resources (human, financial).
Demonstrate that no adequate solution exist in the extant IT knowledge-base	Several information security guidelines/standards have been developed however, they are costly, difficult to implement and often require certain expert skillsets in quantities and at levels that are not easily attained by organizations in developing economies. The adoption rates of these standards remain extremely low.
Development, and presentation of a novel IT artifact (constructs, models, methods or instantiations) that addresses	In this research we present a conceptual Knowledge Acquisition Model (KAM) for strengthening the development context-sensitive information security policies.

the problem	
Rigorous evaluation of the IT artifact enabling the assessment, of its utility	For this stage of the research program, the conceptual KAM is presented along with preliminary results from a knowledge management model outlining the results obtained from the output attained from the initial Knowledge Management Model (KMM).
Articulation of the value added to the IT knowledge-base and practice	The Definition and illustration of an appropriate conceptual knowledge acquisition model that uses knowledge management concepts in the information security domain to strengthen information security capabilities in organizations in the development of context-sensitive information security policies. This adds to the limited knowledge available in relation to the use of knowledge management in the information security domain and practitioners can utilize this method to share and manage information security knowledge within organizations
Explanation of the implications for management and practice	Utilization of established techniques to define the conceptual knowledge acquisition Model that is consistent with the previously proposed Hybrid VFT/Delphi Framework (Maitland & Osei-Bryson, 2014), and A Conceptual Data Model for a Domain Knowledge Base (Barrett-Maitland et al., 2015), and the justification of this 'solution' framework.

Table 1: Application of the design science methodology to this study based on recommendations outlined in (Gregor & Hevner, 2013)

In this study we present an example using a use case. We then developed a conceptual knowledge acquisition model (KAM) see Figure 1. The KAM brings together explicit knowledge in the two most widely adopted security frameworks / standards: COBIT and the ISO/ IEC 27005, and the Value Focused Technique. Figure 2 presents preliminary results of the knowledge management model (KMM) that is being developed based on the KAM presented in Figure 1.

4. Results

In this section we present a use case, a conceptual knowledge acquisition model (KAM), for the development of a knowledge management model (KMM). A sample of the metadata generated after interaction with the KAM is presented in Table 2. In Figure 2 we present a sample of the implementation description of the suggested policies generated by the proposed Knowledge Management Model (KMM). The proposed KAM model can strengthen information security policy development capabilities of organizations in developing countries as it facilitates the development of context-sensitive information security policies.

4.1 Use Case

A small business that sells organic products in Jamaica is expanding its reach to the Caribbean and North America. The company wants to allow customers to interact with the system electronically via the Internet; this includes establishing a social media presence. However, the company is aware of the vulnerabilities that this digital expansion can create and is keen on securing its copyrights and trade secrets. The company intends to offer delivery services via a courier or customers may pick-up orders at the nearest location. Presently, a manual system is used for recording and keeping these records and they are classified as normal, sensitive and extremely sensitive. The present business processes do not require a formal information security policy document. There are three categories of users; senior management, supervisors and line workers. Customers can make orders, view available stock items and request information such as balances, order details, prices. This company will also advertise its products and services and provide basic information regarding the services offered. One very important aspect of this venture is the development of a formal information security policy that will govern interactions of staff at all levels, with other internal stakeholders and with the various publics.

Building on work presented by Belsis et al., (2005) where the tactical and operational levels were identified as the main sources of information security knowledge in organizations'. In Figure 1 we present a conceptual knowledge acquisition model (KAM) for the acquisition of knowledge with a focus on the strategic and operational levels. In table 2 we present a sample of some of the metadata that would be generated after interaction with the KAM. In figure 2 we present output from the knowledge management model that outlines the initial procedures and information that would be generated based on the initial knowledge updated from information security frameworks and other sources of knowledge via the KAM. As pointed out in work done by (Belsis et al., 2005) the strategic and the operational levels are the most valuable sources of information security knowledge. The strategic level will inform policy as it outlines the information security policies and procedures that should be followed for the implementation of these policies. The operational level consists of knowledge repositories such as domain experts (implicit) and explicit sources of knowledge such as frameworks, documents and other system resources.

The conceptual KAM presented in figure 1 brings together the information security control objectives detailed in the COBIT framework and the implementation procedures outlined in the ISO/ IEC 2007 along with the Value Focused Thinking (VFT) objectives and suggestions of domain experts, decision makers and other information security stakeholders. The COBIT and ISO/IEC 2007 standards are the two most widely adopted information security standards as outlined in the previous sections of this study. The KAM provides a medium for strengthening information security policy development as it capitalizes on the strength of each framework. Researchers (Von Solms, 2005) point out that the COBIT framework, though described as a well-researched framework, is not widely adopted because of challenges it poses for information security practitioners. The COBIT framework by its very nature is difficult to implement as it mainly focuses on "what" should be done. On the other hand the ISO/IEC 2005 is described as the practitioners' handbook as it focuses on "how" things should be implemented. The low adoption rate is attributed to its stand-alone nature and the difficulty to integrate it with other systems. The KAM combines the strength of both frameworks and utilizes the VFT methodology to incorporate the domain

experts (decision makers) as part of the development of a context-specific information security policy. The aim of KAM is to provide a medium for the combination of explicit and implicit knowledge in a manner that can result in a more efficient and effective process of knowledge acquisition, resulting in the strengthening of the information security policy development process.

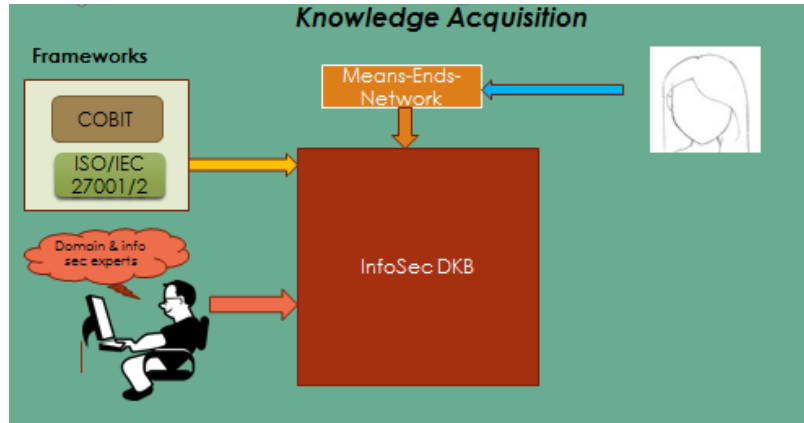
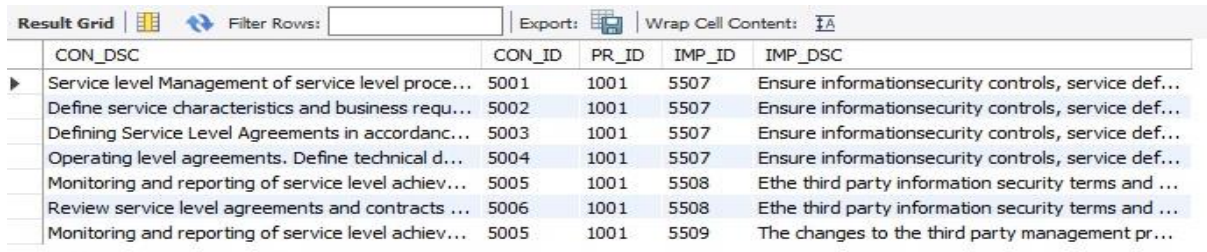


Figure 1: The proposed conceptual knowledge acquisition architecture / Model (KAM)

Responsible Team	Strategic	Operational
Management team	Information security is to protect the organization's information assets from unauthorized use.	An information security document that is aligned with the strategic objectives of the organization and lines up with the laws and regulations of the data protection act/ policy must be developed.
Designated information security officer	Outlines commitment and support that the organization will provide to enable the achievement of information security objectives / goals.	Updates the information security document with the information that outlines management's commitment to the information security process.
Chief information security officer	Controls objectives, objectives risk assessment and management.	Outlines how external stakeholders will interact with the organization's information assets. Determines how information from external sources is handled (stored, cleared) and updated to the system. Controls the verification process for transactions to identify the accuracy of transmitted information (or identify if breaches have occurred. Outlines protocol for accessing and managing the information assets (copying, sharing/ disclosing of companies information. Determines access control policies: Identification requirements for entering controlled environments Clearly document the acceptable use of company/ organization's information assets.
Chief information security	Outlines requirements for compliance with legislation and contractual requirements	Provides documented policies that state the organization's compliance with regulatory legislations and its contractual agreements. Outlines the business continuity plan example: If there is a natural disaster, fire and any other unforeseen circumstance what is the procedure that must be followed to

officer	(JDPP, GDPR). Outline the business continuity plan and how it should be managed. Determines consequences of information security policy breaches.	ensure the business' information assets are protected/ secured? If an employee resigned or is terminated what should be done regarding access to information assets? When should users' access rights be terminated, denied or removed etc.? What are the disciplinary procedures for breaches? The protocol for returning company assets (Identification cards and access chits etc.)
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Table 2: Sample metadata after interaction with the KAM



CON_DSC	CON_ID	PR_ID	IMP_ID	IMP_DSC
Service level Management of service level proce...	5001	1001	5507	Ensure informationsecurity controls, service def...
Define service characteristics and business requ...	5002	1001	5507	Ensure informationsecurity controls, service def...
Defining Service Level Agreements in accordanc...	5003	1001	5507	Ensure informationsecurity controls, service def...
Operating level agreements. Define technical d...	5004	1001	5507	Ensure informationsecurity controls, service def...
Monitoring and reporting of service level achiev...	5005	1001	5508	Ethe third party information security terms and ...
Review service level agreements and contracts ...	5006	1001	5508	Ethe third party information security terms and ...
Monitoring and reporting of service level achiev...	5005	1001	5509	The changes to the third party management pr...

Figure 2: Proposed knowledge management model (KMM)

4.2 Preliminary Evaluation of the Artifact

Maes & Poels (2006) presented an assessment framework based on Seddon's re-specified information systems success model (Seddon, 1997) which acknowledges quality as an antecedent to system's success. This model identified four interconnected construct categories as necessary to assess the quality of an artifact:

- **Perceived semantic quality** describes the correspondence between the information that users think the model contains and the information that users think the model should contain, based upon their knowledge of the problem domain (Krogstie, Lindland, & Sindre, 1995).
- **Perceived usefulness** relates to "the degree to which a person believes that using a particular system has enhanced his or her job performance" (Davis 1989).
- **User satisfaction** is a subjective evaluation of the various consequences evaluated on a pleasant to unpleasant continuum (Seddon 1997).
- **Perceived ease of use** refers to the extent that the user believes using the system would require little effort (Davis, 1989) or perceived as being difficult to use (Moore & Benbasat, 1991).

In Table 3 we present the results of the use of an informed argument approach to conduct a preliminary evaluation of our proposed Conceptual Knowledge Acquisition Model based on the Maes & Poels (2006) framework. This evaluation aims to analyze the benefits of the application of knowledge management to the information security domain and its usefulness in this environment. In Figure 2 we present preliminary results of the proposed knowledge management model (KMM) developed based on the KAM.

Category	Activity
Perceived semantic quality	<p>A Hybrid Value Focused Thinking (VFT) /Delphi methodology proposed by (Maitland & Osei-Bryson, 2014) aims to provide knowledge management support for the elicitation phase of the knowledge acquisition process.</p> <p>A Conceptual Data Model (CDM) proposed by (Maitland, N., Osei-Bryson, K. M., and Mansingh, G. 2015) <i>that</i> compared and combined the equivalent factors of the IS security frameworks ISO/IEC 27001/5, COBIT along with the fundamental objectives of the VFT approach these were identified and modeled. Given that the KAM is based on the integrated combined knowledge of established / information security frameworks and previously proposed Information Security Domain VFT models that contain desires of decision makers, then the corresponding should contain the information that users think it should contain.</p>
Perceived usefulness	Given that the KAM is based on explicit knowledge/information expressed in established frameworks and provides a medium for querying the corresponding Knowledge Management Architecture, then use of the KAM should result in improved performance by stakeholder. The proposed KAM uses knowledge management-based process that could assist stakeholders to develop context-sensitive information security policies.
User satisfaction	Given that stakeholders may be at different levels of knowledge and competence with regards to information systems security, and limitations on human's ability to recall all relevant information, then stakeholders should be satisfied to have access to relevant information that would be contained in the knowledge management system which is based on the KAM.
Perceived ease of use	The stakeholders would not be interacting directly with the KMS but rather through software facilities including those provided by the knowledge management system.

Table 3: Application of the information system success model to the KAM

5. Conclusion and Future Work

In this research we have proposed a conceptual KAM for information security knowledge management that aims to assist developing countries in strengthening and managing information security policy development. Bringing together the various sources of knowledge can result in a more robust framework for developing information security policies. The knowledge acquisition model brings together both explicit and tacit knowledge sources, explicit knowledge that is embedded in the most widely adopted standards COBIT and ISO/IEC 27005 along with tacit knowledge of the information security experts. Preliminary results reveal that knowledge management practices could assist in the development of context-sensitive information security policies. Future components of this research program will involve the development of a software system followed by the evaluation of the system.

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