論文 / 著書情報
Article / Book Information

題目(和文)	ダイナミック・ケイパビリティにもとづくデジタル・ビジネスバリューのためのフレームワーク。日本の中小企業からの洞察
Title(English)	Towards a Framework for Digital Business Value with Dynamic Capabilities. Insights from Japanese SMEs.
著者(和文)	RIERA Christian
Author(English)	Christian RIERA
出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第11321号, 授与年月日:2019年9月20日, 学位の種別:課程博士, 審査員:飯島 淳一,井上 光太郎,妹尾 大,鍾 淑玲,鈴木 定省,平野 雅章
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第11321号, Conferred date:2019/9/20, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Type(English)	Doctoral Thesis

TOWARDS A FRAMEWORK FOR DIGITAL BUSINESS VALUE WITH DYNAMIC CAPABILITIES. Insights from Japanese SMEs

In partial fulfillment of the Degree of Ph.D.

By

Christian RIERA

Supervised by Professor Junichi IIJIMA

A Dissertation Submitted to the
Department of Industrial Engineering and Economics
Graduate School of Decision Science and Technology

Tokyo Institute of Technology

Tokyo, August 2019

Acknowledgement

I would like to thank my supervisor, Professor Junichi Iijima for his guidance and support during the doctoral course. His continuous guidance has always encouraged me to drive for excellence.

To the companies that participated in the study, in particular to the organization which took part in the qualitative exploration. To collaborator partners such as the Innovation Value Institute headquartered in Ireland and its branch in Japan: IVI Japan.

Part of the present dissertation is built on the foundation laid by previous work during the master degree course, hence I would like to acknowledge also to the contributors to that study.

I would like to thank the staff of the Department of Industrial Engineering and Economics for their assistance during the course of my study.

Finally, I would like to thank family and friends; they have always been a source of motivation and inspiration.

Christian Riera

This dissertation is dedicated to my family.
To the generations that raised me,
to my wife and to the new generation
that brought me the light to continue the journey.

Summary

The opportunities that digital technologies like SMACIT (Social, Mobile, Analytics, Cloud and Internet of Things) bring to organizations are currently a major focus for both academia and industry. Since such technologies become available to a wider public, their simple usage or replication is not sufficient to provide a source of competitive advantage. The challenge that organizations face is how to gain a competitive advantage from digital technologies and stay relevant in the market.

While large organizations usually have more resources than Small and Medium Enterprises (SME), SMEs have some advantages such as a simpler decision process supported by fewer levels of hierarchy. This dissertation focuses on Japanese SMEs due to their economic relevance. It is reported by the Ministry of Economy, Trade and Industry in Japan (METI) that they account for 99.7% of all enterprises from the Japanese economy (2016). This emphasizes the importance to understand how organizations can prepare to embrace digital technologies.

The research on Information Systems is looking at this phenomenon covering several aspects like the adoption of specific technologies, the journey to digitalization that brick and mortal organizations are following, the challenges for adoption of a particular technology and the characteristics needed in the organizations in order to support Digital Transformation.

This dissertation is aligned with research suggesting that the way how digital technologies are combined with the organizations' capabilities becomes a key to success in the Digital Age. Furthermore, this dissertation proposes that three perspectives: **Strategic Decision Making**, **Knowledge Creation** and **Technological Capability** perspectives together with their interaction become the foundation for achieving business value from Digital Technologies ("Digital Business Value").

- **Strategic Decision Making perspective** refers to effective decision making based on the information available inside and outside the organization. This becomes critical in the Digital Age as those decisions can shape how to transform the organization and how to use digital technologies. Organizational Intelligence Quotient (OIQ) was selected to provide this context as it is a measure of how organizations assimilate, manage and use information in order to make effective decisions.
- **Knowledge Creation perspective** refers to the Knowledge Creation routines that allow new thinking to be created in the organization in order to generate new value-creating strategies or new sources of competitive advantage. This is fundamental since technologies like Social, Mobile, Analytics or Internet or Things are highly dependent (either generate or use) on data and information and can serve to develop insights on new knowledge. The four Knowledge Creation processes from SECI Model together with Knowledge Creation Capabilities "KCC" are used to evaluate this perspective.

- **Technological Capability perspective** refers to the ability to mobilize and deploy technological resources to support the organization in achieving its business objectives. This becomes relevant to the Digital age as it ensures that the strategic decisions regarding digital technologies made by the previous perspectives can actually be delivered. IT capabilities in the SME IT Capability Maturity Framework "SME IT-CMF" were selected as SME IT-CMF presents a meta-model for managing IT capabilities in organizations sized for SME.

Digital Business Value was defined as the achievement of business objectives through the use of digital technologies. A framework to achieve digital business value is developed based on the three perspectives. The framework is tested following a quantitative approach. The data was collected from Japanese SMEs awarded by METI Industry in the list of "Competitive IT Strategy SME Selection 100" over the years 2015, 2016 and 2017. Data collection was done with questionnaires sent to the awarded organizations and collected 34 responses.
Additionally, a qualitative exploration with a previously awarded company produced further research insights and questions valuable to be pursued on future work.
The quantitative findings verified the relationship of the perspectives with the achievement of business value using digital technologies.

The key findings are summarized as follows and emphasize that Digital Business Value relies on the complementarity between the perspectives:
- Technology Capability (IT-CMF) and Strategic Decision Making (OIQ) perspectives are related to the achievement of Digital Business Value. Their combined effect yielded higher levels of Digital Business Value.
- Knowledge Creation (KCC) and Strategic Decision Making (OIQ) perspectives were related.
- Organizations that were able to achieve Digital Business Value also showed similar achievement regarding "traditional IT".

This dissertation initiates the debate around the "Digital Investment Paradox" when exploring if investments on Digital Technologies yield Business Value. The Digital Transformation literature is extended in particular how dynamic capabilities work together in order to enable Digital Business Value. The results also provide practical insights on how SMEs can prepare to overcome the challenges and seize opportunities from Digital Technologies as it shows which particular capabilities may be of their interest in developing.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

Chapter One: Introduction

1.1 Background

Together with the availability of Digital Technologies like SMACIT (Social, Mobile, Analytics, Cloud and Internet of Things) (Sebastian et al., 2017) organizations have opportunities to reinvent the way they engage with customers and suppliers, create and deliver new services and products to stay competitive. A study produced by Microsoft in partnership with IDC Asia/Pacific (Microsoft Asia News Center, 2018a) based on 1,560 respondents from 15 Asia Pacific markets reported the actual potential of Digital Transformation. For example, the manufacturing industry in the region could add an extra US$387 billion to Asia/Pacific's GDP by 2021 and grow by extra 1.0% annually. A similar scenario was identified for the Financial sector (FSI) where an extra US$292 billion could be added if all FSI organizations in the region embrace digital transformation, representing an annual growth of 1.5% (Microsoft Asia News Center, 2018b). This new force demands that organizations redesign themselves in order to take advantage of digital technologies (Ross et al., 2016a; Ross et al., 2016b). Research suggests that the keys for defining and implementing digital strategies are: an effective digital strategy between customer engagement and digitized solutions, an operational backbone enabling operational excellence, a digital services backbone supporting rapid innovation and responsiveness to new market opportunities and a continuous organizational redesign (Ross et al., 2016b). Digital Technologies are not anymore a luxury option that only large corporations afford but nowadays are available for organizations of any size. Although Small and Medium Enterprises (SME) have limited resources and limited specialization skills compared with larger organizations, SMEs have some advantages. For example, their simpler level of hierarchy allows them for greater agility and quicker decision making (Carcary et al., 2014). It was also found that small companies that can implement new applications faster have an early advantage (Ross et al., 2016a).

These characteristics combined with the economic relevance that SMEs play in Japan became the motivation for this study aiming to reach a deeper understanding of how such organizations can effectively use digital technologies. It is reported by the Ministry of Economy, Trade and Industry in Japan that SMEs account for 99.7% of all enterprises in the Japanese economy (SME Agency, 2016).

This study is aligned with the research agenda on Information Systems (IS) in general but most importantly with the development in the Asia Pacific region. As can be observed on the IS articles published on the PAJAIS's community and PACIS's conferences. In case of PAJAIS, the attention is evident starting with special issues dedicated to Digital Society and E-Technologies (Issa et al., 2013), Social Media and Social Commerce (Ye et al., 2016) in which the focus was on the adoption or use case of specific technologies first. With a recent focus looking more at the characteristics needed in the organizations in order to support Digital Transformation such as Digital leadership (Tanniru et al., 2018). Similar attention is also observed in the papers presented at PACIS conferences over

the recent years. With studies focusing on describing the journey to digitalization that brick and mortal organizations or traditional industries are following (Tim et al., 2018; Törmer, 2018), as well as specific studies on the challenges for adoption of a particular technology like cloud or mobile (Budiono et al., 2018; Rana et al., 2018). In addition studies have also targeted how IT capabilities such as IT infrastructure, IT managerial skills and IT technical skills can support the delivery of new technologies (Zhu et al., 2018) as well as how IT exploration and exploitation (named IT Ambidexterity) have an impact on the digital innovation capability of the organizations (Tai et al., 2017).

This dissertation is aligned with existing research which suggests that the way how digital technologies are combined with the organizations' capabilities becomes a key for success in the Digital Age. Furthermore, this dissertation proposes that three perspectives: Strategic Decision Making, Knowledge Creation and Technological Capability perspectives together with their interaction become the foundation for achieving business value from Digital Technologies ("Digital Business Value").

1.2 Goals and Objectives

This dissertation aims to develop a framework to achieve business value from Digital Technologies. The research framework is based on dynamic capabilities and proposes that three perspectives: Strategic Decision Making, Knowledge Creation and Technological Capability together with their interaction are required in order to achieve Digital Business Value.

The framework leverages the experiences from the "IT Productivity Paradox" (Brynjolfsson and Hitt, 1998) which unveiled that organizational characteristics act as moderators of the benefits that organizations achieve with technology or IT.

The following specific objectives are considered.

- To identify the role that each perspective has both individually and collectively on the achievement of Digital Business Value.

- To identify on a detail level which components of each perspective are related to Digital Business Value.

- To initiate the debate around the "Digital Investment Paradox" by exploring if investments on Digital Technologies yield Business Value.

- To extend the Digital Transformation literature is extended in particular how dynamic capabilities work together in order to enable Digital Business Value.

- To provide practical insights on how SMEs can prepare to overcome the challenges and seize opportunities from Digital Technologies as it shows which particular capabilities may be of their interest in developing.

1.3 Research Question

The research question can be described as follows;

What are the organizational capabilities that Small and Medium Enterprises need to develop in order to achieve Business Value from Digital Technologies ("Digital Business Value")?

Digital Business Value was defined as the achievement of business objectives through the use of digital technologies. The categorization proposed by the Balanced Scorecard was used in order to address the individuality of the organizations as they have their own objectives when they invest or engage in digital technologies initiatives. Following the Balanced Scorecard categorization, four categories of business objectives were used: Customer, Financial, Business Process and Learning & Growth.

This dissertation proposes that organizations need to consider three perspectives and their interaction as the foundation to achieve Digital Business Value: Strategic Decision Making, Knowledge Creation and Technological Capability perspectives.

- Strategic Decision Making perspective refers to effective decision making based on the information available inside and outside the organization. This becomes critical in the digital age as those decisions can shape how to transform the organization and how to use digital technologies. Organizational Intelligence Quotient (OIQ) was selected to provide this context as it is a measure of how organizations assimilate, manage and use information in order to make effective decisions.

- Knowledge Creation perspective refers to the Knowledge Creation routines that allow new thinking to be created in the organization in order to generate new value-creating strategies or new sources of competitive advantage. This is fundamental since technologies like Social, Mobile, Analytics or Internet or Things are highly dependent (either generate or use) on data and information and can serve to develop insights on new knowledge. The four Knowledge Creation processes from SECI Model together with Knowledge Creation Capabilities "KCC" are used to evaluate this perspective.

- Technological Capability perspective refers to the ability to mobilize and deploy technological resources to support the organization in achieving its business objectives. This becomes relevant on the Digital Age as it ensures that the strategic decisions regarding digital technologies made by the previous perspectives can actually be delivered. IT capabilities in the SME IT Capability Maturity Framework "SME IT-CMF" were selected as SME IT-CMF presents a meta-model for managing IT capabilities in organizations sized for SME.

The integration of these three perspectives enables the organizations to address changes on the market through the adaptation of their organizational resources and capabilities and be able to respond to the challenges and opportunities that Digital technologies bring. The interaction of the perspectives can be described as follows.

In order to be able to stay relevant and competitive in the market, organizations need to effectively assimilate, manage information and use it to make effective decisions (Strategic Decision Making) regarding digital technologies and strategy. Such decisions can be shaped by -and need to be integrated with- organizational knowledge (Knowledge Creation) to be translated into products and services that take advantage of digital technologies. Then these decisions need to be translated into actual embracement and delivery of digital technology thru IT capabilities (Technological Capability perspective).

1.4 Structure of this Dissertation

This dissertation is organized in seven chapters as described in Figure 1-1.

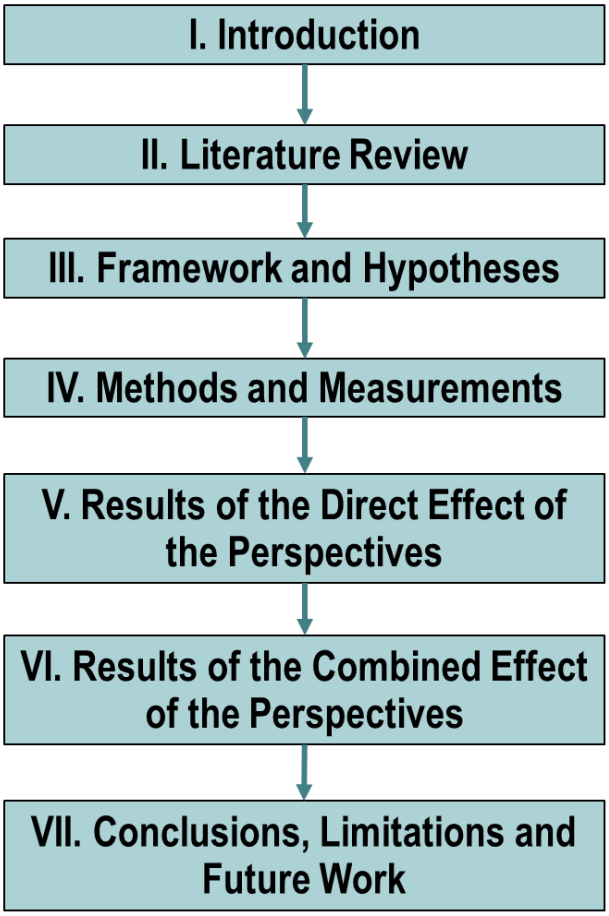


Figure 1-1: Organization of this Dissertation

This chapter provides the main context of this dissertation, including goals, research question, and main contributions.

A review of literature is presented in chapter two, starting with the reasoning for the “Digital Investment Paradox” and each of the three perspectives proposed in this dissertation.

In chapter three the proposed framework together with its associated hypotheses is described. Starting with each of the three proposed perspectives, the final hypotheses reflect the need for a combined approach.

Chapter four begins with a brief description of the research project itself. Then the methods and instruments used for both the main quantitative study as well as the supplementary qualitative exploration.

The results of all the hypotheses together with the interpretation are included in chapters five and six. Chapter five examines the direct relationship of the perspectives with Digital Business Value. Chapter six explores the combined effect of the perspectives on Digital Business Value.

Conclusions and future work are included in chapter seven. The implications of the findings from this dissertation (both quantitative analysis and qualitative exploration) to Small and Medium Enterprises are included in this chapter.

1.5 Position and contribution of this Dissertation

This study is based on Dynamic Capabilities theory and Knowledge-based view. It emphasizes the role of the combined effect of three different but complementary perspectives involving Organizational and IT capabilities towards the achievement of business objectives by the application of Digital Technologies. The study is aligned with the current research focusing on how to enable organizations to face the challenges, opportunities and risks that Digital Technologies offer (Ross et al., 2015; Ross et al., 2016a; Ross et al., 2016b).

With this empirical study the concern of “Digital Investment Paradox” is raised within the academia and doors for new research are opened. This debate is initiated with the proposed three perspectives as enabling capabilities to achieve business value from Digital Technologies.

Chapter Two: Literature Review

Considering that Digital Technologies are an application of technology, this section first presents a literature review covering how research on the contribution of technology (IT) to organizations has evolved. Then the key concepts used in the three perspectives and Digital Business Value are elaborated.

2.1 From IT Productivity Paradox to Digital Investment Paradox

The concern regarding the contribution that IT has on organizations officially initiated in the late 1980s when the term “Productivity Paradox” was coined by the Nobel Prize winner economist Robert Solow. Solow said: “We see the computer age everywhere except in the productivity statistics” (Brynjolfsson and Hitt, 1998). This was a concern raised to the fact that large investments in information technology apparently failed to produce significant increases in productivity. Several empirical studies in the 1980s and early 1990s supported such concept as they did not find an association between IT spending and financial performance (Dos Santos et al., 1993; Strassmann, 1997). At the same time, researchers proposed possible causes for such findings. The mismeasurement of inputs and outputs, lags due to learning and adjustment, redistribution and dissipation of profits, and mismanagement of information and technology were proposed by Brynjolfsson (Brynjolfsson, 1993) as a possible explanation for the productivity paradox. Bakos proposed a list of similar possible reasons for the productivity paradox: mismanagement, mismeasurement, diffusion delay, among others (Bakos, 1998). It was also noted that there was no uniform conceptualization of IT investment or identification of appropriate performance measures (Rai et al., 1997). Another shortfall found on initial studies was that such studies were focused on “computing machinery” as the input value for IT investment instead of considering the whole spectrum like hardware, telecommunications hardware and software, purchased software, software development, consulting services, and personal training (Oz, 2005).

In the 1990s studies brought inconclusive results; some researchers identified a positive effect of IT on firm performance (Barua et al., 1991; Hitt and Brynjolfsson, 1994; Hitt and Brynjolfsson, 1996; Lichtenberg, 1993). Others instead found a negative effect of IT spending on the cost-effectiveness of the organizations (Alpar and Kim, 1990; Harris and Katz, 1991; Mitra and Chaya, 1996).

The variety of measures used for the input (IT investment) and output (organization performance) of this relationship made some researchers to consider different types of IT investment. Several classifications emerged, for example, IT investment into capital, budget, client-server expenditure, information systems staff expenditure, hardware expenditure, software expenditure, and telecom expenditure (Rai et al., 1997). Other researcher classified them onto a portfolio of four IT assets by strategic purpose: infrastructure, transactional, informational and strategic investments (Weill, 1992).

Later on, the research evolved from the view that considered IT spending as an independent asset towards the view in which the combination

of IT spending with organizational capabilities moderated the results that organizations obtained from IT. For example specific organization characteristics such as market position, rigidities in cost structures, brand recognition, the vision and leadership abilities of key executives, specific features of organizational structure, strategy, and complementary management practices -such as decentralization of decision-making, business process redesign, and total quality management- (Riera, 2007 (Master Thesis)). Other studies hinted at organizational and management practices (Brynjolfsson 1996; Bresnahan et al., 2002). A study in Japanese firms explained that the underperformance of IT users was explained by underinvestment in organizational capital complementary to IT, therefore introducing changes with technology may also need to be jointly addressed with adjustments in supplier and customer relationships, internal work practices and incentive systems (Motohashi, 2006).

Such research and efforts helped to understand why returns from IT were not similar to all organizations. The academia was able to address the questions on how IT investment might combine with the business processes being touched by IT (Sandulli et al., 2007) as well as organizational factors or capabilities affecting the organization performance (Bresnahan et al., 2002; Riera and Iijima, 2007; Weill and Aral, 2007; Riera and Iijima, 2017 (published work during this dissertation)).

Over the last decade and with the increasing availability of Digital Technologies like SMACIT (Social, Mobile, Analytics, Cloud and Internet of Things), the research agenda has looked onto the new challenges and opportunities that Digital Technologies offer, how to create competitive advantage from digital technologies and which capabilities are needed to reinvent the organizations to navigate the digital threat and opportunity (Weill and Woerner, 2018).

As the businesses are becoming digital, with increasing interconnections among products, processes and services; digital technologies can fundamentally transform business strategies, business processes, products and services, and the relationships in partners. This has opened new business opportunities that challenge existing organizations (Bharadwaj et al., 2013, Ross et al., 2016a; Ross et al., 2016b; Stockhinger and Teubner, 2018). Within this context, there has been a shift on the role of IT not to only be aligned with the business strategy but instead to be a fusion between business strategy and IT strategy as referred as “Digital Business Strategy” (Bharadwaj et al., 2013). The relevance of digital technologies to the organizations can be observed on the different notions or concepts in which the digital strategy is being explored on the IS literature: “Digital business strategy” addressing the concern of “How can digital technologies leverage differential value and build competitive advantage?”, “Digital IT/IS strategy” focusing on the concern of “What is the potential of digital technologies? Which capabilities are required to exploit their potential? How can these technologies be implemented in competitive IS?” and “Digital transformation strategy” which is concerned on “How to plan, govern, and implement digital transformation?”(Stockhinger and Teubner, 2018).

Such shift from IT to a Digital portfolio taken by the academia can be observed for example on how the IT investment definition used by the Center

for Information Systems Research at MIT (MIT Sloan CISR) while collecting data changed on 2015. CISR has been executing surveys on IT investment data from 1993, and until 2015 the IT investment was conceptualized as "Total IT spending in the enterprise -operating expenses plus capital depreciation- including all IT, technology, services, data, outsourcing, and people dedicated to IT". On 2015 the definition expanded to digital investment as "all digital spending in the enterprise -operating expenses plus capital depreciation- including all IT, technology, services, digitized information, outsourcing, and people dedicated to IT" (Weill and Woerner, 2016).

With all the attention and effort that is being directed to digital initiatives, it is reasonable to think that sooner rather than later the actual effect on organizational performance may be of similar scrutiny as the investment in IT was put under the IT Productivity paradox, raising to what has been termed as "Digital Investment Paradox" (Riera and Iijima, 2018 (published work during this dissertation)). Such scrutiny is recently being tested for example linking the organization's Digital orientation positively with firm performance indicators such as profitability and market value (Beutel, 2018). Other studies have focused on unveiling the link of organizational capabilities -such as knowledge creation- with organizational performance -measured as the level of business objective achievement named Digital Business Value- (Riera and Iijima, 2017 (published work during this dissertation)).

The present study is aligned with such agenda and investigates the relationship of three perspectives: Strategic Decision Making, Knowledge Creation and Technological Capability perspectives on the organizational performance achieved with digital technologies.

A list of relevant studies exploring IT, organizational performance, and organizational capabilities is included in Table 2-1. Table 2-2 lists recent studies related to Digital technologies, organizational capabilities and firm performance.

Table 2-1: Key studies exploring IT, organizational performance and organizational capabilities

Key studies exploring IT, organizational performance and organizational capabilities	
Studies	**Findings**
The relationship between IT and organizational performance	
Mahmood M.A. et al. (1993), Weill (1992), Wilson (1993), Loveman (1994)	None or Negative relationship
Weill (1992), Wilson (1993), Loveman (1994), Brynjolfsson and Hitt (1995), Brynjolfsson and Hitt (1996), Hitt and Brynjolfsson (1996), Brynjolfsson et al. (1998), Greenan et al. (2001)	Positive relationship

The relationship among IT, organizational performance and organizational capabilities	
Bresnahan et al. (2002), Brynjolfsson et al. (1998), Ramirez et al.(2001), Francalanci and Galal (1998), Devaraj and Kohli (2002),Tallon et al. (2000), Weill et al. (2004, 2005), Weill and Aral (2007), Riera and Iijima (2007)	Positive relationship
Source: Adapted from Dedrick, Gurbaxani and Kraemer, 2003	

Table 2-2: Recent studies exploring Digital Technologies

Recent studies exploring Digital Technologies	
Studies	Focus and *Findings*
Digital Technologies (e.g. adoption)	
Budiono et al. (2018)	Cloud computing adoption *Contributing factors affecting cloud computing adoption*
Rana et al., (2018)	Adoption of Digital Financial Services *Identify challenges for Digital financial services adoption and establish relationships.*
Tim et al. (2018)	Journey to digitalization (traditional industry) *<Research-in-progress>*
Törmer (2018)	Journey to digitalization (brick-and-mortar company) *<Research-in-progress>*
Zhu et al. (2018)	IT capabilities supporting the delivery of big data services
Digital Technologies and Organization Capabilities	
Bharadwaj et al. (2013)	Digital Business Strategy conceptualization *(Model proposition)*
Ross et al. (2015)	Business Strategy / Organizational Design for Digital Innovation *Digital strategy: the decision between customer engagement and digitized solutions*
Ross et al. (2016a, 2016b)	Business Strategy / Organizational Design for Digital Innovation *Three elements for successfully leverage opportunities from digital technologies*
Rossmann (2018).	Digital Maturity and capabilities *(Model proposition)*
Stockhinger and Teubner (2018)	Digital Strategy conceptualization *(Content / IS literature analysis)*
Tai et al. (2017)	Digital Innovation capabilities *IT exploration and exploitation impact on the innovation capability* *Research-in-progress*

Tanniru et al. (2018)	Digital leadership *Three leadership styles and four foundational platforms to support business transformations*
Digital Technologies, Organizational Capabilities and firm performance	
Beutel (2018)	Digital strategy (digital orientation) and firm performance. *Positive relationship.*
Riera and Iijima (2017)	Organizational capabilities and firm performance. *Positive relationship (specific organizational objectives).* (published work during this dissertation)
Riera and Iijima (2018, 2019a, 2019b)	Organizational capabilities and firm performance. *Positive relationship (specific organizational objectives).* (published work during this dissertation)
Weill and Woerner, (2013)	Digital business models: capabilities linked to firm performance. *Positive relationship.*
Weill and Woerner, (2016)	Infrastructure capabilities and their management. *Positive relationship.*

2.2 Organizational Capabilities Perspectives

Starting with the resource-based view and later on with dynamic capabilities, a fair amount of research has been done aiming to explain how organizations develop and maintain a competitive advantage.
The resource-based view sees organizations as a collection of physical, human and organizational resources and considers that when resources possess certain characteristics -valuable, rare, imperfectly imitable and imperfectly substitutable-, those could become the source of sustainable competitive advantage (Barney, 1991). It differentiates between resources and organizational capabilities. Resources are converted into products or services, while capabilities are the organizations' capacity to deploy resources to achieve a desired end (Amit and Schoemaker, 1993). An organization capability refers to an organization's ability to "perform a set of coordinated tasks, utilizing organizational resources, for the purposes of achieving a particular end result" (Helfat and Peteraf, 2003).

Dynamic Capabilities emerged to acknowledge that since the market is dynamic, organizations' resources needed to change over a period of time to make them relevant to changing market conditions (Teece and Pisano, 1997). Dynamic capabilities become the foundation on which managers decide how to develop, acquire and combine such resources in order to generate value-creating strategies (Grant, 1996). Dynamic capabilities can be considered as the "organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die" (Eisenhardt and Martin, 2000).

Strategic decision making, for example, is a dynamic capability in which managers pool their various business, functional, and personal expertise to make the choices that shape the major strategic moves for their organizations (Eisenhardt and Martin, 2000).

Dynamic capabilities were later categorized into three capabilities: the ability to sense and shape opportunities and threats; the ability to seize opportunities and the ability to reconfigure the organization assets to meet changing customer needs in a way that builds long-run value (Teece, 2007). One characteristic of the conceptualization is that dynamic capabilities may not only support the adaptability to market changes. Instead, an "enterprise(s) with strong dynamic capabilities will be able to profitably build and renew resources, assets, and ordinary capabilities, reconfiguring them as needed to innovate and respond to (or bring about) changes in the market" (Teece, 2018).

This dissertation examines dynamic capabilities from three perspectives for achieving business value from Digital Technologies

2.2.1 Strategic Decision Making Perspective (Organizational Intelligence Quotient)

The Strategic Decision Making perspective focuses on the ability to assimilate, manage and use information in order to make effective decisions; as measured by the Organizational Intelligence Quotient (OIQ) (Mendelson, 2000).

Organizational IQ "OIQ" has its root in the mid-1990s and was proposed by Stanford Business School professor Haim Mendelson and consultant Johannes Ziegler (Mendelson and Ziegler 1999). The empirical data that they collected showed that companies with higher Organizational IQ showed higher growth, performance and productivity than their peers with lower Organizational IQ (Mendelson and Pillai, 1999). OIQ is a quantitative measure of an organization's effectiveness in information distribution, decision making, and execution (Synesis 2001). OIQ can be considered closely associated with human IQ but viewing the organization as an organism that grows and adapts to environment changes (Mendelson and Pillai, 1999). However, a key difference is that an organization's intelligence (OIQ) can be improved with focused effort (Hansen, 2003).

The core OIQ principles (called dimensions) are included in Table 2-3.

Table 2-3: Organizational IQ Dimensions

Organizational IQ Dimensions	
External Information Awareness (EIA)	The degree to which a company or business unit has developed a deep and consistent understanding of its environment; including information about customers, suppliers, technology and competitors.
Internal Knowledge Dissemination (IKD)	Ensures that each part of the organization knows what it needs to know when it needs to know. It includes metrics across 3 axes: horizontal (cross-functional), vertical (hierarchy) and time (internal feedback, reviews and external benchmarking of key processes).
Effective Decision Architecture (EDA)	Ensures that decisions are made at the right level, by people with the best knowledge. EDA frees key-decision makers from the burden of tactical decisions and makes them available to take critical and strategic decisions.
Organizational Focus (OF)	Refers to the need to work against information overload and organization complexity, as well as aligning organizations along their strategy. It includes the development of a focused strategy, its communication, and the alignment of incentives with strategic goals.
Continuous Innovation (CI)	Refers to the need of reinventing products and services, as well as processes (i.e., entrepreneurial environment and promoting creativity).
Source: Synesis (2001).	

Although it has been a while since OIQ was first introduced and linked with specific financial performance measures (profitability and growth); a key characteristic of OIQ has kept the concept relevant in the academia over the years: the more dynamic the business environment of a company, the greater the importance of a high OIQ is for organizations (Mendelson and Pillai, 1999; Hansen, 2003).

The verification of the impact of OIQ on firm performance has continued over the years (Suzuki and Mori, 2005; Riera and Iijima, 2007). In addition, OIQ has been used as a framework to conceptualize and prioritize management measures to improve an organization's knowledge and information processing and, to gain insights on the differences of the managerial practices between Japan and US organizations (Hirano et al., 2006). The most recent study on OIQ was published in 2016 and investigated the relationship of IT investment/spending and OIQ in order to "understand and envision the future of organizational design in a digitized world" (Hirano and Goodman, 2016).

The existing literature positions OIQ first as an organizational capability which is directly associated with organizational performance (based on particular financial measures) and second, an organizational capability influences how the organization utilizes its resources (e.g. IT spending/investment).

This study expands the literature and tests OIQ impact on the organization performance not only against a specific financial performance measure but includes together with financial objectives, other 3 categories of business objectives: customer-related, business process improvement and learning & growth objectives. In addition, the overall effect of OIQ on the relationship between IT capability Maturity and Digital Business Value is evaluated.

2.2.2Knowledge Creation Perspective (Knowledge Creation Capabilities and SECI Processes)

Over the years academia and scholars have studied and developed several concepts with the aim to explain how competitive advantage can be achieved and sustained. It starts with the resource-based view that considers that the organization is a collection of resources (Amit and Schoemaker, 1993) and suggests that competitive advantage can be achieved when an organization is able to develop difficult-to-imitate resources (Barney, 1986).
Later on, recognizing the dynamic nature of the market and its changes over time, the concept of Dynamic Capabilities was developed. This concept states the need that the firm's resources need to change over a period of time to keep them relevant (Teece and Pisano, 1997). Researchers (Grant, 1996) explain that dynamic capabilities are the foundation that makes managers acquire and combine resources in order to generate value-creating strategies. To make the difference clear between Resources and Capabilities the academia (Amit and Schoemaker, 1993) defined that resources are converted into final products or services, while capabilities enable a firm to deploy resources, using organizational processes to achieve a desired end.
The knowledge-based view considers knowledge as the most important resource for a firm. Within the phases of KM, the knowledge creation and integration phases were considered the most important assets of the firm from a strategical point of view (Lewin and Massini, 2004).
A very important work in the area of knowledge was done by Nonaka and Takeuchi (1995). They introduced the SECI Model, an acronym for Socialization, Externalization, Combination and Internalization, as a model of knowledge creation process to understand the dynamic nature of knowledge creation, and to manage such a process effectively. They suggested that the most important aspect of understanding a firm's capabilities in terms of knowledge is the dynamic capability to continuously create new knowledge out of existing firm-specific capabilities, rather than the stock of knowledge that a firm possesses at one point in time (Nonaka et al., 2000).
The concept of Balanced SECI (Riera et al., 2009) was developed as a measure of Knowledge Creating Capabilities (KCC) and considers that there could be bottlenecks in the process of knowledge creation when a firm is either over-focused or has a lack of focus in one of the four processes of the SECI Model.

The Knowledge Creation perspective is based on the Knowledge-Base view and recognizes that knowledge creation process as one of the most important strategic assets of the firm (cited in Lewin and Massini, 2004). This perspective is represented by Knowledge Creating Capabilities (Riera, et

al., 2009) and the four Knowledge Creation processes from SECI Model (Nonaka and Takeuchi, 1995).

2.2.3 Technological Capability Perspective (IT Capability Maturity: IT-CMF)

The Technological capability perspective refers to the maturity of the IT capability in the organizations; as measured by the IT Capability Maturity Framework "IT-CMF" from the Innovation Value Institute (Curley et al., 2016). IT capability is defined as the "organizations' ability to mobilize and deploy IT-based resources to effect a desired end, often in combination with other resources and capabilities" (Curley et al., 2016).

IT capability maturity is measured by the IT Capability Maturity Framework (IT-CMF). It allows organizations to identify and develop the IT capabilities in the organization to deliver agility, innovation and value for the organization (Curley et al., 2016). As mentioned by Curley, "the IT-CMF leverages the concept of dynamic capabilities providing a mechanism for not only developing capability but enabling reconfiguration to dynamically adapt to changing circumstances and strategy" (Curley, 2008).

The IT-CMF has its origins in 2000 when Intel Corporation started an initiative to transform its IT function and realized that there was no comprehensive, integrated, CIO-level framework available. Intel approached it by developing a maturity framework approach. Such approach was further developed with additional research and feedback from users from several industries in order to make the framework applicable across industries (Curley et al., 2016).

The IT-CMF was developed following Design Science Research principles (Donnellan and Helfert, 2010; Carcary, 2011) and its architecture covers on a higher layer four strategic areas (called macro-capabilities): managing IT like a business, managing the IT budget, managing the IT capability, and managing IT for business value. Each the four macro-capabilities embraces a number of critical processes (called critical capabilities) central to the IT organization. Such capabilities are said that can contribute to agility, innovation and value (Donnellan and Helfert, 2010; Curley et al., 2016).

The Innovation Value Institute acknowledged that SMEs are different to large organizations and may not be examined under the same lens and developed the SME IT-Capability Maturity Framework "SME IT-CMF" (Doherty et al., 2013; Carcary and McLaughlin, 2014). The SME IT-CMF focuses on 10 IT critical capabilities which were identified applying a mixed-methods approach through direct engagement with SME organizations. Such 10 critical capabilities address the top challenges/priorities concerning IT that SMEs face (Doherty et al., 2013; Carcary and McLaughlin, 2014; Doherty et al., 2015).

The IT capabilities included in the SME IT-CMF are listed in Table 2-4.

Table 2-4: IT critical capabilities part of SME IT Capability Maturity

IT critical capabilities part of SME IT Capability Maturity	
Risk Management (RM)	The ability to assess, prioritize, handle, and monitor the exposure to and the potential impact of IT-related risks that can directly impact the business in a financial or reputational manner.
Business Planning (BP)	The ability to produce an approved document that provides implementable detail for the IT strategy, setting out the IT function's tactical objectives, the operational services to be provided, and the financial and other resources and constraints that apply in the coming planning period.
Solutions Delivery (SD)	The ability to design, develop, validate, and deploy IT solutions that effectively address the organization's business requirements and opportunities.
Strategic Planning (SP)	The ability to formulate a long-term vision and translate it into an actionable strategic plan for the IT function.
Relationship Asset Mgmt (RAM).	The ability to analyse, plan, maintain, and enhance relationships between the IT function and the rest of the business. Currently named Relationship Management "REM" in the second edition of IT-CMF Body of knowledge.
Business Process Mgmt. (BPM)	The ability to identify, design, document, monitor, optimize, and assist in the execution of both existing and new organizational processes.
Funding and Financial (FF)	The ability to determine the funding level required for IT and to allocate it appropriately.
Sourcing (SRC)	The ability to evaluate, select, and integrate IT service providers according to a defined strategy and sourcing model, which could include service providers both inside and outside the organization.
Service Provisioning (SRP)	The ability to manage the life cycle of IT services to satisfy business requirements. This includes ongoing activities relating to operation, maintenance, and continual service improvement, and also transitional activities relating to the design and introduction of services, their deployment, and their eventual decommissioning.
User Experience Design (UED)	The ability to proactively consider the needs of users at all stages in the life cycle of IT services and solutions.
Source: Curley et al., 2016. IT Capability Maturity Framework (IT-CMF) - The Body of Knowledge Guide - Second Edition. Van Haren Publishing: Zaltbommel/Netherlands.	

There is also a current attempt linking the original IT-CMF with some of the keys for defining and implementing digital strategies. Such attempt is

part of the Innovation Value Institute (IVI)'s Digital Readiness Assessment (IVI, 2018). The 10 SME IT capabilities were also included into the plan-make-sell-operate framework of IVI.

2.3 IT and Digital Technologies

Information Technology (IT) in this dissertation refers to components such as applications, infrastructure, licenses, services and data used to support business processes. This definition is aligned with below definitions of IT provided by the industry.

The definition by the Information Technology Infrastructure Library (ITIL):

> "The use of technology for the storage, communication or processing of information. The technology typically includes computers, telecommunications, applications and other software. The information may include business data, voice, images, video, etc.. Information technology is often used to support business processes through IT services." (AXELOS, 2019).

The defined by ISACA (previously known as Information Systems Audit and Control Association):

> "The hardware, software, communication and other facilities used to input, store, process, transmit and output data in whatever form." (ISACA, 2019).

On the other hand, this dissertation uses the term "Digital Technologies" to refer to SMACIT (social, mobile, analytics, cloud, and Internet of things "IoT") technologies (Sebastian et al., 2017) and other emerging technologies. The "SMACIT" acronym implies additional technologies like Artificial Intelligence, blockchain, robotics and virtual reality which become a set of powerful and readily accessible technologies (Sebastian et al., 2017).

In the study, the list of Digital Technologies was adapted from SMACIT (Sebastian et al., 2017) and technology trends from IVI's Digital Readiness Assessment (IVI, 2018). The list included: Social Networking Service (SNS), Mobile technology, Big Data and Analytics, Internet of Things (IoT), Artificial Intelligence (AI), 3D printing technology and others.

It can be argued that Digital Technology at the very end relies on applications, infrastructure, services, etc. from IT. However, digital technologies have the potential to disrupt businesses and bring opportunities to increase the organization's value proposition. Their full potential can be achieved by the integration of such technologies, not only the application of an individual technology (Ross et al., 2015).

2.4 IT Business Value

The term IT Business Value has been considered to address the concerns raised by the IT Productivity Paradox but from a positive perspective.

Productivity or profitability improvement, cost reduction, revenue and sales increase are some of the financial contributions where IT has been linked to (Melville et al., 2004). At the same time, other measures that derive in organizational performance such as developing competitive advantage, increasing customer proximity or improving customer satisfaction are also areas where IT can contribute. An early study proposed IT Business Value Model based on the Resource-based view where the combination of IT resources (Technology and HR) with complementary organizational resources enabled business processes and, then business processes performance was actually perceived as Organizational Performance (Melville et al., 2004).

Based on the dynamic capabilities theory and previous research, IT Business Value is defined as the contribution that IT resources and capabilities make to help an organization to achieve its objectives (Riera and Iijima, 2017 (published work during this dissertation)).

In order to address the different objectives that organizations pursue, the study used the four categories defined by the Balanced Scorecard (Kaplan and Norton, 1996): Customer, Financial, Business Process and Learning & Growth. This approach offered a simple but concrete way to address the individuality of the organizations.

2.5 Digital Business Value

Digital Business Value refers to the level of achievement of business objectives using digital technologies (Riera and Iijima, 2017 (published work during this dissertation)). The concept uses the categorization given by the Balanced Scorecard in order to generalize the business objectives. Four categories of business objectives are used: Financial objectives (expanding revenue, improving productivity, improving the financial structure, etc.), Customer-related objectives (improving customer satisfaction, improving customer loyalty, increasing sales to new customers, etc.), Business Process objectives (quality improvement, productivity improvement, etc.) and Learning and growth objectives (securing human resources, human resources education, creativity, development capability, etc.).

This definition of Digital Business Value was designed to address a pitfall revealed by the IT Productivity Paradox. In the past decades, studies have referred to a particular set of organization performance indicators (usually financial) and did not acknowledge the individuality of the organizations when selecting the objectives they pursue with IT or digital initiatives (Riera and Iijima, 2017 (published work during this dissertation)). The definition of Digital Business Value provided a business-oriented perspective while proposing a concrete way to measure the contribution of digital technologies to towards organizational goals.

The difference between Digital Business Value and IT Business value relies then on which technology was used to achieve business objectives. Digital Business value is achieved by the application of digital technologies (i.e. SMACIT) rather than IT (traditional applications, infrastructure, etc.).

2.6 Difference between Digitized and Digital

The terms Digitized, Digital, Digitalization and Digital Transformation among others have been heavily used over recent years without a shared definition. During the data collection this study avoided using such terms and instead referred to digital technologies or SMACIT in order to avoid any misconception of the terms.

This dissertation is aligned with the definition provided by the Centre for Information Systems Research from Massachusetts Institute of Technology (CISR) in which Digitized is seen as an operational necessity requiring standardizing business process, with benefits mainly on the operational excellence. Digital referring to a customer-centric value proposition or creation of new customer value delivered in the form of digital offerings (Ross et al., 2017). Digitized may include digital technologies but it may not necessarily translate onto new digital offerings or new value for the customers. The same study suggests that successful companies in the digital economy will have both characteristics: Digital to provide customer value and Digitized to provide scale and efficiency.

Figure 2-1 shows the elements proposed by MIT CISR and how the three perspectives proposed by this dissertation maps.

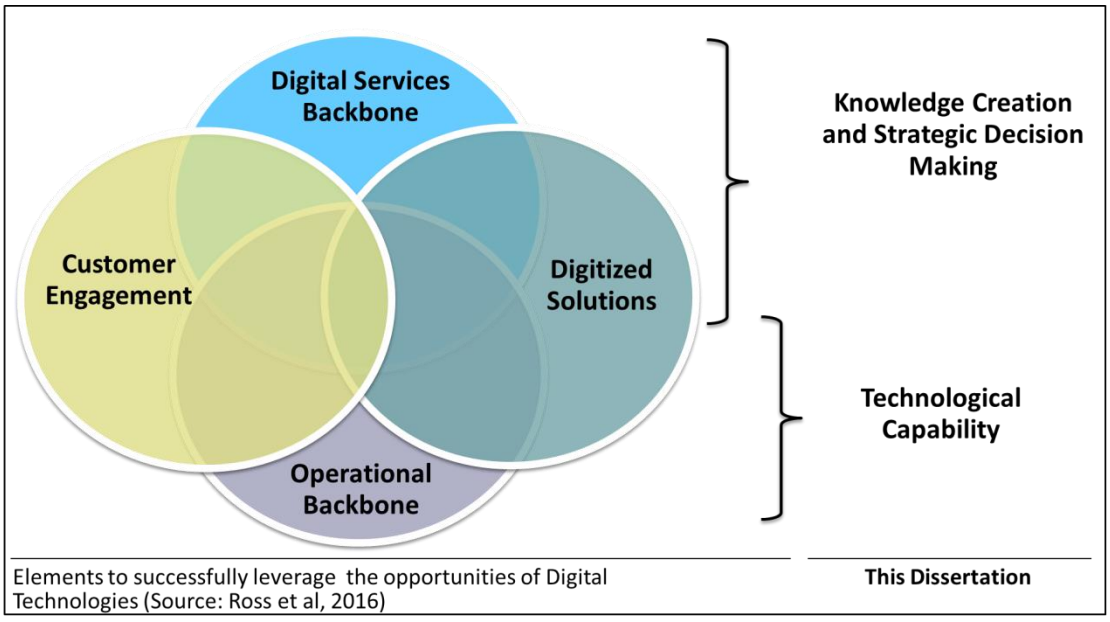


Figure 2-1: Mapping of the three perspectives with MIT CISR research

This study inquired on business objectives where digital technologies like SMACIT contributed. We consider the data collected may include both business objectives searching Digitization (Digitize) and Digitalization (Digital) objectives. The main assumption is that the majority of the SMEs from the target population may be still on the Digitized stage. This cannot be verified as the study didn't collect information on digital strategy or specific value created for customers based on digital offerings.

2.7 The need for a combined approach

Some of the instruments representing the three perspectives suggested in this dissertation have been previously tested independently and associated with some kind of organization effect or performance:

- Organizational IQ has been tested and associated positively directly with organizations' financial and market performance (Mendelson and Pillai, 1999; Mendelson, 2000), positively associated together with IT investment to Labour Productivity (Riera and Iijima, 2007); and recently also used in an effort to understand its relationship with IT investment with the purpose of getting insights of organizational design in a digitized world (Hirano and Goodman, 2016).

- Knowledge Creating Capabilities have been previously identified as a moderator of IT investments and two specific financial measures (Riera et al., 2009). The Knowledge creation process has been verified as a mediator between entrepreneurial orientation and firm performance (Li et al., 2009) and positively related to the performance of organizations (Rezaei Dolat Abadi et al., 2013).

- Although the IT-CMF at its core acknowledges that IT capability is the organization's ability to mobilize and deploy IT-based resources to effect a desired end (Curley et al., 2016), there is no measurement proposed that links the IT capability maturity (IT-CMF) with the achievement of organizations' objectives. This dissertation investigates if such linkage exists specifically with the value that Digital Technologies can contribute to organizations.

This research focuses on the complementarity between the perspectives in order to acknowledge that IT capabilities used for the design and delivery of Digital solutions are actually embedded into an organization and its capabilities.

The integration effect has previously been explored against "traditional IT" but not tested in the Digital Age where digital technologies offer new challenges and opportunities to existing business models. For example, the interaction of Organizational IQ and Knowledge Creating Capabilities proved to moderate the effects of IT investments on financial performance (Riera, 2007 (Master Thesis); Riera and Iijima, 2007; Riera et al., 2009).

The combination of the three perspectives acknowledges the organizational context where technological capabilities develop and where they translate onto execution and implementation. This dissertation suggests that in order to achieve Digital Business Value it is not only required to have an appropriate technological capability perspective (maturity of IT capabilities) but also other organizational capabilities such Strategic Decision Making (Organizational IQ) and Knowledge Creation (Knowledge Creation Capabilities) where the technological capabilities coexist.

The decisions made prior to any Digital initiative start by defining a digital strategy or focus for the digital endeavor at the organizational level. These are equally important as the digital initiative implementation itself.

A conceptualization of how the strategies interact is presented in Figures 2-2, 2-3 and 2-4.

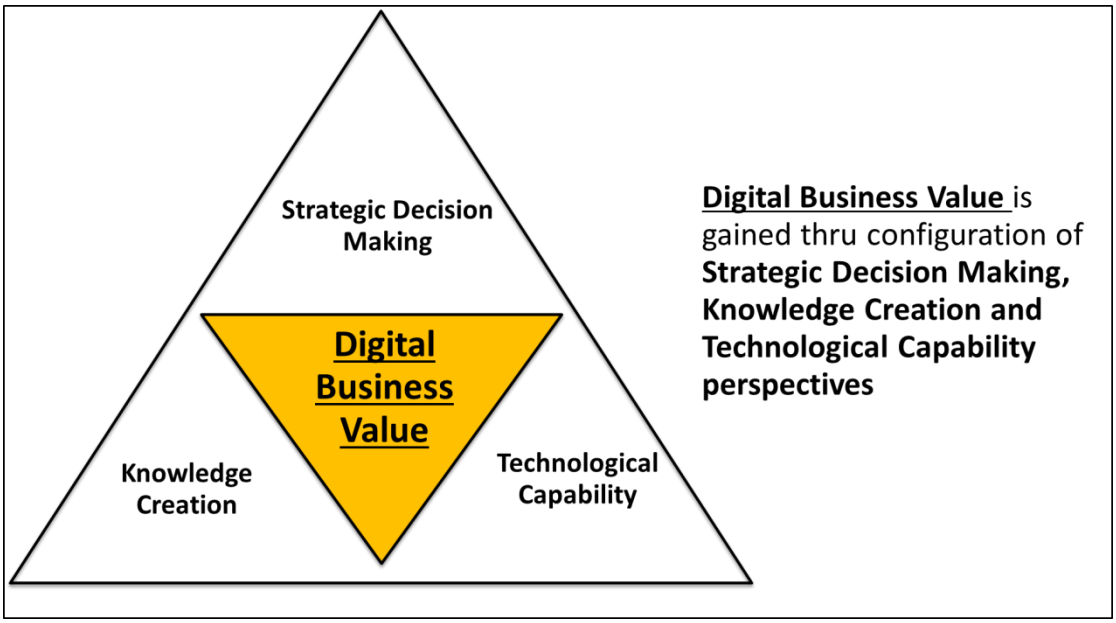


Figure 2-2: Three perspectives for Digital Business Value:

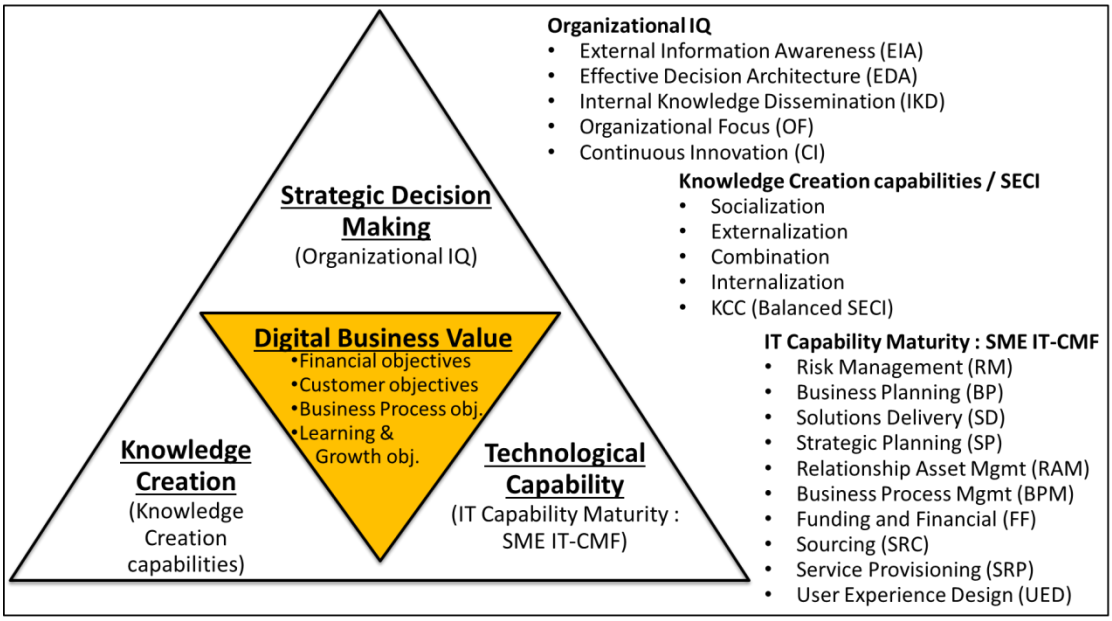


Figure 2-3: Components of each perspective

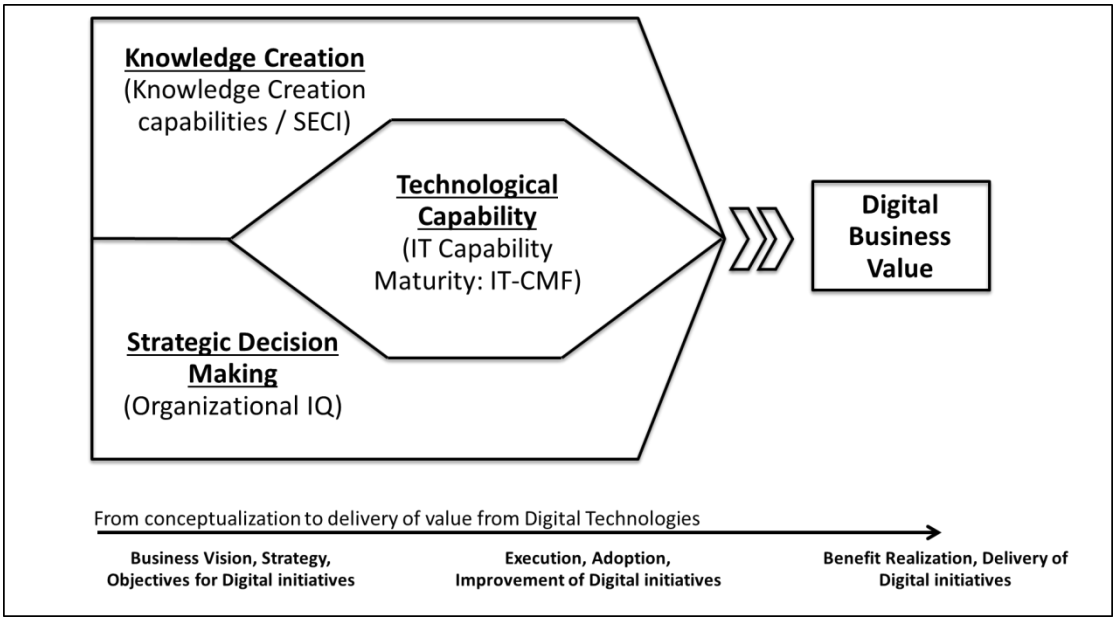


Figure 2-4: Interaction of the perspectives for Digital Business Value

Chapter Three: Framework and Hypotheses

3.1 Overview

This study explores the relationship of three perspectives: Strategic Decision Making, Knowledge Creation and Technological Capability perspectives covering both Organizational Capabilities (Organizational IQ, Knowledge Creation) and Technological Capabilities (IT maturity capability: SME IT-CMF) with the achievement of business objectives by the application of Digital Technologies. Such achievement of business objectives with Digital technologies is referred as "Digital Business Value". The theoretical development of the framework is built on dynamic capabilities and knowledge-based view. It recognizes that the effect of Digital technologies can be impacted or leveraged by the organizational capabilities surrounding them.

This dissertation also aims to identify which components of the capabilities should organizations be aware to be successful in the Digital Age.

- Organizational IQ is a quantitative measure of an organization's effectiveness in information distribution, decision making, and execution. OIQ can be the base for organizations to define which digital strategies to pursue.

- Knowledge Creation and SECI processes provide the environment and practices where new ideas and knowledge integrates with existing knowledge; then converted onto organizational knowledge that can serve to leverage the new technologies.

- IT-CMF is considered a meta-model and acts as the unifying or umbrella framework that complements domain-specific frameworks such as ITIL, PMP, COBIT, etc. IT maturity level measured by SME IT-CMF can be the operational backbone that enables operational excellence.

The research framework is described by the following figures. Figure 3-1 shows the direct relationship between Digital Business Value and the perspectives. Figure 3-2 includes the hypotheses relevant to the combined effects. The framework contains also the initial hypotheses which involve the investment in digital technologies as well as the business value achieved from "traditional IT" (named IT Business Value).

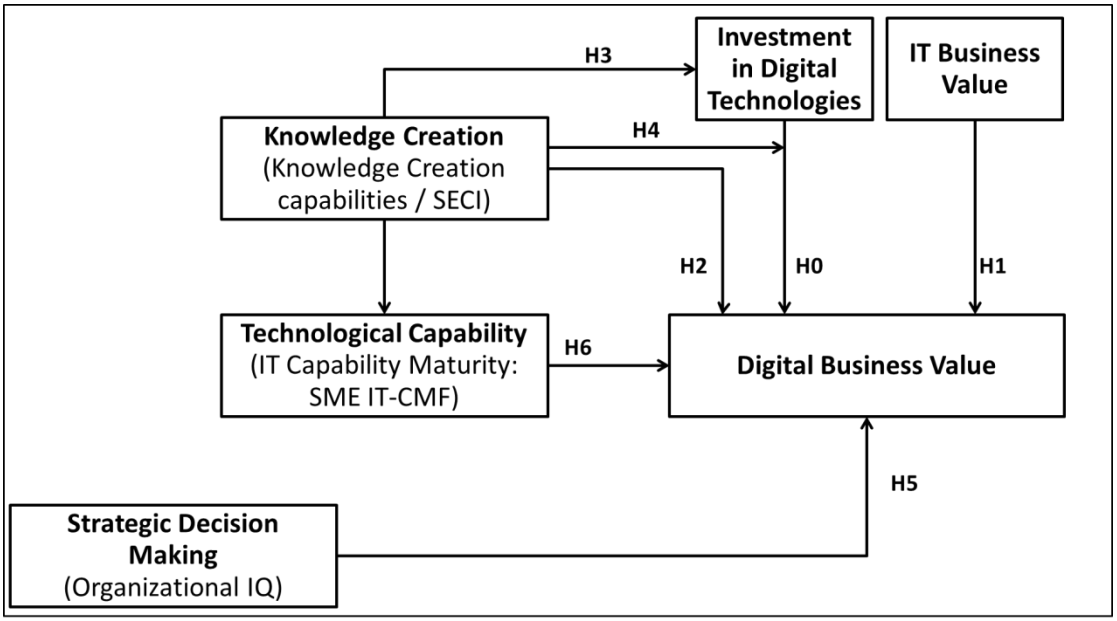


Figure 3-1: Research Framework (direct relationships of the perspectives and Digital Business Value)

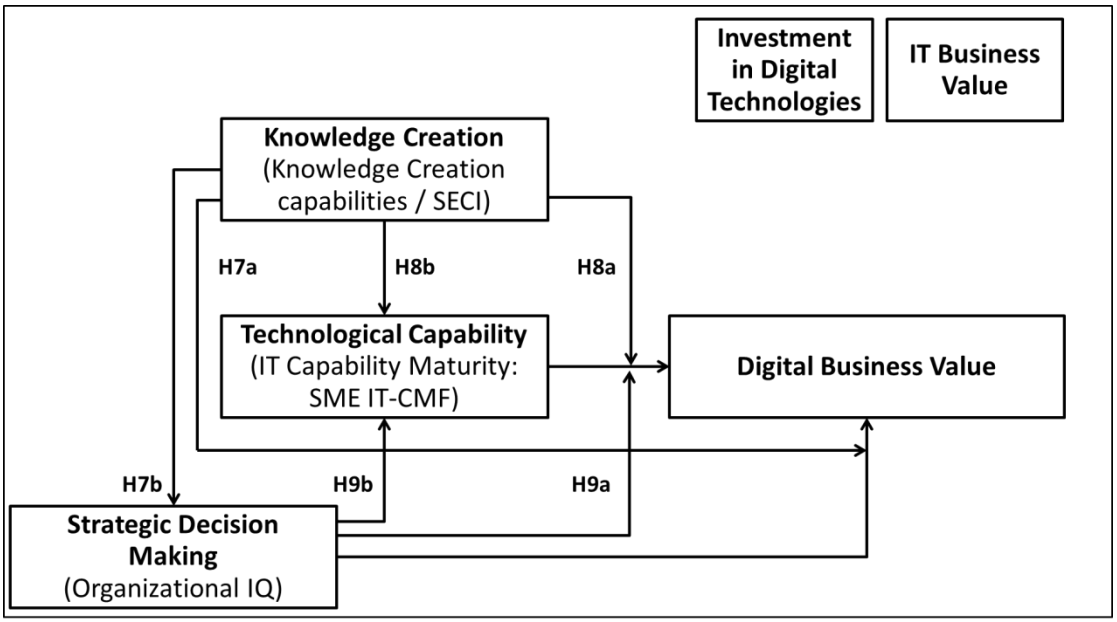


Figure 3-2: Research Framework (combined effect of the perspectives and Digital Business Value)

The main hypothesis in this study is defined as follows:

Strategic Decision Making, Knowledge Creation and Technological Capability perspectives together with their interaction are enablers of Digital Business Value. This dissertation aims also to identify which organizational capabilities (both organizational and technological) are directly related to such achievement.

3.2 Initial perspective

Leveraging the experiences from the IT paradox, the first set of hypotheses investigates the relationship of the investment in digital

technologies and the level of achievement of business value by "traditional IT" (IT Business Value) with Digital Business Value.

[H0] Investment in Digital technologies has little or no effect on Digital Business Value

Previous research on IT paradox showed already that investment itself is not related to organizational performance thus this hypothesis aims to validate the same effect when considering Digital technologies. Therefore this hypothesis is negative.

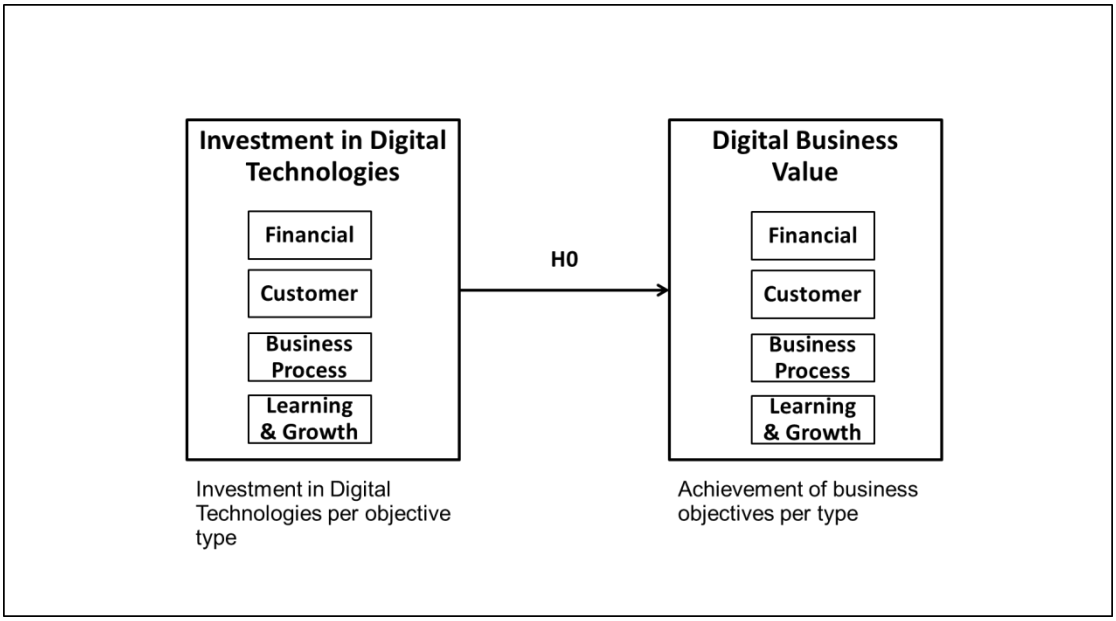


Figure 3-3: [H0] Investment in Digital Technologies and Digital Business Value

[H1] IT Business Value is directly related to Digital Business Value

This hypothesis aims to test if organizations that are successful at using "traditional IT" are also successful at utilizing digital technologies. A positive relationship would suggest that such organizations have a similar set of organizational capabilities that would make them succeed in both terrains. Literature suggests that the new strategies created by business leaders to leverage the power of digital technologies are not limited to a separate technology strategy but are "business strategies that incorporate the opportunities that the digital economy presents" (Chen et al., 2010 in Ross et al., 2016a). It can be argued that being successful with traditional IT is not a full predictor of success with Digital initiatives but it could be a foundation for Digital Business Value. Hence this hypothesis is positive.

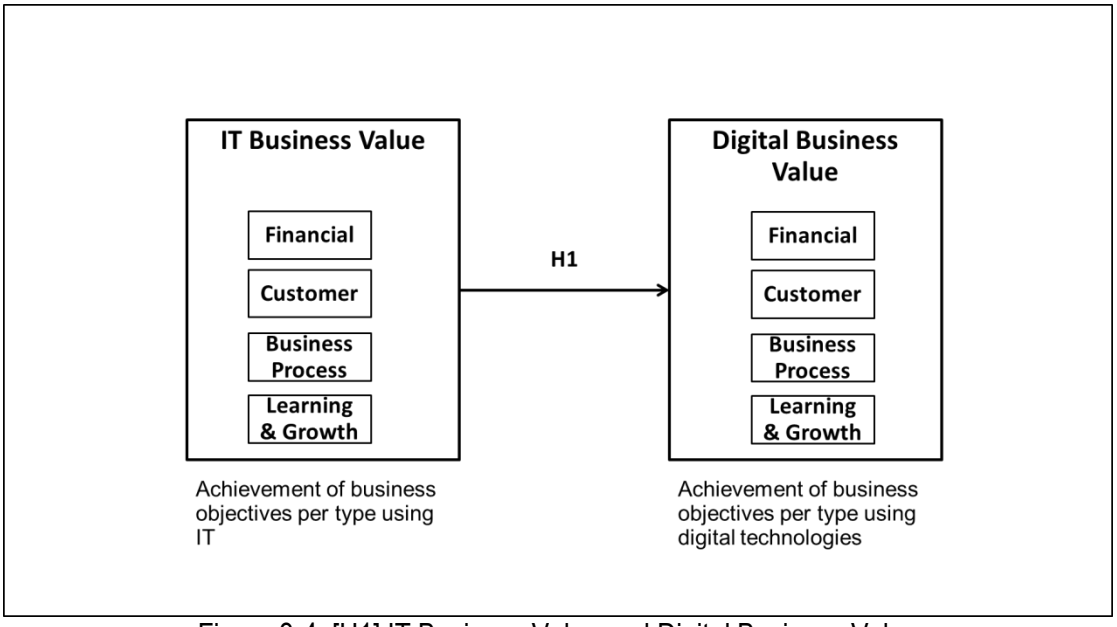


Figure 3-4: [H1] IT Business Value and Digital Business Value

3.3 Knowledge Creation Perspective (Knowledge Creation Capabilities)

This section describes the hypotheses around the first perspective: Knowledge Creation and Digital Business Value. The direct effect of Knowledge Creating capabilities have on Digital Business Value is investigated in Hypothesis 2. A possible relationship with the Investment in Digital Technologies is tested on Hypotheses 3 and 4.

[H2] KCC are present in organizations that achieve Digital Business Value

This hypothesis aims to test the relationship of Knowledge Creating Capabilities with the level of achievement of organizational business objectives by using digital Technologies. A positive relationship would be justified by the fact that new technologies are heavily related to information and the knowledge that can be generated from it. Such information would need to be articulated, refined and integrated with organizational knowledge in order to become part of a digitized solution, enhance the engagement with the customers, under an environment and culture that enables innovation.

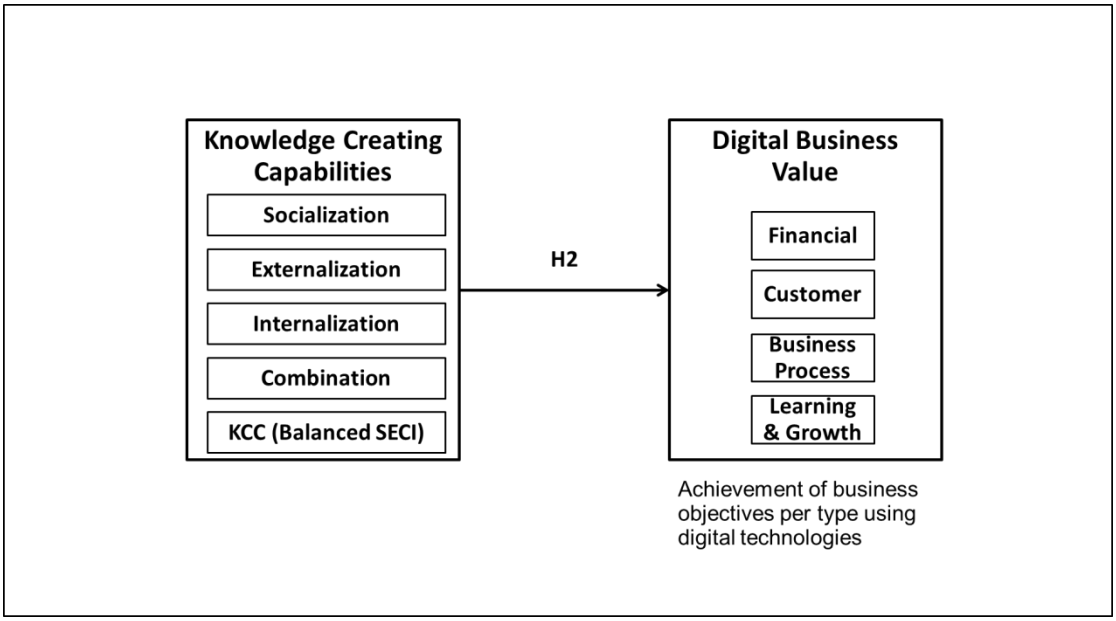


Figure 3-5: [H2] Knowledge Creating Capabilities and Digital Business Value

[H3] KCC is positively related to the Investment in Digital technologies

This hypothesis explores if there is a positive relationship between knowledge creation capabilities and investment in Digital technologies. This would suggest that the more organizations are focused on knowledge creation processes the more they would be interested in the opportunities that digital technologies bring and this is reflected in the intensity of investment in such technologies.

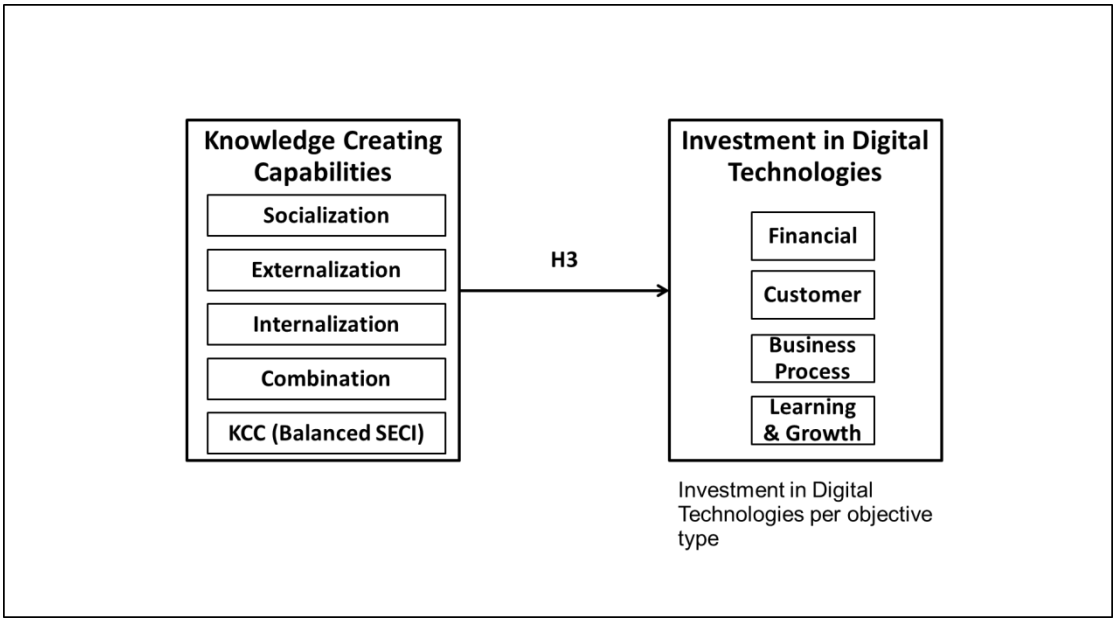


Figure 3-6: [H3] Knowledge Creating Capabilities and Investment in Digital Technologies

[H4] KCC leverages the effect of Digital Technologies investment on Digital Business Value

The effect of Knowledge Creating Capabilities over the results that organizations achieve from the investment in Digital technologies is explored in this hypothesis. A positive result would suggest that Knowledge Creating Capabilities have a moderating role and can shape the results that organizations yield from digital investments.

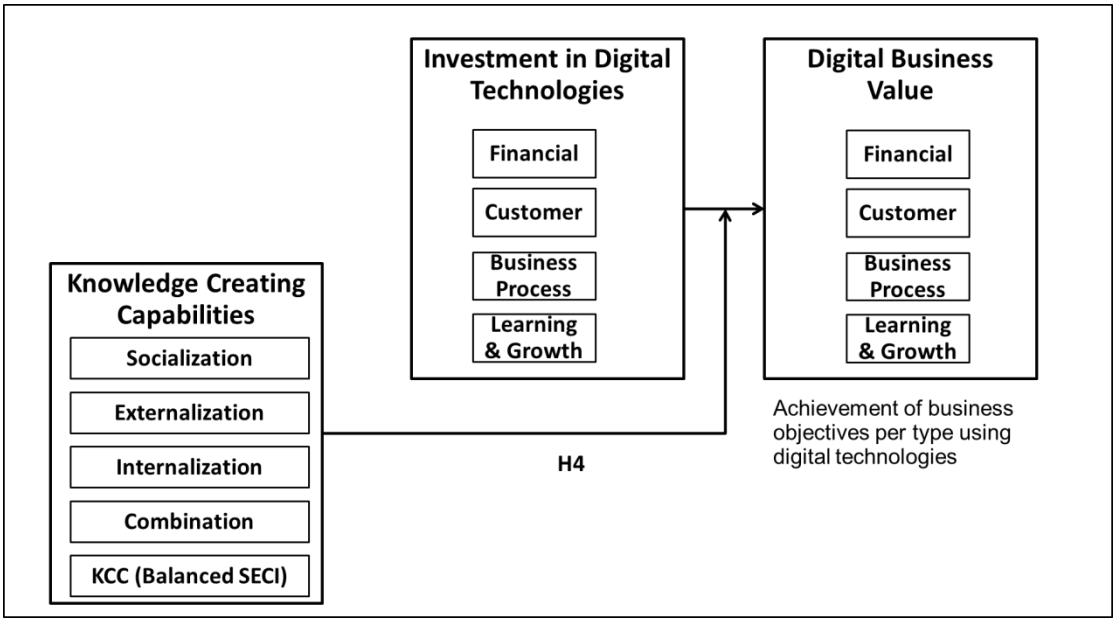


Figure 3-7: [H4] Knowledge Creating Capabilities moderates the effect that Investment in Digital Technologies has on Digital Business Value

3.4 Strategic Decision Making Perspective (Organizational Intelligence Quotient)

The next hypothesis tests the direct relationship between Strategic Decision Making Perspective -measured by Organizational IQ- has over Digital Business Value.

[H5] Strategic Decision Making (OIQ) is positively related to Digital Business Value

Hypothesis 5 elaborates on the premise that while the more dynamic the business environment is, the greater the importance of a high Organizational IQ. Hypothesis 5 tests the impact of Organizational IQ on the achievement of business objectives using Digital Technologies.

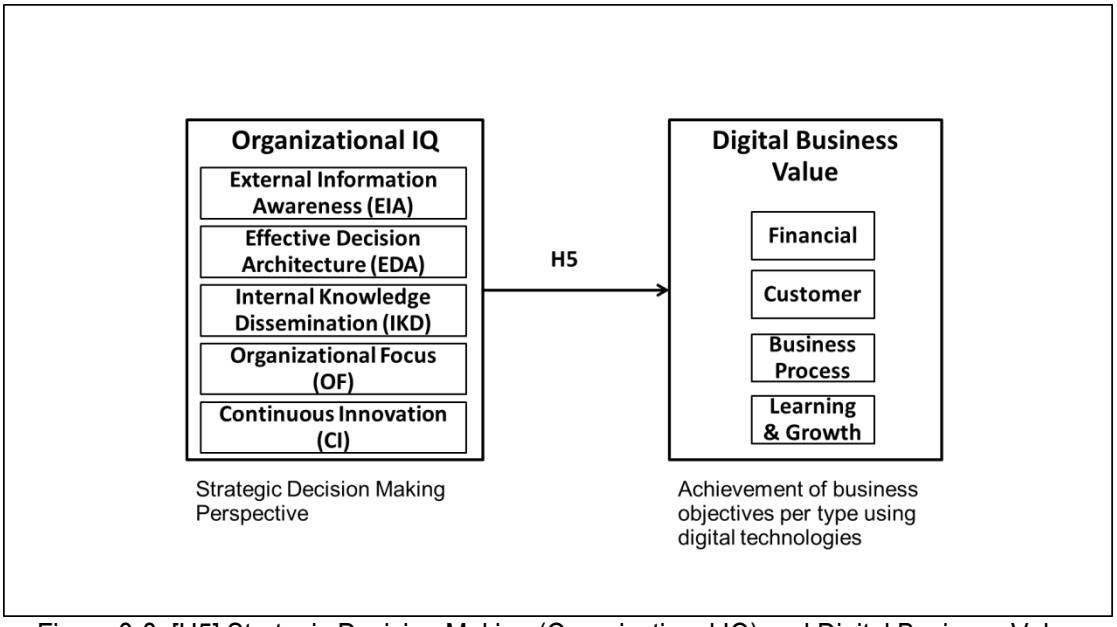


Figure 3-8: [H5] Strategic Decision Making (Organizational IQ) and Digital Business Value

3.5 Technological Capability Perspective (IT Capabilities perspective: IT Maturity (IT-CMF))

The direct relationship between Technological Capability Perspective measured by the SME IT-CMF and Digital Business Value is explored in the next hypothesis.

[H6] IT Maturity Capability (SME IT-CMF) is positively related to Digital Business Value

Hypothesis 6 goes back to the concept of business value, which is the contribution that IT-based resources and capabilities make to helping an organization to achieve its business objectives (Curley et al., 2016). Hypothesis 6 addresses the lack of measurements of the impact of IT Capability Maturity Framework (IT-CMF) on the achievement of business objectives.

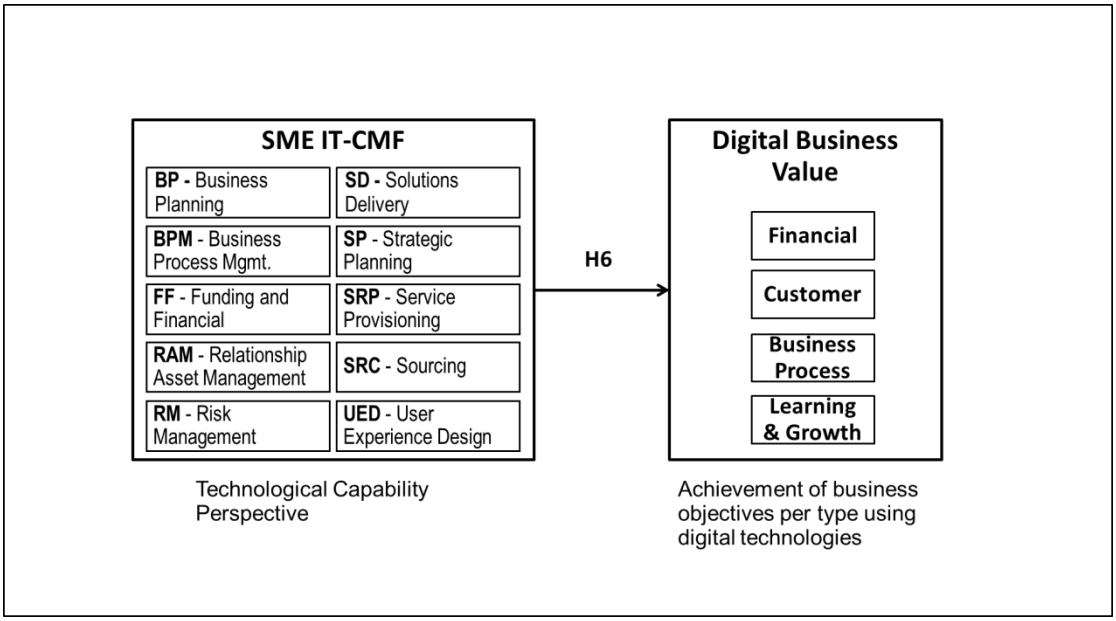


Figure 3-9: [H6] Technological Capability perspective (IT Capability Maturity: SME IT-CMF) and Digital Business Value

3.6 The combined effect of the perspectives

The next sections explore the integrated effect that one perspective has over the other two perspectives. The first pair of hypotheses explores the role that Knowledge Creation perspective has on Strategic Decision Making perspective. This integrated effect is explored first considering the achievement of Digital Business Value and then on the relationship between the two perspectives (Knowledge Creation on Strategic Decision Making).

3.7 The combined effect of Knowledge Creation and Strategic Decision Making perspectives

Hypotheses 7a and 7b propose to take a look at the combined effect of Knowledge Creating Capabilities on Strategic Decision Making perspective (Organizational IQ).

A direct relationship of Knowledge Creation with Strategic Decision Making perspective (i.e. H7b) would indicate that the focus on knowledge creation that organizations have may be linked with the capability to assimilate and manage information and use it to make effective decisions (Organizational IQ). Similarly, the confirmation of a relationship between Knowledge Creation with the business value that is delivered by Strategic Decision Making (i.e. H7a) would emphasize the importance of knowledge creation to generate new organizational knowledge that could derive on digital-based services and products.

This potential relationship may be understood when considering the components -named “dimensions”- of Organizational IQ. Four of the five

OIQ's dimensions could actually get benefits from knowledge creation processes and practices. For example, External Information Awareness and Internal Knowledge Dissemination dimensions would be facilitated by knowledge conversion processes (e.g. "BA" concept from knowledge creation theory). Continuous Innovation dimension is supported by knowledge creation practices (e.g. brainstorming, prototypes, a culture of innovation, etc.).

[H7a] KCC leverages the effect of Strategic Decision Making (OIQ) on Digital Business Value

[H7b] KCC has a positive effect on Strategic Decision Making (OIQ)

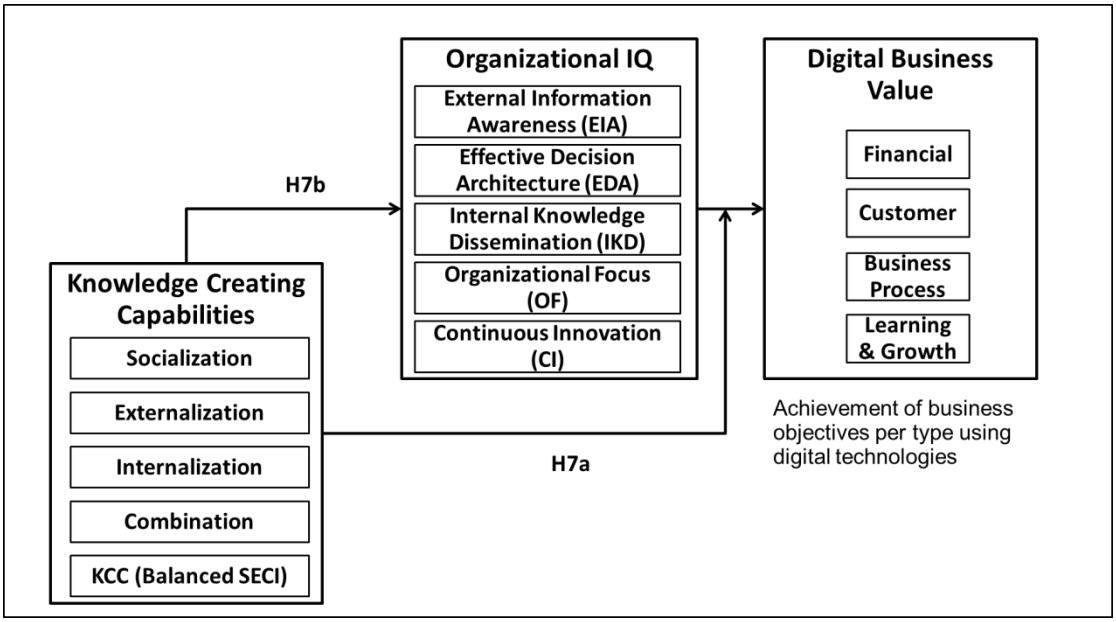


Figure 3-10: [H7a, H7b] Knowledge Creating Capabilities and Strategic Decision Making (Organizational IQ) on Digital Business Value

3.8 The combined effect of Knowledge Creation and Technological Capability perspectives

Hypothesis 8a and hypothesis 8b explore the integrated effect of Knowledge Creating Capabilities on Technological Capability perspective (SME-IT CMF).

These hypotheses aim to reveal if the level of Knowledge Creating Capabilities moderates the effect of the maturity of IT Capabilities on Digital Business Value. A positive relationship with the maturity level of IT Capabilities (i.e. H8b) would suggest that organizations that have a focus on knowledge creation may also have developed higher IT capability maturity levels. A positive relationship with the business value derived by the IT capability maturity (i.e. H8a) would indicate a moderating role of Knowledge Creation perspective onto the Technological Capability perspective / Digital Business Value relationship. When considering the specific capabilities identified by the SME IT-CMF it could be argued that they could actually

benefit from knowledge creation processes (e.g. Risk Management capability would benefit from the continuous cycle of knowledge creation that is described by the knowledge conversion processes in the SECI Model. Having acknowledged this, it is also worth to note that the "Knowledge Management (KM)" capability is not included in the SME IT-CMF as part of its 10 critical capabilities; although it belongs to the 36 critical capabilities from its parent framework "IT-CMF".

[H8a] KCC leverages the effect of Technological Capability perspective (SME IT-CMF) on Digital Business Value

[H8b] KCC has a positive effect on Technological Capability perspective (SME IT-CMF)

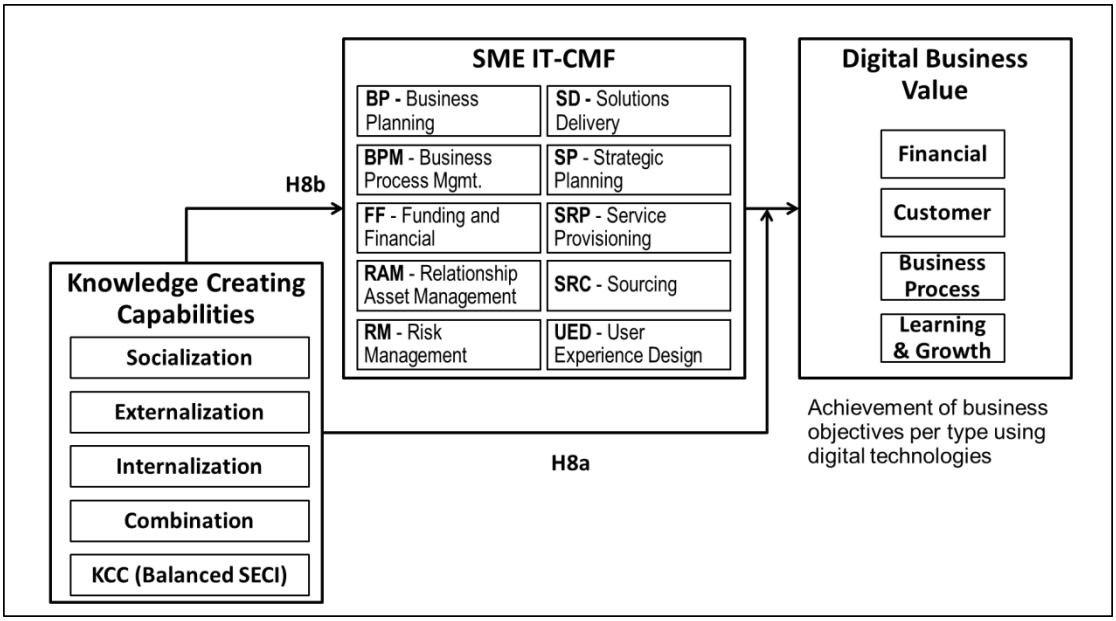


Figure 3-11: [H8a, H8b] Knowledge Creating Capabilities and Technological Capability perspective (SME IT-CMF) on Digital Business Value

3.9 The combined effect of Strategic Decision Making and Technological Capability perspectives

Hypothesis 9a and hypothesis 9b propose to take a look at the combined effect of Strategic Decision Making (Organizational IQ) and Technological Capability perspective (SME IT-CMF) when considering the opportunities that the new technologies offer.

This exploration is needed due to the boundaries of the SME IT Capability Maturity Framework (SME IT-CMF). SME IT-CMF can ensure that the IT function or IT objectives are in close alignment with the overall organizational objectives (business objectives), however, it may not be able to influence on the strategic business decisions themselves. Organizational IQ instead, as it is a metric of how organizations assimilate and manage

information and use it to make effective decisions; can actually shape such business decisions which become fundamental when looking how to transform the organization and make the best use of the new digital technologies.

A positive relationship on hypothesis 9b would indicate that organizations at higher Strategic Decision Making (Organizational IQ) would also have developed stronger Technological Capabilities (IT capability maturity: SME IT-CMF). A positive relationship with the business value achieved by the Technological Capability perspective (i.e. H9a) would position Strategic Decision Making (Organizational IQ) as a moderating factor in the Technological Capability perspective / Digital Business Value relationship.
The above would provide significant evidence that in order to be successful with the embracement of digital technologies, it is not only the Technological Capability perspective that matters but it needs to be integrated with a strong capability in the organizations that enables them to make use external and internal information in order to make the right decisions when embracing digital technologies; all of this supported by a culture that motivates and facilitates continuous innovation (Strategic Decision Making).

[H9a] Strategic Decision Making (OIQ) leverages the effect of Technological Capability perspective (SME IT-CMF) on Digital Business Value

[H9b] Strategic Decision Making (OIQ) has a positive effect on Technological Capability perspective (SME IT-CMF)

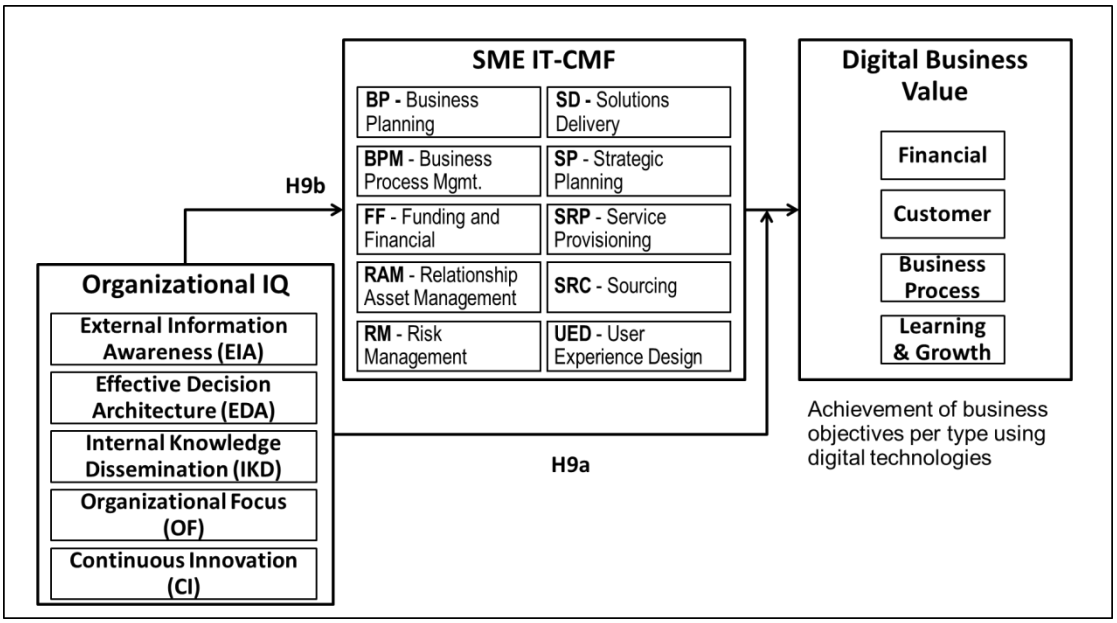


Figure 3-12: [H9a, H9b] Strategic Decision Making (OIQ) and Technological Capability perspective (SME IT-CMF) on Digital Business Value

Chapter Four: Methods and Measurements

4.1 The Research Project

An empirical (quantitative) approach was used to evaluate the research model in alignment with previous studies that explored the relationship of IT and organizations performance (Weill and Aral, 2007; Riera and Iijima, 2007).

In addition, a minor qualitative exploration was done after the quantitative results were available in order to get a further understanding of the quantitative findings.

4.2 Methods for Quantitative Study

In order to collect the empirical data, a questionnaire to evaluate the three perspectives: Knowledge Creating (Knowledge Creating Capabilities), Strategic Decision Making (Organizational IQ), Technological Capability perspective (SME IT-CMF) and the Digital Business Value per organization was used.

The questionnaire is included in Appendix section (Appendix 1).

4.2.1 Metrics, Survey Design and Data

This section explains the data set and how each component was measured.

(1) Measuring Digital Business Value

Digital Business Value was measured by the level of achievement that the organization had using Digital Technologies over the past three years on four types of business objectives. The four types of business objectives referred to the Balanced Scorecard (Kaplan and Norton, 1996): Financial (expanding revenue, improving productivity, improving the financial structure, etc.), Customer-related (improving customer satisfaction, improving customer loyalty, increasing sales to new customers, etc.), Business Process (quality improvement, productivity improvement, etc.) and Learning & Growth (securing human resources, human resources education, creativity, development capability, etc.).

The measurement was organized from an investment perspective. The organizations were requested to consider the past three years and asses how much (in percentage) they had invested in IT over the four categories of business objectives. This was done for several purposes. At first, to consider lagged results from IT investment. Secondly, to consider that organizations may pursue different objectives over the years and finally, to acknowledge that organizations focus may differ between organizations. Some may focus for example on improving financial outcomes by digital technologies while

others could focus on increasing internal process integration or harmonization. The study considered that for these two different categories of organizations Digital Business Value exists and it is valid as Digital Technologies can contribute to the realization of business objectives.

The achievement scale used was: “Not Achieved”, “Partially Achieved”, “Highly Achieved” and “Fully Achieved”. In order to align the responses from the organizations, the survey asked first to identify the percentage of investment in digital technologies (Social, Mobile, Analytics and Big Data, Cloud, IoT, AI, 3D printing and others) for each of the four types of business objectives: financial, customer-related, business process and learning & growth and then assess what was their achievement level. The questionnaire on Digital Business Value is included in Table 4-1.

Table 4-1: Questionnaire on Digital Business Value

Questionnaire on Digital Business Value						
Business Objective	**Sample**	**Percentage of IT Investment per business objective from the past 3 years**	**From that investment, in a scale of 0-10 how much was used on Digital Tech.**	**Objective Achievement from the IT Investment**	**Objective Achievement from Digital Technologies**	**Digital Technologies**
Financial	expanding revenue, improving productivity, improving the financial structure, etc.	%		[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Social [ ] Mobile [ ] Analytics & Big Data [ ] Cloud [ ] IoT [ ] AI [ ] 3D printing [ ] others
Customer	improving customer satisfaction, improving customer loyalty, increasing sales to new customers, etc.	%		[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Social [ ] Mobile [ ] Analytics & Big Data [ ] Cloud [ ] IoT [ ] AI [ ] 3D printing [ ] others
Business Process	quality improvement, productivity improvement, etc.	%		[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Social [ ] Mobile [ ] Analytics & Big Data [ ] Cloud [ ] IoT [ ] AI [ ] 3D printing [ ] others
Learning &Growth	securing human resources, human resources education, creativity, development capability, etc.	%		[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Not Achieved [ ] Partially Achieved [ ] Highly Achieved [ ] Fully Achieved	[ ] Social [ ] Mobile [ ] Analytics & Big Data [ ] Cloud [ ] IoT [ ] AI [ ] 3D printing [ ] others

Similarly, IT Business Value was captured with the same level achievement scale as Digital Business Value.

The data collected were:

- Percentage of investment in IT for Financial, Customer, Business Process and Learning & Growth objectives.
- From that value, the percentage of investment in Digital Technologies for Financial, Customer, Business Process and Learning & Growth objectives.

- Investment in Digital Technologies for Financial, Customer, Business Process and Learning & Growth objectives: calculated as the product of the previous two variables.
- Digital Business Value as the level of business objective achievement from the investments in Digital Technologies for Financial, Customer, Business Process and Learning & Growth objectives.
- IT Business Value as the level of business objective achievement from the investments in IT for Financial, Customer, Business Process and Learning & Growth objectives.

(2) Measuring Knowledge Creation (Knowledge Creating Capabilities and SECI Model)

Knowledge Creation Capabilities were assessed by questions based on the literature review (Nonaka et al. 1994; Nonaka et al. 2000; Nonaka and Takeuchi 1995). Such set of questions were selected and refined during the previous study (Riera, 2007 (Master Thesis)). The four knowledge processes from SECI Model were assessed using 24 questions in which behaviors from each knowledge conversion process were described. 6 behaviors correspondent to each knowledge process: Socialization, Externalization, Combination and Internalization. The evaluation consisted of asking the organizations to select 12 of the 24 behaviors or activities which most represent their organization culture. The behavior or activities representing the 4 knowledge conversion processes intended to measure the knowledge creation capability.

The score for each knowledge conversion process was calculated as the number of items selected by the organizations which corresponded to the process behaviors. Sample of the behaviors for each knowledge conversion process is included in Table 4-2.

Questionnaire on Knowledge Creation (sample items from SECI Model's processes behaviors)	
Socialization	Needs and problems are drawn by direct contact with the client
Externalization	Sharing your ideas and images with others using charts and pictures
Combination	A new idea is created by using previously analyzed information and data
Internalization	Taking successful examples from inside or outside the company and sharing them for use between departments and within your own

Table 4-2: Questionnaire sample items on Knowledge Creation

Finally, the concept of Knowledge Creation Capabilities or "Balanced SECI" (Riera et al., 2009) was calculated. This is done by taking the minimal score between the four knowledge conversion processes and focuses on the importance of the balance to avoid knowledge bottlenecks in the knowledge creation cycle or over-focus in a particular knowledge conversion process.

The collected variables were:
- Individual score of Socialization, Externalization, Combination and Internalization.
- Balanced SECI score: calculated as the minimal score, named: KCC.
- Total SECI score: calculated as the sum of the four processes' score.

(3) Measuring Strategic Decision Making (Organizational IQ)

The questionnaire included 78 items covering the five dimensions of Organizational IQ: Effective Decision Architecture (EDA), External Information Awareness (EIA), Internal Knowledge Dissemination (IKD), Organizational Focus (OF) and Continuous Innovation (CI). Approximately half of the questions used a "yes / no / don't know" style; the majority of the other half were multiple-selection type questions. The questions relevant to OIQ from the survey were developed and validated by previous studies (Riera and Iijima, 2007; Riera 2007 (Master Thesis)). These studies built on the available OIQ literature such as the 22 variables proposed by the mentors of OIQ (Mendelson and Pillai, 1999); 26 variables measured by Japanese researchers (Suzuki and Mori, 2005) and other studies done in Japan (Hirano, 2005; Hirano et al., 2006; Stoffels et al., 2006).

Below are the verifications that were reported for the survey (Riera, 2007 (Master Thesis)):
- Content validity was done based on a wide literature review and discussions with academic advisors and researchers.
- Construct validity was tested using confirmatory factor analysis.
- All the items of the questionnaire could be grouped under a certain topic within each OIQ dimension, for example:
  - EDA: Agile decision making, Decentralization Authority
  - EIA: Client awareness, Competitor and Industry awareness, Environment Awareness, Market and Technology awareness
  - IKD: Knowledge Integration, Cross-functional teams, Knowledge Reutilization, Knowledge Transparency
  - OF: Strategy Focus
  - CI: Entrepreneurial Spirit, Knowledge Creation, Learning from Clients, Learning from Industries.

Sample questions are included in Table 4-3.
Each of the five dimensions of OIQ is measured on an ordinal scale of a 5 point scale and is calculated based on the average score of its factors. The aggregated score of the 5 dimensions becomes the total OIQ score of each organization.

Table 4-3: Questionnaire sample items on Strategic Decision Making (Organizational IQ)

Questionnaire on Strategic Decision Making (sample items from OIQ)	
Effective Decision Architecture (EDA)	Period and decision maker until a new price is determined when necessary after the main raw-material cost changes or the competitors' price changes. - Period: <1week, 1 week-1 month, 1-3 months, 3-6 months, >6months - Decision maker: a. President b. Director / Executive / Department Head / Factory Manager c. Division or Line Head d. Section or Subsection Head e. Regular Employee
External Information Awareness (EIA)	Call center or client service divisions are used not only for customer service but also to obtain information about customer needs (yes, no, don't know).
Internal Knowledge Dissemination (IKD)	The corporate culture encourages the creation of new ideas and theories (yes, no, don't know).
Organizational Focus (OF)	Please order the following strategies by importance for your company a. Narrowing the business and product and service, b. Differentiation of product and service, c. Cost Reduction, d. All have the same importance
Continuous Innovation (CI)	The corporate culture encourages taking risks and challenges.

The collected variables were:

- Individual score for the 5 Organizational IQ dimensions (EDA, EIA, IKD, OF, CI): calculated
- Total OIQ score: calculated as the aggregated score of the dimensions

(4) Measuring Technological Capability (SME IT-CMF)

The assessment of the maturity of IT capabilities was done with the SME IT-CMF framework.

The framework itself offers two types of capability assessments: 1) an "Executive" Assessment which is at a higher level or the organizations and provides the current IT maturity across all ten capabilities; and 2) "Critical Capability Deep Dive" Assessments. The deep dive assessments provide a detailed status of a particular IT capability (Carcary and McLaughlin, 2014). The standard methodology proposed by the Innovation Value Institute when executing an Executive Assessment of the IT-CMF capabilities in an organization was applied. This is done with a questionnaire inquiring the current maturity level of IT capabilities. While the whole IT-CMF consists of 36

IT Capabilities; 10 IT Capabilities relevant for SME organizations were selected as part of the SME IT-CMF provided by IVI (Doherty et al., 2015).

The questionnaire of IT-CMF for the 36 IT capabilities was developed by the Innovation Value Institute (https://ivi.ie/it-effectiveness/) as part of their standard offering. The questions selected for this study are the ones relevant to the 10 IT capabilities included on the SME IT-CMF. The maturity of the 10 IT capabilities was measured in total with 20 statements which described a desired maturity. Organizations answered based on a Likert-scale: Disagree, Partially Agree, Strongly Agree, and Fully Agree. The score for a particular IT critical capability was the average of the score from the questions associated with it. The total maturity was calculated as the average of the 10 capabilities for each organization.

The IT capabilities included in the SME IT-CMF are listed in Table 3. Sample maturity statements are included in Table 4-4.

Table 4-4: Questionnaire sample items on Technological Capability (SME IT-CMF)

Questionnaire on Technological Capability (sample items from SME IT-CMF)
Processes that are used to run the organization are managed using common standards, methods, governance models and technologies.
IT funding levels and sources of funding are flexible, aligned with IT and business strategies
IT solutions are specified, designed, and implemented in a consistent manner.
Business and IT alignment is validated, ensuring that IT strategy is aligned with business priorities.

The collected variables were:

- Individual score for the 10 Critical Capabilities (BP, SD, BPM, SP, FF, SRP, RAM, SRC, RM, UED)
- Total IT Maturity score: calculated as the average score of the 10 critical capabilities.

4.2.2 Target Population and Data Collection

100 Japanese SMEs awarded by the Japanese Ministry of Economy, Trade and Industry on the list of “Competitive IT Strategy SME Selection 100” (in Japanese “攻めの IT 経営中小企業百選”) from 2015, 2016 and 2017 (METI, 2017) were selected due to their characteristic of proven effective utilization of IT to support business performance.

The SMEs are in principle self-nominated but they needed to include a case or sample of effective utilization of IT and demonstrated good business performance for the selection. This data set was selected precisely due to the characteristic of having evidence showing effective use of technology. This was expected to facilitate testing of the relationship between Digital Business Value and the three perspectives.

A similar data set was previously used in other studies (Hirano, 2005; Riera and Iijima, 2007).

The questionnaire title was “Survey on Organizational Characteristics and IT in the Digital Age” and it was distributed to the 100 companies mailbox address and follow up calls were done to increase the responses. A total of 34 organizations answered the survey (response ratio: 34%).

Figure 4-1 and Table 4-5 describe the industry composition of the target population and the received answers. The composition for the answers received is as follows: 32% Manufacturing, 18% Service, 12% Printing, 12% Wholesale, 9% Construction, and 3% for Information and Communication, Transportation, Gravel sampling, Food & Beverage, Dental technology and other industries. Non-Response bias was tested with the Kruskal-Wallis Test and no differences were found between the organizations that answered the survey versus the organizations that did not answer. The non-parametric tests were done for the organization’s capital, size (number of employees) and years of operations.

A results report was provided to the organizations that participated. The content included brief explanations of the concepts being measured (e.g. Organizational IQ, SECI Processes, IT Capability Maturity, etc.), a benchmark on the contribution of IT and Digital Technologies to Business Objectives and a basic analysis and considerations on the differences between the organizations that were able to achieve their objectives in comparison to the ones that were not successful.

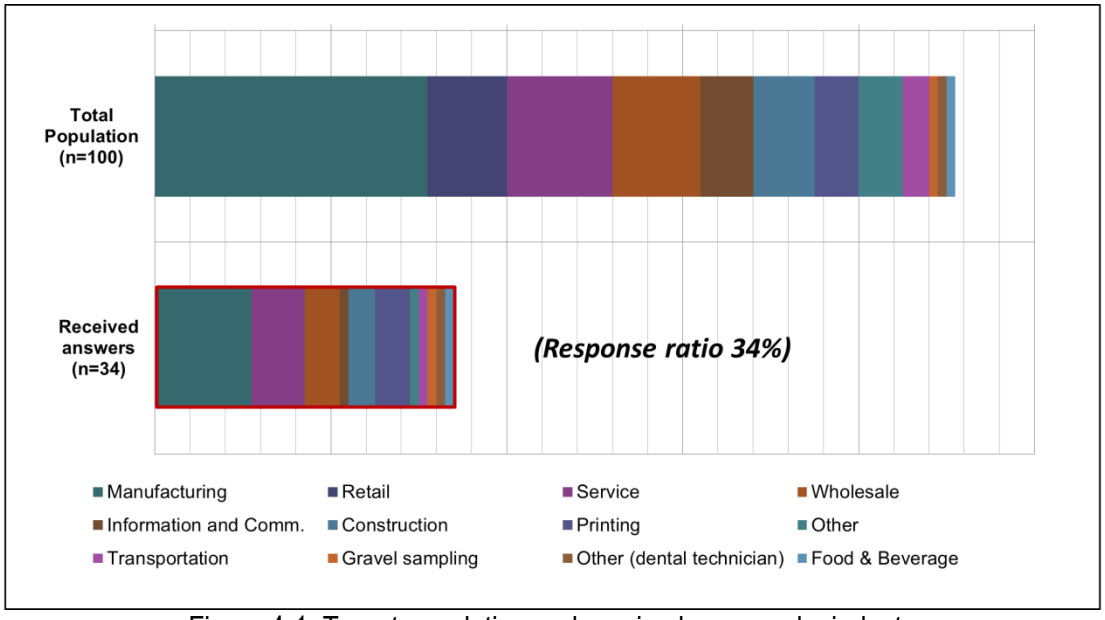


Figure 4-1: Target population and received answers by industry

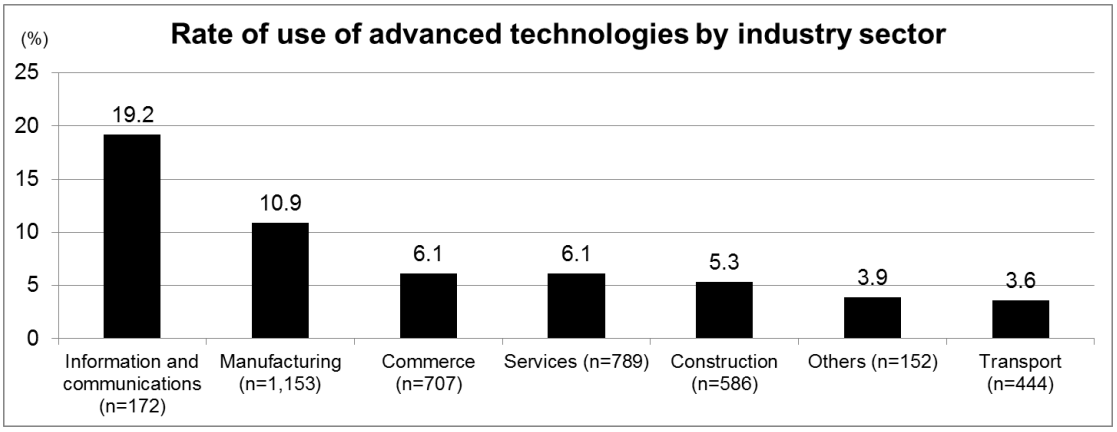
Table 4-5: Target population and received answers by industry

Industry	Total Population	Received responses	Response (%)
Manufacturing	31	11	35%
Service	12	6	50%
Wholesale	10	4	40%
Retail	9	-	-
Construction	7	3	43%
Information and communication	6	1	17%
Printing	5	4	80%
Other	5	1	20%
Transportation	3	1	33%
Agriculture	2	-	-
Wholesale and retail trade	1	-	-
Other (nursing care)	1	-	-
Accommodation	1	-	-
Retail / nursing care	1	-	-
Gravel sampling	1	1	100%
Other (dental technician)	1	1	100%
Food & Beverage	1	1	100%
Real Estate	1	-	-
Information service	1	-	-
Manufacturing - Agriculture	1	-	-
Total	***100***	***34***	***34%***

4.2.3 Controlling for Industry, Size, Years of Operation and Capital effects

The control for industry, company size (number of employees) and years of operation was done using analysis of variance (parametric or non-parametric tests as applicable). The analysis did not identify a significant difference between the groups for key variables used in the analysis. This included IT Business Value, Digital Business Value, and the three perspectives: Knowledge Creation, Strategic Decision Making and Technological Capability perspective.

The grouping criteria used for industry control considered the rate of usage of advanced technologies (i.e. AI, big data, IoT and Robot Process Automation) that was reported by The Small and Medium Enterprise Agency in its 2018 White Paper on Small and Medium Enterprises (SME Agency, 2018), see Figure 4-2. Two groups were classified: “High” use rate for Information and communication, and Manufacturing industries; and “Low” use rate for other industries.



Source: Mitsubishi UFJ Research and Consulting Co. (*Survey on Initiatives for Increasing Productivity to Address Labor Shortages)* cited from SME Agency (SME Agency, 2018).

Figure 4-2: Rate of use of advanced technologies by industry sector

Company size considered the total number of employees. Years of operation considered how many years the organization has been operating. Three groups were used for each categorization using their 25th and 75th percentiles. The groups were recent: SMEs with less than 32 years of operation, middle: between 32 and 54 years of operation, and, old: more than 54 years of operation. Regression models considered both the industry control as well as the years of operation control. Details can be found in Chapter 6.

The control for capital used the standardized scores of the capital amount of the organization. The analysis did not identify differences between the groups for Digital Business Value, and the three perspectives: Knowledge Creation, Strategic Decision Making and Technological Capability perspectives.
For IT Business Value, the analysis identified difference as the organizations with a medium capital amount (10M JPY < capital amount < 50M JPY) seem to achieve higher IT Business Value than organizations with lower capital (<= 10M JPY). This was confirmed statistically between the medium and low capital groups. Although not confirmed statistically, the benefits organizations with larger capital (>= 50M JPY) achieved from IT seem to decrease.

4.2.4 Data Preparation

Normality test was done with Shapiro-Wilk tests over the variables in order to identify deviation from normality. Skewness and Kurtosis values were also verified in order to confirm the level of non-normality. The criteria provided by West et al. (1995) on skewness and kurtosis were used to verify levels of non-normality: Values of skewness between 2.0 and 3.0 and kurtosis values ranging from 7.0 to 21.0 are considered moderately non-normal. Values over 3.0 for skewness or values greater than 21.0 for kurtosis indicate extreme non-normality.
The normality verification identified mainly moderate non-normality for the majority of the variables identified by the Shapiro-Wilk test as non-normal.
Descriptive statistics for the key variables are listed in the appendix section (Appendix 2). Abbreviations and description of the variables are included in the Appendix section (Appendix 3).

4.3 Supportive Qualitative exploration

4.3.1 Qualitative Data Collection

Semi-structured interviews were conducted with participants from one organization after the analysis of quantitative results. The objectives included to clarify the differences between the participants' responses as they belonged to different departments and also to collect supportive evidence for the findings that the quantitative analysis yielded.

4.3.2 Target Organization

The target organization is a Japanese wireless engineering services company. The organization's primary business services are Mobile Communications and Engineering Services, ICT and Engineering Services, Wireless Broadband Communication Design and Knowledge Management System Support. It has been operating for more than 50 years and reported 725 employees in the year 2017.

Below are the factors that made this subject to be a candidate for qualitative exploration.

- The organization was previously awarded by the Ministry of Economy, Trade and Industry in the list of "IT Management" Best 100 Enterprises (in Japanese: IT 経営百選最). In such terms, it could be comparable to the sample in the quantitative study.
- The organization has a strong focus on knowledge management. Knowledge Management system support is part of their services portfolio.
- The organization is familiar with IT capabilities and IT Maturity Framework (IT-CMF). In the past the organization has executed capability assessments as well as a capability improvement initiative.

Chapter Five: Results of the direct effect of the perspectives

This chapter presents the analysis and results for the direct relationships between the perspectives and Digital Business Value.

5.1 General

The quantitative study used statistical analysis in order to verify the hypotheses proposed by the framework.

All the relationships were tested first by correlation analysis (parametric Pearson's tests and non-parametric Spearman's tests as applicable) and later on with regression analysis for the cases where a relationship was suggested. Values reported on correlations are Pearson's results unless specified. The analysis was done first on an overall level and later on a component level. For example, first testing the relationship between Digital Investment itself against overall Digital Business value; then taking a deeper look at the investment done at objective level tested against the business value (achievement of business objectives using Digital Technologies) per objective type.

The key variables in the data set were verified as normal thus parametric tests are executed unless specified. The analysis starts with correlations to identify relationships. The organizations were classified into groups based on their scoring (low, medium and high). Analysis of Variance (ANOVA or Kruskal-Wallis) and Post Tukey HSD tests were done in order to identify if the difference of the means between the groups was also statistically significant. Linear Regression analysis was done to identify if the variables concerning each of the three perspectives could explain the level of achievement of Digital Business Value independently. Finally, the General Linear Model was used to explore the combined effect of the perspectives on Digital Business Value. The interaction effects analysis was done with mean-centered variables when applicable.

The list of variables used in each perspective is mapped with the hypothesis in Table 5-1.

Table 5-1: List of Key Variables

Variable		Hypothesis												
		0	1	2	3	4	5	6	7a	7b	8a	8b	9a	9b
Digital Business Value														
- Digital BV (average of the achievement of business objectives through Digital Technologies) - Achievement of 4 types of business objectives through Digital technologies (financial, customer, business processes, learning & growth objectives)	O	X	X	X		X	X	X	X		X		X	
IT Business Value														
- IT BV (average of the achievement of business objectives through IT) - Achievement of 4 types of business objectives through IT (financial, customer, business processes, learning & growth objectives)	I		X											
Digital Investment														
- % of investment in digital technologies for each of the 4 types of business objectives (financial, customer, business processes, learning & growth objectives)	I	X			X	X								
Knowledge Creation Perspective														
- KCC (minimum of SECI process score) - SECI (aggregated score) - Score for the 4 processes in the SECI Model (S, E, C, I)	I			X	X	X			X	X	X	X		
Strategic Decision Making Perspective														
- OIQ (total score of the 4 dimensions) - Score for each of the 4 OIQ dimensions (EIA, EDA, IKD, CI)	I						X		X	X			X	X
Technological Capability Perspective														
- IT Capability Maturity Score (average score of the 10 capabilities) - Score for each of the 10 IT capabilities (BP, SD, BPM, SP, FF, SRP, RAM, SRC, RM, UED)	I							X			X	X	X	X
O = output (dependent variable) I = input (independent variable)														

5.2 Initial Perspective

5.2.1 Hypothesis testing

[H0] Investment in Digital technologies has little or no effect on Digital Business Value

The empirical analysis using correlation did not identify a relationship between the overall Digital Investment and Digital Business Value as can be observed in Figure 5-1.

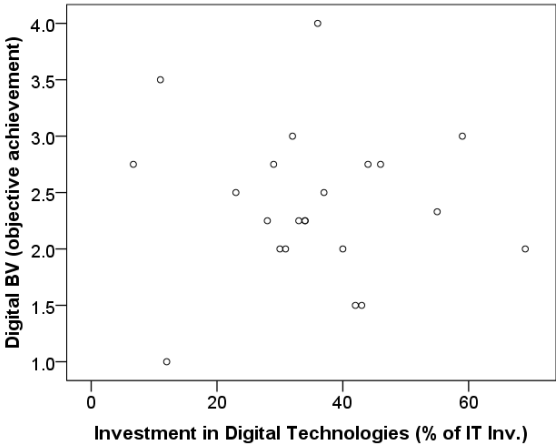


Figure 5-1: Digital Investment and Digital Business Value

This suggested that the achievement of business objectives with Digital Technologies is not related to the investment in Digital Technologies itself.
The analysis continued by exploring if at each level of the four business objectives there were results linking both the investment in Digital Technologies and the objective achievement. The four business objectives types are financial-related, customer-related, business and process-related and learning & growth-related.
First, correlation analysis identified a relationship ($r(13) = .697$, $p = .003$) between the investments in Digital Technologies for Learning & Growth objectives with the level of achievement of such objectives (Digital Business Value for Learning & Growth). This was also confirmed by regression analysis where a significant regression equation was found ($F(1,13) = 12.315$, $p = .004$), with an R^2 of .486. The results can be seen in Figure 5-2.

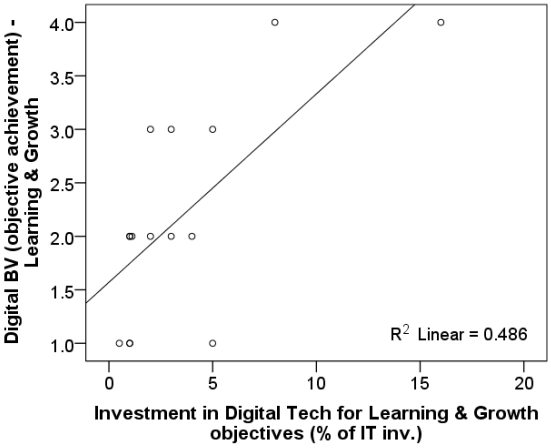


Figure 5-2: Digital Investment in Learning & Growth business objectives and its achievement.

This finding indicates that the more an organization invests in Digital Technologies for Learning & Growth objectives it would be likely that they would be able to achieve such objectives.

Additionally, a negative relationship was identified between the digital investments for customer-related objectives and the achievement of financial-related objectives ($r(18) = -.680$, $p < .001$). This was also verified by regression analysis, where a significant regression equation was found ($F(1,18) = 15.517$, $p = .001$), with an R^2 of .463. The results can be seen in Figure 5-3.

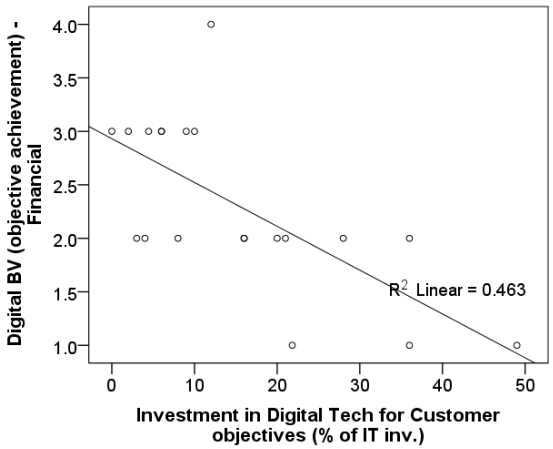


Figure 5-3: Digital Investment in Customer business objectives and Financial objective achievement.

Such negative cross-objective relationship suggests that the more an organization invests onto Digital Technologies in order to achieve Customer-related business objectives; the organization will actually see a decrease in the achievement level for Financial-related objectives and few or zero impact on the achievement of Customer-related objectives.

[H1] IT Business Value is directly related to Digital Business Value

The correlation analysis identified below relationships:

- A positive relationship ($r(26) = .795$, $p < .001$) between overall IT Business Value and overall Digital Business Value (compound achievement of 4 types of business objectives by the use of digital technologies). See Figure 5-4.

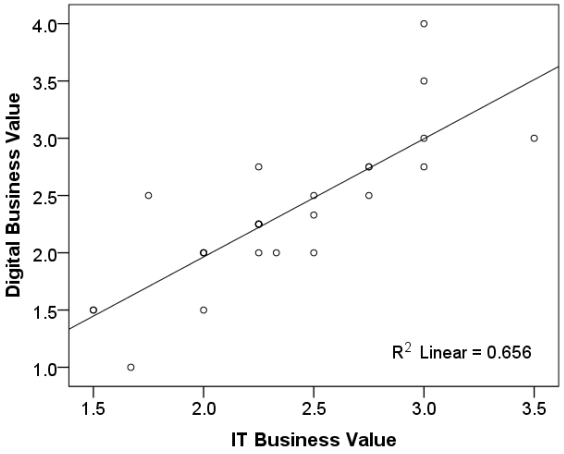


Figure 5-4: IT Business Value and Digital Business Value

- Positive relationships between IT Business Value per each of the 4 types of business objectives and their pair on Digital Business Value (Pearson's correlations are reported).
  - Achievement of Financial related objectives by IT and by digital technologies ($r(22) = .803$, $p < .001$) (see Figure 5-5).
  - Achievement of Customer related objectives by IT and by digital technologies ($r(23) = .796$, $p < .001$) (see Figure 5-6).
  - Achievement of Business Process related objectives by IT and by digital technologies ($r(22) = .743$, $p < .001$) (see Figure 5-7).
  - Achievement of Learning & Growth related objectives by IT and by digital technologies ($r(17) = .910$, $p < .001$] (see Figure 5-8).

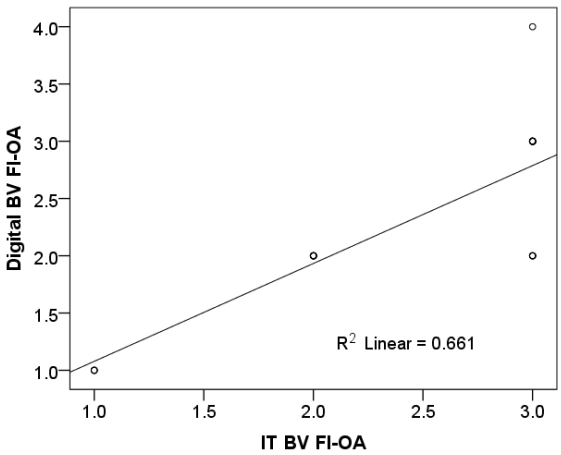


Figure 5-5: Achievement of Financial related objectives using IT and digital technologies

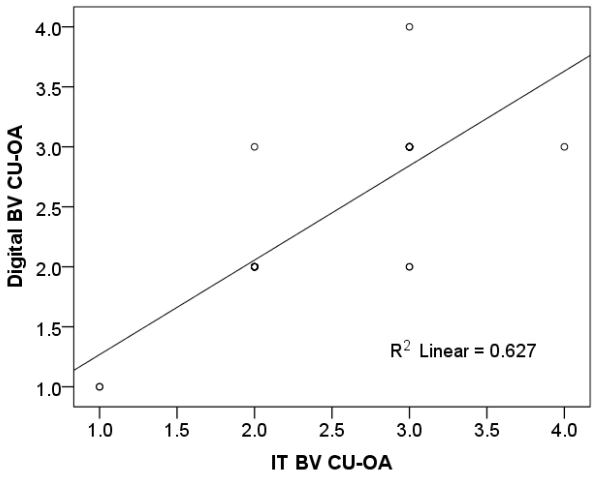


Figure 5-6: Achievement of Customer related objectives using IT and digital technologies

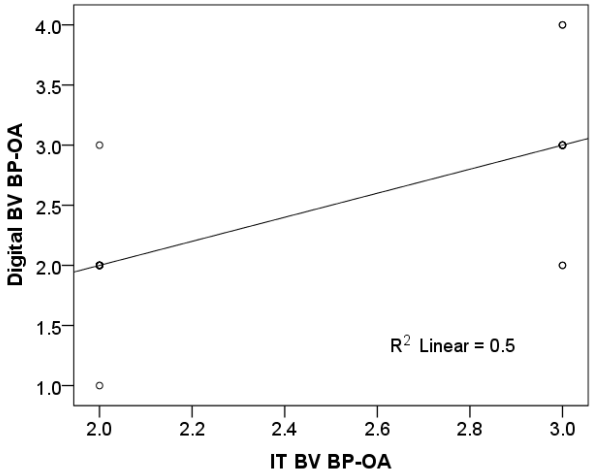


Figure 5-7: Achievement of Business Process related objectives using IT and digital technologies

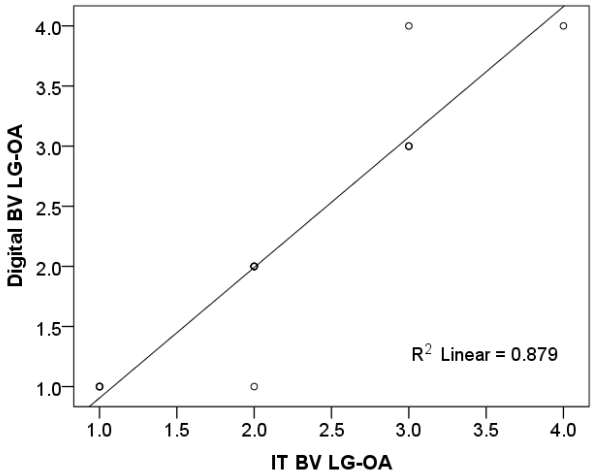


Figure 5-8: Achievement of Learning & Growth related objectives using IT and digital technologies.

- A positive relationship between the achievement of below business objective types by using IT:
  - Business Process and Learning & Growth objectives by IT (r(20) = .582, p = .005).

- Positive relationships between the achievement of the following business objective types by using digital technologies:
  - Customer and Business Process objectives (r(20) = .544, p = .002).
  - Business Process and Learn & Growth objectives (r(16) = .678, p = .002).
  - Financial and Customer objectives (r(20) = .453, p = .034).

- A positive relationship between the achievement of below business objective types by IT and digital technologies:
  - IT Customer and DI Business Process objectives (r(20) = .431, p = .036).

The above relationship was not explored further as considered a possible effect of the other correlations between each of the four types of business objectives by IT and their correspondent achievement by digital technologies.

Partial correlation analysis in order to control for the capital amount of the organizations provided similar results at both an overall level and component level (between the four categories of business objectives).

5.2.2 Hypothesis results

Figures 5-9 and 5-10 show the results for these two hypotheses.

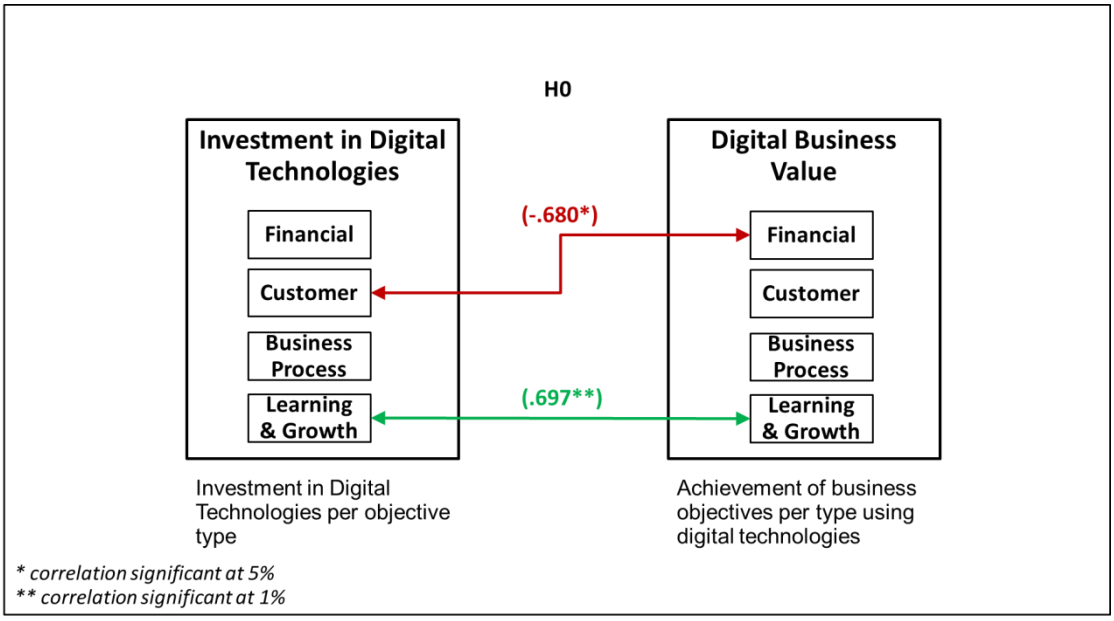


Figure 5-9: [H0] Results: Investment in Digital Technologies and Digital Business Value

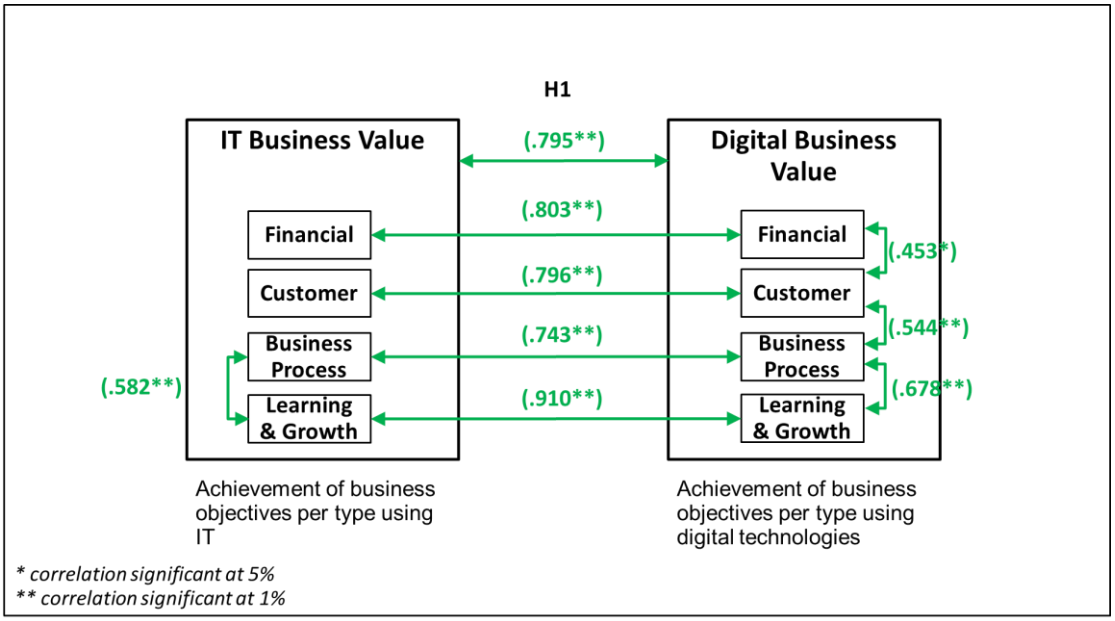


Figure 5-10: [H1] Results: IT Business Value and Digital Business Value

5.2.3 Discussion and Interpretation of Quantitative results

The empirical analysis from hypothesis [H0] initially did not identify a relationship between Digital Investment and the level or achievement of objectives using such technologies (Digital Business Value). These results were not surprising as they are in alignment with studies in the field of IT Paradox where the investment in IT is not necessarily related with the level of benefits that organizations perceived (Weill, 1992). This was nevertheless the case when the analysis was done at the objective type level. For the Learning & Growth objective type, this relationship was positive, suggesting that the more investment in Digital Technologies would result in a higher level of achievement of such objectives.

An explanation for this relationship can be found if it is considered in one hand that objectives in the Learning & Growth area are highly dependent on people such as education, development capability, retention and; in the other that some of the most widely used Digital Technologies like social and mobile rely on and connect people facilitating their interaction. By this particular people-centered characteristic, the investment in Digital Technologies on such objectives may directly lead to the achievement of the objectives. It could be easy to acknowledge for example that if an organization invests in social networking alternatives to increase collaboration and knowledge sharing, the delivery itself of such platform may result in such collaboration increase.

It would be nevertheless harder to justify similar direct relationship between investment in Digital Technologies and achievement of objectives for the other three types of business objectives (Financial, Customer and Business Process-related) as the objectives may have several dimensions for example if the objective is improving customer loyalty; it may be not be achieved by the only deployment of a digital technology but it may require a

set of additional factors that influence the customer behavior. This was also confirmed by the empirical data as no direct relationship was identified between the investments on Digital Technologies on Financial, Customer and Business Process-related objectives and their achievement.

The negative relationship identified between the investments in Digital Technologies for Customer-related objectives with the level of achievement of Financial objectives using Digital Technologies could indicate an opposition between customer centered-approach vs financial-centered approach that organizations may take while deciding on investments in Digital Technologies. While financial objectives could focus on expanding revenue, improving productivity; customer-related objectives focus on improving customer loyalty or satisfaction. Regardless this explanation it is worth to mention as well that another sign from this opposition between the customer and financial objectives should have been if there was a negative relationship between the investment in Digital Technologies between financial and customer objectives. Unfortunately, this was not the case, therefore, it cannot be validated.

The results from the exploration of hypothesis [H1] confirmed the relationship between IT Business Value and Digital Business Value. In other words, the level of achievement of business objectives by the utilization of IT was identified to be related to the level of achievement of business objectives by the utilization of digital technologies and vice versa. This was observed not only at an overall level between IT Business Value and Digital Business Value but also was between each of the four types of business objectives: Customer related, Financial related, Business Process and Learning & Growth. For instance, the level or achievement of Customer related business objectives by IT was related to the level of achievement Customer related business objectives by digital technologies. All these relationships were positive.

An explanation for such relationship is aligned with dynamic capabilities. In this case, the observed relationship may reflect that some organizations have mastered (developed or enhanced their capabilities) how to use IT for delivering business value and, such capabilities are also useful for delivering business value with digital technologies. Additionally, it may be considered that since the experience that organizations have dealing with IT spans over decades, succeeding with new technologies may be partially moderated by the success organizations face with IT (or “traditional” IT).

A relationship was also identified between the achievement of Business Process objectives and the achievement of Learning & Growth objectives supported by IT.

The relationship between the four types of business objectives was stronger on Digital Business Value. The multiple relationships identified between Customer, Business Process and Learning & Growth objectives, together with the relationship between Customer and Finance types of business objectives supported by digital technologies suggested that the organizations that are able to benefit from digital technologies have some capabilities that allow them to succeed in any of the types of business objectives.

5.3 Knowledge Creation Perspective (Knowledge Creation Capabilities)

5.3.1 Hypothesis testing

[H2] KCC are present in organizations that achieve Digital Business Value

The correlation analysis did not identify a direct relationship between KCC and overall Digital Business Value (compound achievement of 4 types of business objectives by the use of digital technologies). The analysis of variance suggested a negative relation but it was not verified statistically ($F(1,25) = 2.124$, $p = .157$) (see Figure 5-11).

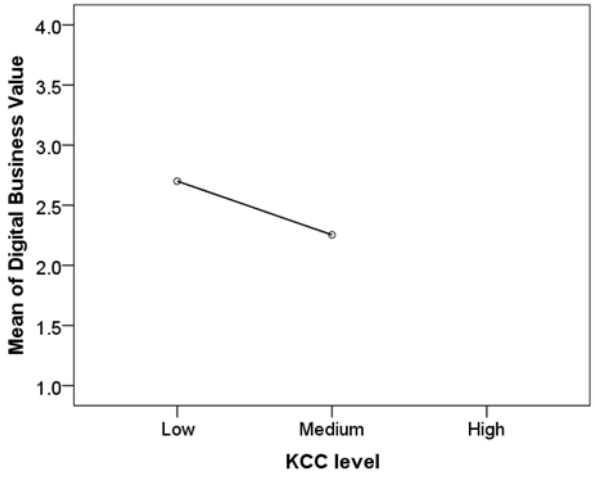


Figure 5-11: KCC level and Digital Business Value (objectives achievement using digital technologies), not statistically significant.

The exploration of the impact of overall KCC on the achievement of any of the four types of business objectives did not produce statistically significant results. Similar negative trends could be observed on Financial (see Figure 5-12), Customer and Business Processes related objectives but was positive for Learning & Growth objectives (see Figure 5-13).

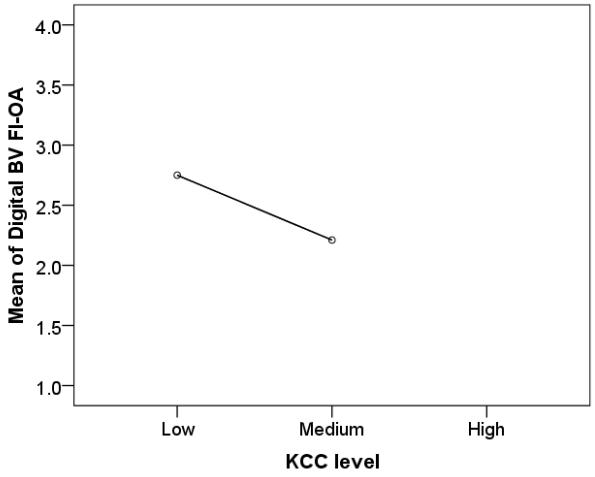


Figure 5-12: KCC level and achievement of Financial related objectives using digital technologies, not statistically significant.

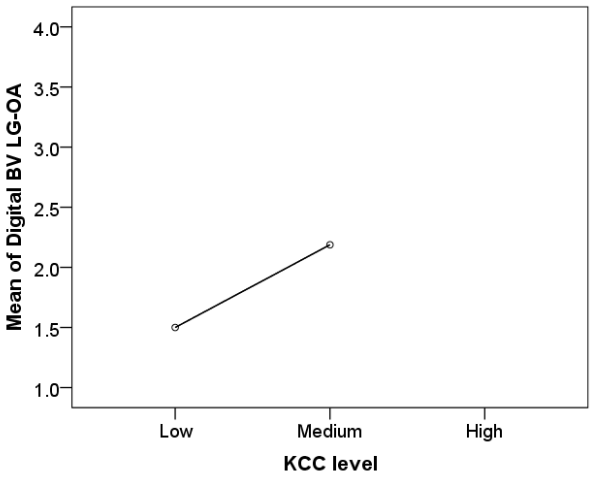


Figure 5-13: KCC level and achievement of Learning & Growth related objectives using digital technologies, not statistically significant.

A deeper look on each of the four SECI Processes (Socialization, Externalization, Socialization and Combination) in KCC and their relationship with Digital Business Value was conducted.

This exploration yielded the below results:

- No statistically significant relationship identified Digital Business Value neither at overall level nor at business objectives categories.
- Difference ($F(2,21) = 5.707$, $p = .010$) identified by analysis of variance between Combination levels and the achievement of Customer objectives by the use of digital technologies (Digital Business Value) (see Figure 5-14).

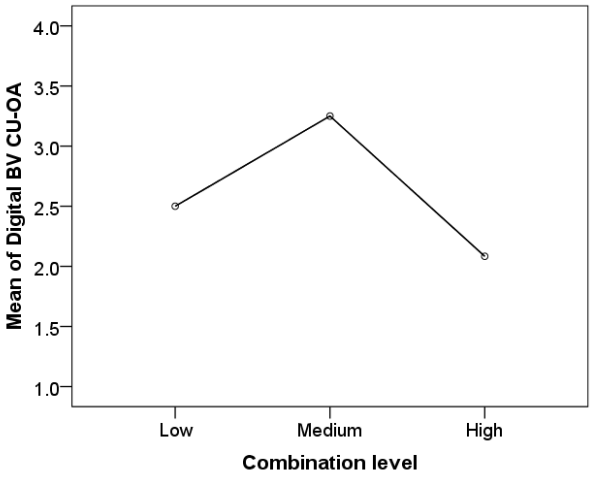


Figure 5-14: SECI Combination Process level and achievement of Customer objectives using digital technologies (High and Medium groups difference at $p = .008$)

[H3] KCC is positively related to the Investment in Digital technologies

On an overall level the statistical tests did not find a direct relationship between Knowledge Creation Capabilities (Balanced SECI and Total SECI score) and the Investment in Digital Technologies. Such result can be observed in Figure 5-15.

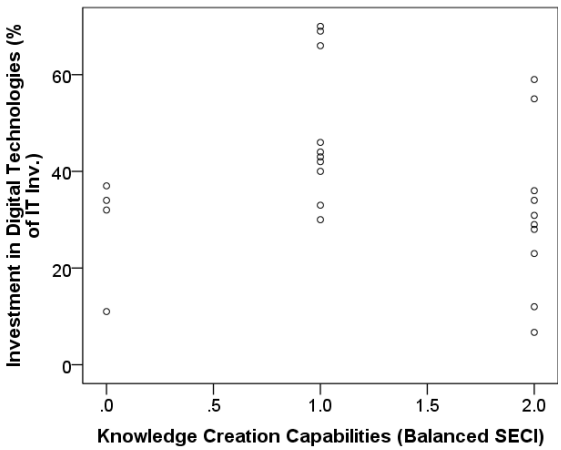


Figure 5-15: Knowledge Creation Capabilities and Digital Investment

Analysis of variance was done in order to identify if there was any difference between the organizations with Low, Medium and High Knowledge Creation Capabilities and the intensity of investment in Digital Technologies with no significant results. These results implied that the score of Knowledge Creation Capabilities measured as Balanced SECI and Total SECI was not related to the level of overall investment in Digital Technologies.

The analysis between Balanced SECI and the investment on the four categories of business objectives identified a positive relationship with the investment in Digital Technologies for Learning & Growth objectives ($r_s(22) = .505$, $p = .012$).

The analysis by each Knowledge Creation Processes (Socialization, Externalization, Combination and Internalization) against all of the four business objectives types (financial-related, customer-related, business and process-related and learning & growth-related) yielded the following results.

First of all, the correlation analysis using parametric tests suggested a negative relationship ($r(24) = -.462$, $p = .017$) between SECI's Externalization process and the investments in Digital Technologies for Financial objectives. However the appropriate Spearman's tests ($r(24) = -.035$, $p = .079$) did not verified such negative correlation. Since both variables are not normal Spearman's results are prioritized for correlation results. Regression analysis found a significant regression equation ($F(1,24) = 6.526$, $p = .017$), with an R^2 of .214. The results can be seen in Figure 5-16.

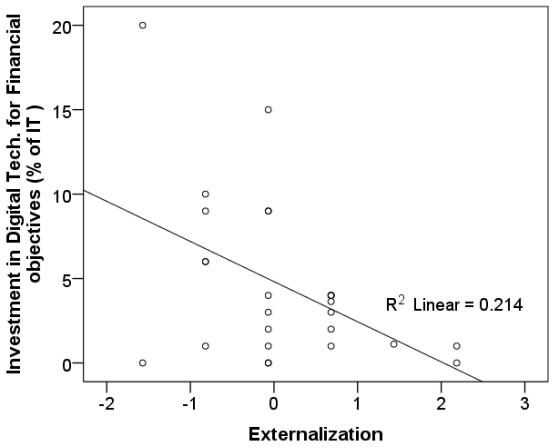


Figure 5-16: SECI's Externalization and Digital Investment in Financial business objectives

This suggests that the more an organization focuses on the conversion of tacit into explicit knowledge (measured by SECI's Externalization); the more likely it will route its investments in Digital Technologies to financial objectives.
Secondly, a positive relationships were found between SECI's Combination process and the level of investments in Digital technology for Financial ($rs(24) = .512$, $p = .007$,) and Learning & Growth ($rs(22) = .517$, $p = .010$) business objectives. Regression analysis confirmed such relationship with equations like ($F(1,24) = 4.514$, $p = .044$), with an R^2 of .158 for investment in Financial objectives while a regression equation ($F(1,22) = 9.319$, $p = .006$), with an R^2 of .298 for the investments in Learning & Growth objectives. The results can be seen in Figures 5-17 and 5-18.

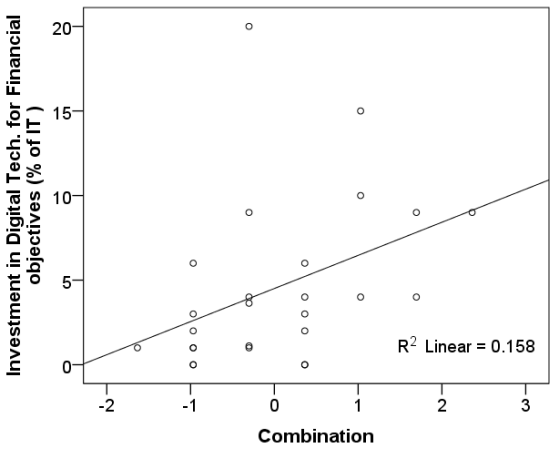


Figure 5-17: SECI's Combination and Digital Investment in Financial business objectives.

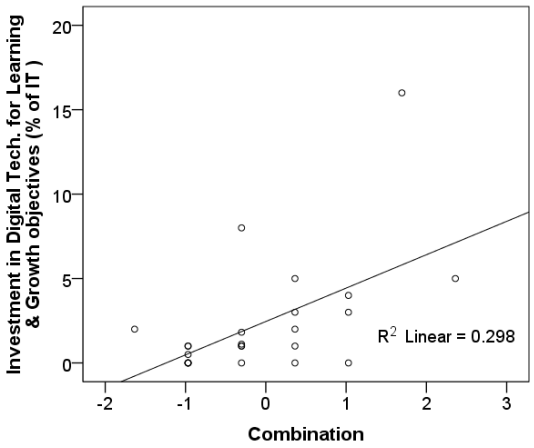


Figure 5-18: SECI's Combination and Digital Investment in Learning & Growth business objectives

Although weak to moderate, such positive relationships indicate that the more an organization is focused on the integration or combination of explicit knowledge in order to create new knowledge (measured by SECI's Combination process score); the more likely it will route its investments in Digital Technologies to achieve its Financial or Learning & Growth objectives.

[H4] KCC leverages the effect of Digital Technologies investment on Digital Business Value

First of all an analysis on the overall effect of Knowledge Creation Capabilities -measured as Balanced SECI and also total SECI score- had on Digital Business Value was tested with the General Linear Model. Although there were no significant results, a positive trend can be seen in Figures 5-19 and 5-20.

Digital Business Value (Y-axis scale) on Figures 5-19 and 5-20 values are represented by: 1 - Not achieved, 2 - Partially achieved, 3 - Highly achieved and 4 - Fully achieved.

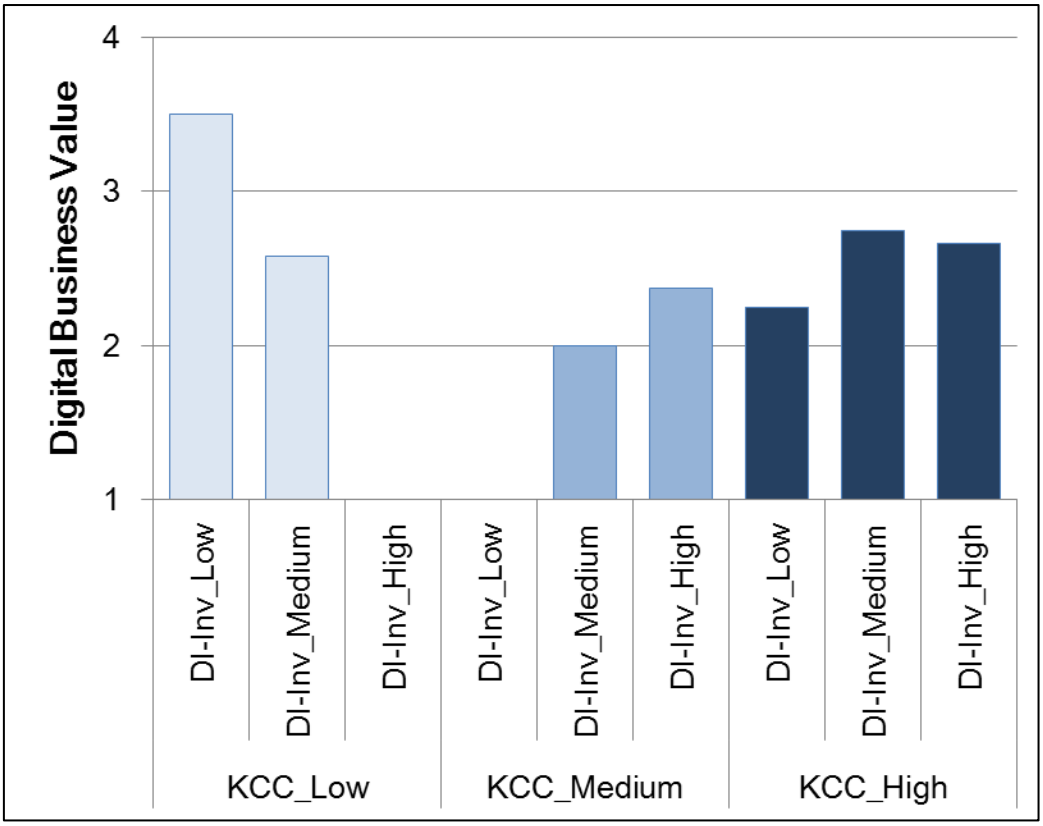


Figure 5-19: Influence of KCC (Balanced SECI score) on Digital Investment and Digital Business Value

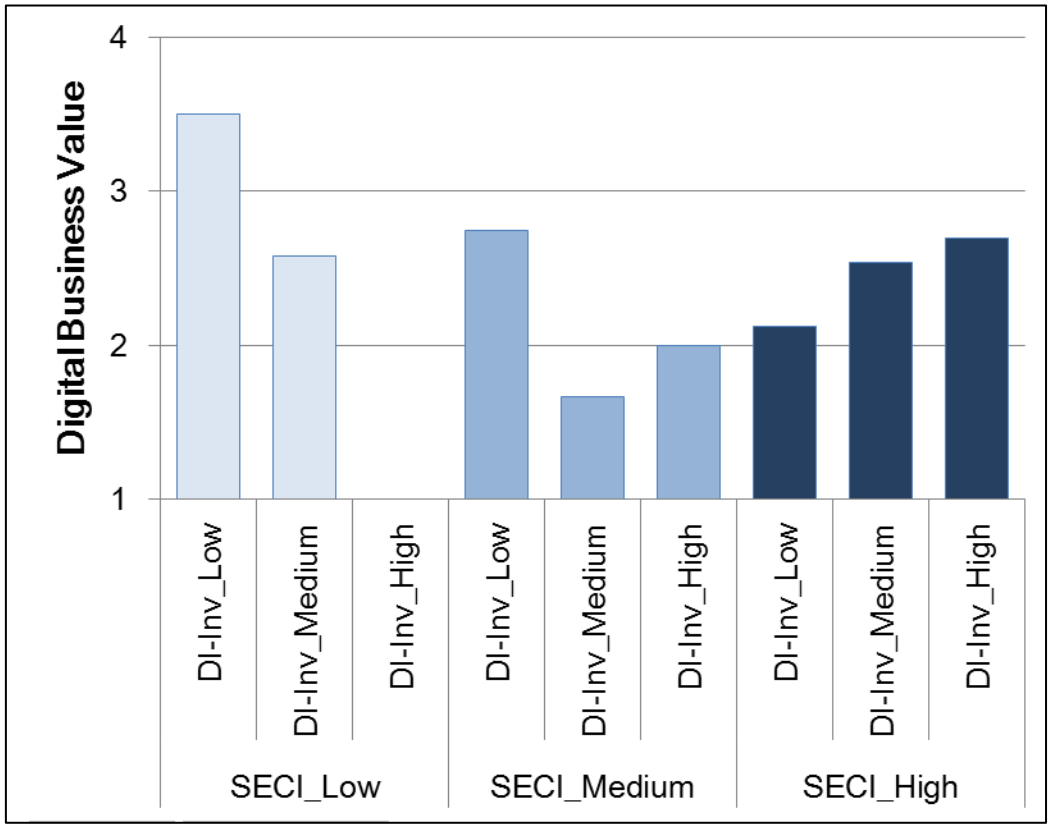


Figure 5-20: Influence of Knowledge Creation Process (Total SECI score) on Digital Investment and Digital Business Value

Figures 5-19 and 5-20 show that when organizations have low Knowledge Creating capabilities (either Balanced SECI or Total SECI score), the benefits they get from the investment in Digital Technologies (Digital Business Value) actually decrease with the level of investment increases. On the other hand, when organizations have higher Knowledge creation capabilities the benefits from investment in Digital Technologies increase when the investment increases.

In addition, analysis on a component level was also done. Based on the results from hypothesis [H0] and hypothesis [H3], the statistical analysis focused on identifying the combined effects of KCC and Digital Investment in the Learning & Growth business objectives. Digital Business Value on Learning & Growth objectives was the dependent variable for the models. As the independent variables first the level of investment in Digital Technologies to achieve Learning & Growth objectives is used (1). Then, the score of the Combination process from the SECI Model becomes the independent variable in the next model (2). Afterwards the independent variables are combined in the last model (3). Equations (1), (2) and (3) specify the models and Table 5-2 summarizes the analysis regression results. Model (3) is calculated with the General Linear Model.

$$DI\_BV\_LG = \alpha + \beta \times DI\_Inv\_LG \quad (1)$$
$$DI\_BV\_LG = \alpha + \beta \times Combination \quad (2)$$
$$DI\_BV\_LG = \alpha + \beta \times Combination + \gamma \times DI\_Inv\_LG + \delta \times (Combination \times DI\_Inv\_LG) \quad (3)$$

Table 5-2: Regression results for [H4]

Model	(1)	(2)	(3)
Constant	2.053*** (0.186)	2.053*** (0.211)	2.051*** (0.218)
DI_Inv_LG	0.190** (0.054)		0.245** (0.094)
Combination		0.375 (0.217)	0.091 (0.231)
DI_Inv_LG × Combination			-0.067 (0.062)
R^2	.486	.149	.539
Adj. R^2	.447	.099	.414

- Standard errors are reported in parenthesis.
- *, **, *** indicates significant at 10%, 5%, and 1% respectively.
- Predictors: DI_Inv_LG was centered at its mean. Combination used standardized scores.

Although the results in model (3) show a small increase in the R^2, the values for Adjusted R^2 confirm the model didn't improve from the combination effects. Also coefficient for the combined effect: DI Inv. LG × Combination is

very low and non-significant. Multicollinearity tests indicated there was no collinearity (VIF=1.440) between the independent variables: Combination and Digital Investment in Learning & Growth.

This indicates that although Combination score of an organization was found to be related with the level of Investment in Digital Technologies for various types of business objectives as identified by hypothesis [H3]; it certainly does not have a major effect with the achievement of the objectives or Digital Business Value.

5.3.2 Hypothesis results

Figure 5-21 show the results for these three hypotheses.

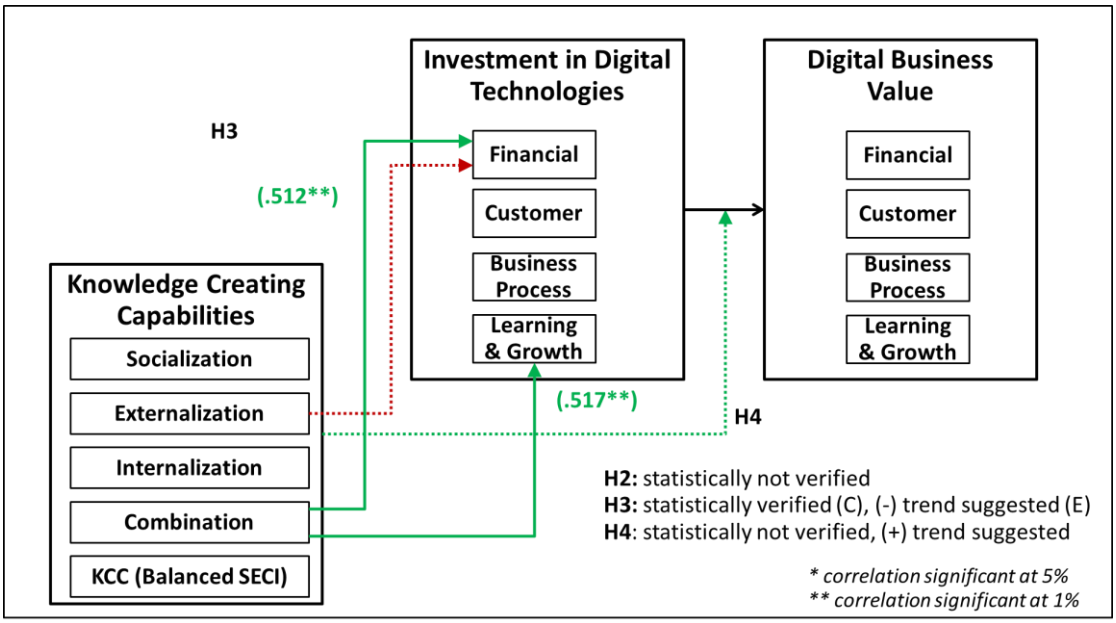


Figure 5-21: [H2, H3, H4] Results: Knowledge Creation perspective, Digital Investment and Digital Business Value

5.3.3 Discussion and Interpretation of Quantitative results

Hypothesis [H2] explored the relationship that Knowledge Creating Capabilities (KCC) had with the achievement of business objectives by the use of digital technologies. Without statistically significant results, the negative relationship observed suggests that the stronger the organizations focus on the creation of new knowledge, they may see a decrease in the level of achievement of business objectives in general. The negative trend was observed for three of the business objectives types (Financial, Customer and Business Processes) but positive for Learning & Growth objectives. This shows a positive relationship between the focus on knowledge creation by the organizations and the achievement of Learning & Growth objectives by the use of digital technologies. Although not validated by the statistical analysis the perceived negative relationship between KCC and the remaining three types of business objectives may actually remind us that the organizational resources are limited, therefore the more an organization pursues knowledge

creation and devotes its resources to such objectives then they risk of not paying attention to other business objectives categories.

Hypothesis [H3] explored if the Knowledge Creation Processes from the SECI Model were able to influence the digital investments decisions. The results positioned the SECI Processes as an influencer on the Digital Technology investment results. At an overall level, the Balanced SECI (or minimal score between the four processes in the SECI Model) was found to be related to the level of investments on Learning & Growth business objectives. This suggests that the higher balance an organization has on its knowledge creation process it is more likely that the level of investments on Digital Technologies for Learning & Growth objectives increase. This is a relationship worth to note since it was already identified by hypothesis [H0] that the investment in Digital Technologies in such objectives type was actually related to its achievement. Thus organizations may consider increasing their knowledge creation process in order to increase the achievement of Learning & Growth objectives using Digital Technologies.

From the analysis of each Knowledge Creation process, there were 2 processes from SECI Model which had an impact on the digital investments.

The first process was Externalization and had a negative impact on the investments in Digital Technologies for Financial-related objectives. Such negative relationship suggested by the regression analysis indicates an opposite focus in organizations between the aim to make tacit knowledge available thru the conversion to explicit in a way that can be shared within the organization and the pursuit of Financial objectives like expanding revenue, etc.

The second process was Combination and it showed a positive relationship with the investment in Digital Technologies to achieve Financial and Learning & Growth objectives. From the nature of the Combination process in which the knowledge gathered both from outside and inside the organization is processed to form new knowledge, it could be expected that it relates to investment in Digital Technologies of all objective types. Since the empirical evidence found that relationship only with two of the four objective types; it suggests that the organizations with a high score of Combination invest more in Financial and Learning & Growth objectives. An alternative explanation is that in the studied organizations the knowledge was created through the Combination process and it resulted in investment in Digital Technologies for such two specific objectives.

In hypothesis [H4], the analysis showed the effects that Knowledge Creation capabilities had on the relationship between Digital Investment and Digital Business Value. A trend showed that when organizations with low Knowledge Creating capabilities invest in Digital Technologies, the benefits decreased as the level of investment increased. Similarly, the benefits increased as the level of investment increased when organizations had high Knowledge Creating capabilities. Although this was not confirmed statistically, it provides insights on the role of Knowledge Creating capabilities.

On an individual SECI process level, the combined effects of SECI Process Combination and Digital Investment on the achievement of Learning

& Growth business objectives were explored. This was done based on the results from the former hypotheses and the results instead verified that the combined effect did not differ much from the scenario of individual effect. The interpretation is then that Knowledge Creation Processes are related to the level of investment in Digital Technologies in some types of business objectives.

5.4 Strategic Decision Making Perspective (Organizational Intelligence Quotient)

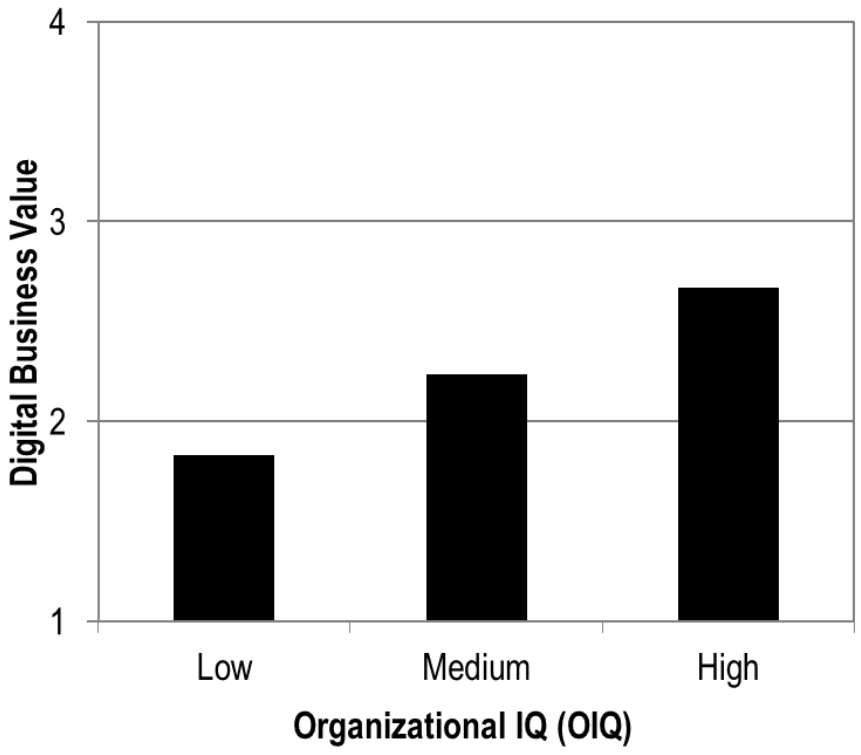
5.4.1 Hypothesis testing

[H5] Strategic Decision Making (OIQ) is positively related to Digital Business Value

Similarly to the analysis of previous hypotheses, first the relationship was tested on an overall level, this identified a "weak to moderate" relationship ($r(26) = .469$, $p = .012$) between the score of Organizational Intelligence Quotient (OIQ) and Digital Business Value. The differences according to OIQ level are presented below followed by analysis at each of the five dimensions of OIQ.

Differences in Digital Business Value according to the level of Organizational IQ

It was verified by ANOVA ($F(2,25) = 3.366$, $p = .050$) and Post Tukey HSD tests that SMEs with high OIQ score demonstrated higher Digital Business Value achievement than their peers with low OIQ score. The difference between the groups is presented in Figure 5-22.



Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies with scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

Figure 5-22: Organizational IQ and Digital Business Value Achievement

Figure 5-22 shows that SMEs with Low OIQ scores were between the "Not Achieved (1)" and "Partially Achieved (2)" range while SMEs with High IT capability maturity scores were between the "Partially Achieved (2)" and "Highly Achieved (3)" range.

The exploration per each OIQ dimension found that Digital Business Value had below relationships with OIQ dimensions:

- A weak relationship with Internal Knowledge Dissemination (IKD) and Continuous Innovation (CI) (IKD: $r(26) = .400$, $p = .035$; CI: $r(25) = .430$, $p = .025$).
- No statistically significant relationship found with External Information Awareness (EIA) and Effective Decision Architecture (EDA) dimensions of OIQ.
- There was no difference in score for Organizational Focus (OF) for the organizations thus it was excluded from the analysis.

A summary of these results is included in Table 5-3.

Table 5-3: Summary of Results for [H5]: Digital Business Value by OIQ and OIQ's dimensions

Relationship between Digital Business Value and OIQ.	**Correlation Analysis**	**Analysis of Variance.** Groups: L/M/H OIQ
OIQ	Weak	"Low" and "High" OIQ groups show different Digital BV Achievement level. Higher OIQ shows high achievement of Digital Business Value. However, "Low" and "High" Digital Business Value did not find a significant difference.
EDA - Effective Decision Architecture	none	none
EIA - External Information Awareness	none	"Low" and "Medium" EIA groups show different Digital BV.
IKD - Internal Knowledge Dissemination	Weak	"Medium" and "High" IKD groups show different Digital BV.
CI - Continuous Innovation	Weak	Not verified statistically, (+) trend observed

The results indicate that SMEs experiencing benefits from Digital technologies are SMEs with higher levels of OIQ. Such SMEs are able to combine information and knowledge available outside their organizations (from the customer, competitors, suppliers) with internal information and knowledge in order to make effective decisions regarding their products and services that allow them to remain competitive in the market.

The analysis at OIQ dimensions unveiled the link between OIQ's Internal Knowledge Dissemination (IKD) and Continuous Innovation (CI) dimensions with Digital Business Value. This may be evidence that although it may be important that SMEs are aware of their environment (EIA) and have

practices or processes that enable them to take the right decisions at the right organizational level (EDA); what really pays off is how the SMEs are able to use knowledge and information from outside together or combined with the internal knowledge and information (IKD) in order to reinvent their products and services, supported by a company culture fostering innovation at all levels in the organization (CI).

A complementary analysis to verify a potential relationship between Strategic Decision Making (OIQ) with IT Business Value was done. The correlation analysis between OIQ and IT Business Value didn't identify a relationship between OIQ either at an overall level nor at OIQ's dimension level with the overall IT Business Value. When considering each of the four business objectives in IT Business Value, it was identified that OIQ had a positive relationship with the achievement of Business process and Learning & Growth business objectives (IT_Ach_BP: rs(26) = .403, p = .033, IT_Ach_LD: rs(21) = .429, p = 0.041). This suggests that OIQ is also important for the generation of Business Value with IT. Multicollinearity was present on the IT_Ach_LD, DI_Ach_LD pair with respect to OIQ but not in the IT_Ach_BP, DI_Ach_BP pair with respect to OIQ.

5.4.2 Hypothesis results

Figure 5-23 show the results for this hypothesis.

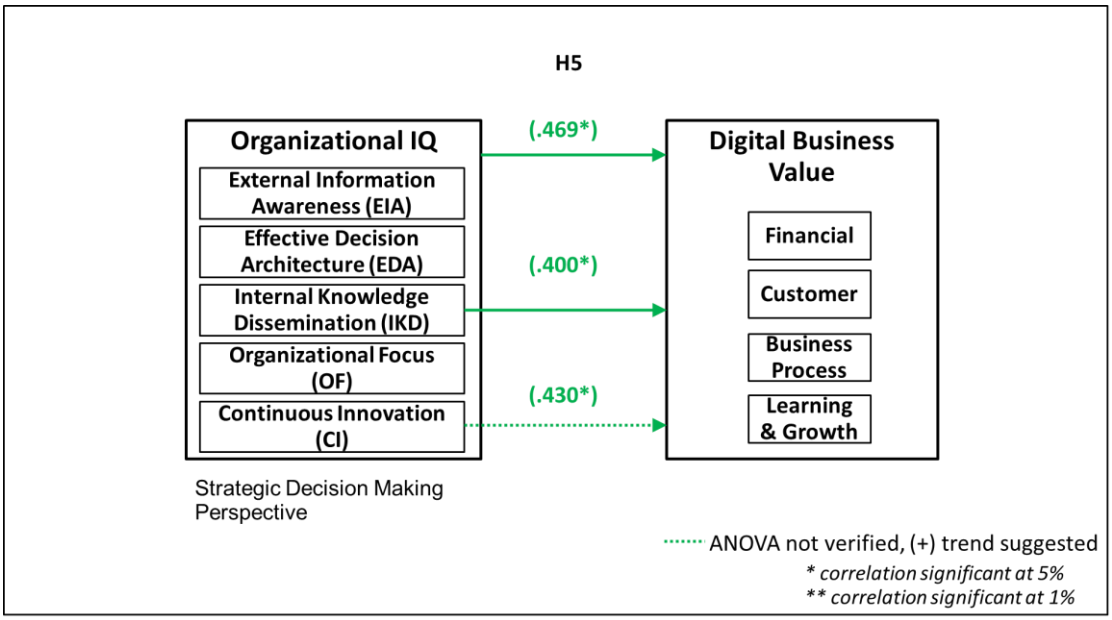


Figure 5-23: [H5] Results: Strategic Decision Making (OIQ) and Digital Business Value

5.4.3 Discussion and Interpretation of Quantitative results

The empirical analysis indicated that from the four OIQ dimensions considered in the analysis only Internal Knowledge Dissemination (IKD) and Continuous Innovation (CI) were relevant for the achievement of business objectives with Digital Technologies. This suggests that SMEs that achieve

Business Value in the Digital Age have also two additional characteristics: the right knowledge is available for each part of the organization at the required time and; promote creativity and innovation across all functions, hierarchies, and boundaries.

Other OIQ dimensions like External Information Awareness (EIA) and Effective Decision Architecture (EDA) did not appear in the results from the tests; this should be interpreted as that the levels of these two dimensions were present on both organizations that were able to achieve Digital Business Value but also in the ones that were not as successful.

5.5 Technological Capability Perspective (IT Capability Maturity)

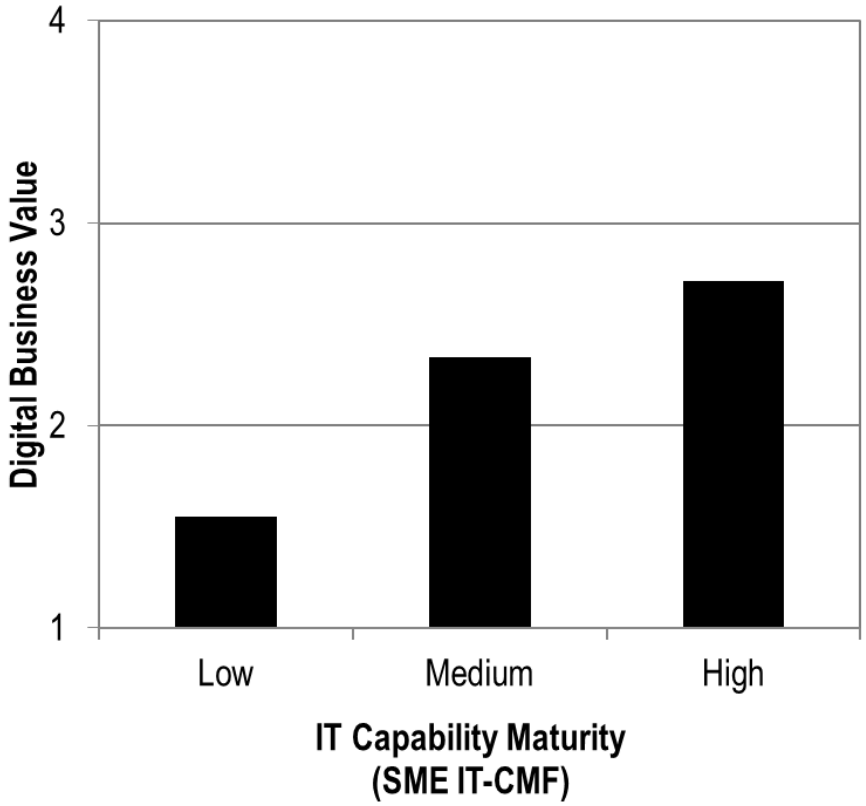
5.5.1 Hypothesis testing

[H6] IT Capability Maturity (SME IT-CMF) is positively related to Digital Business Value

The tests for hypothesis [H6] identified a moderate ($r_s(26) = .642$, $p < .001$) relationship between the level of IT Capability Maturity on the organizations and the level of achieved Digital Business Value.
Detailed analysis is presented below. The differences according to IT Capability Maturity are presented below followed by analysis at each of the 10 IT Capabilities.

Differences in Digital Business Value according to the level of IT Capability Maturity

The overall result was also verified by ANOVA and Post Tukey HSD tests where SMEs with High IT Capability Maturity demonstrated higher Digital Business Value achievement (achievement of business objectives by the use of Digital Technologies) than their peers with low IT Capability Maturity ($F(2,24) = 6.01$, $p = .008$). The difference between the groups is presented in Figure 5-24.



Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies with scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

Figure 5-24: IT Capability Maturity and Digital Business Value Achievement

Figure 5-24 shows that SMEs with Low IT Capability Maturity were between the "Not Achieved (1)" and "Partially Achieved (2)" range while the organizations with High IT Capability Maturity were between the "Partially Achieved (2)" and "Highly Achieved (3)" range.

An exploration per each SME IT-CMF Critical Capability (10 IT critical capabilities) found that Digital Business Value had below relationships with IT critical capabilities (Spearman correlation values are reported):

- A strong relationship with Risk Management (RM) critical capability ($rs(25) = .639$, $p < .001$).
- A moderate relationship with Business Planning (BP), Strategic Planning (SP), Solutions Delivery (SD) critical capabilities (BP: $rs(26) = .524$, $p = .004$; SP: $rs(25) = .458$, $p = .016$; SD: $rs(24) = .483$, $p = .012$);
- A weak relationship with Business Process Management (BPM), Financial and Funding (FF) critical capabilities (BPM: $rs(24) = .495$, $p = .010$; FF: $rs(25) = .431$, $p = .025$);
- No statistically-significant relationship found with Sourcing (SRC), Service Provisioning (SRP), Relationship Asset Management (RAM) and User Experience Design (UED) IT critical capabilities.

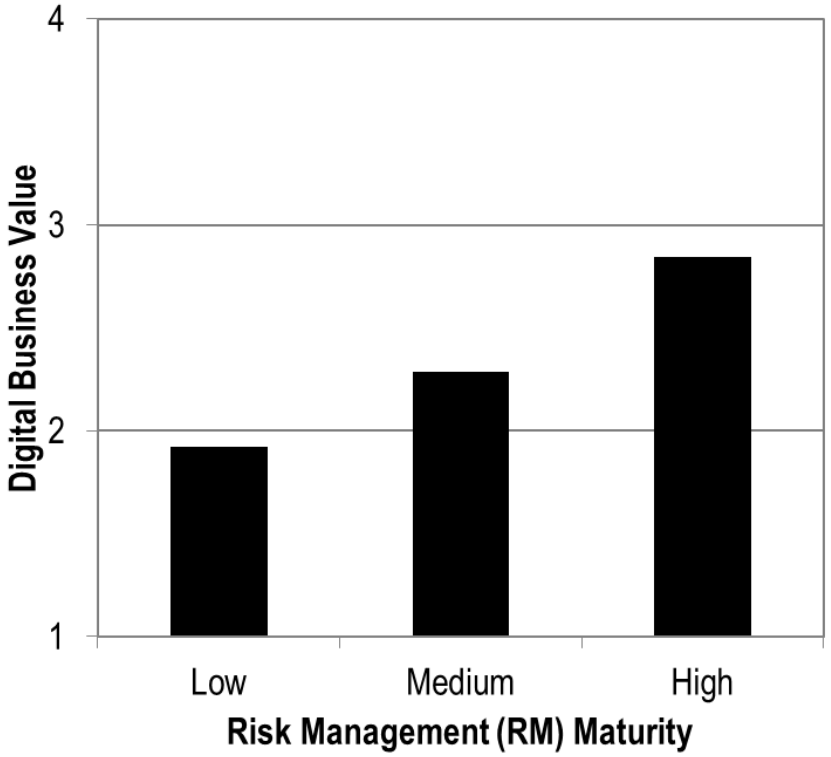
The comparison using Analysis of variance and Post Tukey HSD tests over the individual capabilities also validated the majority of the relationships identified previously by correlation analysis as described below. For this analysis the organizations were classified onto Low, Medium and High groups using their capability maturity score and analysis of variance was done.

- Between the Low and High groups for Risk Management (RM) ($F(2,24) = 6.083$, $p = .007$), Business Planning (BP) ($F(2,25) = 5.123$, $p = .014$), Relationship Asset Management (RAM) ($F(2,24) = 5.318$, $p = .012$), Solutions Delivery (SD) ($F(2,24) = 4.536$, $p = .021$), Strategic Planning (SP) ($F(2,24) = 5.857$, $p = .008$) critical capabilities.

Analysis of variance did not find a difference in the means of the groups for below IT critical capabilities.

- Financial and Funding (FF) and Business Process Management (BPM) critical capabilities, in contrary to the weak relationship that the correlation analysis identified.
- Service Provisioning (SRP), Sourcing (SRC) and User Experience Design (UED) critical capabilities, no difference found aligned with the results from the correlation analysis.

Figure 5-25 shows the variance difference between the groups for the findings supported by both correlation analysis and analysis of variance at a capability level for Risk Management capability. Similar figures were observed for BP, SD, SP, RAM capabilities.



Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies with scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

Figure 5-25: Risk Management capability maturity and Digital BV Achievement

A summary of the results is included in Table 5-4.

Table 5-4: Summary of Results for [H6]: Digital Business Value by IT Capability Maturity

Relationship between Digital Business Value and IT Cap.	**Correlation Analysis**	**Analysis of Variance.** Groups: L/M/H IT Capability Mat
IT Capability Maturity (10 CC)	Moderate	"Low" and "High" IT capability maturity groups show different Digital BV Achievement level. Higher IT capability maturity group shows a higher achievement of Digital Business Value.
RM - Risk Management	Strong	
BP - Business Planning	Moderate	
SD - Solutions Delivery	Moderate	
SP - Strategic Planning	Moderate	
BPM - Business Process Mgmt.	Weak	
FF - Funding and Financial	Weak	
RAM - Relationship Asset Management		Low" and "High" IT capability maturity groups show different Digital BV Achievement level. Higher IT capability maturity group shows a higher achievement of Digital Business Value.
SRC - Sourcing		
SRP - Service Provisioning		
UED - User Experience Design		

The results for hypothesis [H6] indicate that the level of IT Capability Maturity (measured by SME IT-CMF) is related to the level of achievement of business objectives using Digital technologies (Digital Business Value). These initial findings are not unexpected considering that existing study noted that organizations that manage their IT capabilities better have better performance (Mithas et al., 2011) and also considering how the Innovation Value Institute defines IT-CMF: enabler for organizations to identify and develop the IT capabilities needed to deliver agility, innovation and value for the organization (Curley et al., 2016).

The results at IT capability level provide further insights. The results suggest that only a set of particular IT capabilities such as Risk Management (RM), Business Planning (BP), Solutions Delivery (SD), Strategic Planning (SP) are indeed directly related with the achievement of Business Value using Digital technologies.

The association of these particular IT capabilities with Business Value from Digital technologies could emphasize the importance for SMEs to develop the ability to translate their vision into actionable strategic plan for IT (SP, BP), to design and deliver solutions (SD) while being able to handle risks of IT or Digital technologies (RM).

Other IT capabilities like Relationship Asset Management (RAM), Service Provisioning (SRP), Sourcing (SRC) and User Experience Design (UED) were not found directly related to Business Value with Digital technologies. Finally, mixed results were identified for Business Process Management (BPM) and Financial and Funding (FF) capabilities. This may indicate that although these capabilities could be important for traditional IT, they may not be significant influencers in the Digital Age.

5.5.2 Hypothesis results

Figure 5-26 show the results for this hypothesis.

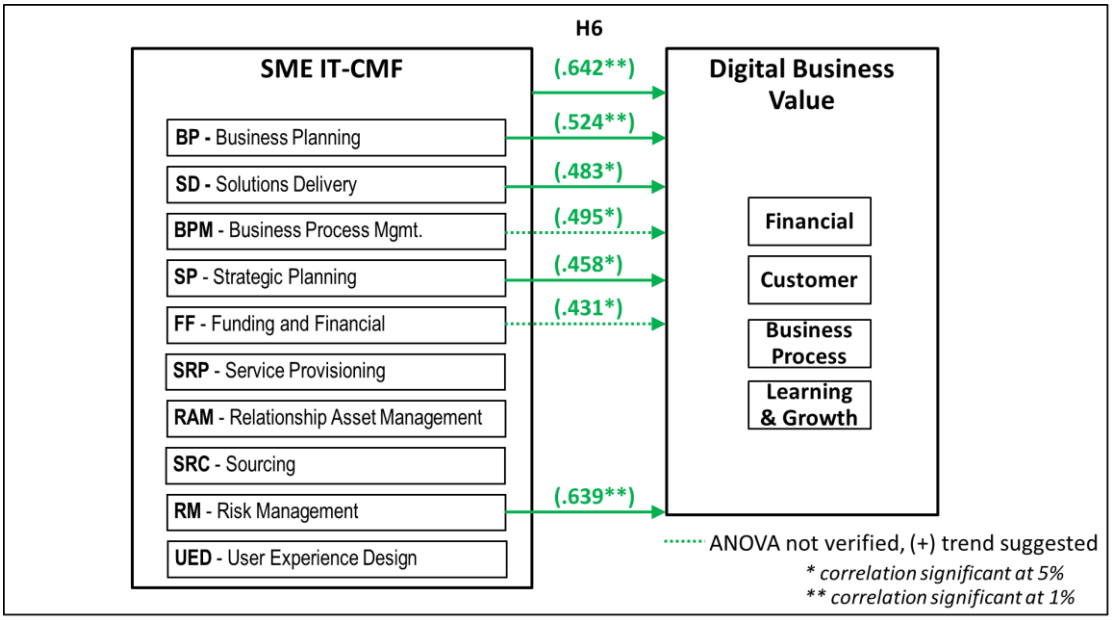


Figure 5-26: [H6] Results: Technological Capability Perspective (SME IT-CMF) and Digital Business Value

5.5.3 Discussion and Interpretation of Quantitative results

The analysis for the ten IT capabilities from SME IT-CMF confirmed that only seven IT capabilities were actually directly linked with Digital Business Value. A strong relevance of Risk Management (RM), moderate relevance of Solutions Delivery (SD), Business Planning (BP), Strategic Planning (SP) and with lower but still relevant contribution of the capabilities of Business Process Management (BPM) and Funding & Financial (FF) for the achievement of Digital Business Value.

The strong relation observed on Risk Management (RM) emphasizes the importance of the ability to assess, prioritize, handle and monitor the exposure and potential impact of IT (or Digital) related risks as a key factor for achieving value from Digital Technologies.

The moderate relation observed for Strategic Planning (SP), Business Planning (BP) and Solutions Delivery (SD), indicates that SMEs that obtain better Digital Business Value performance have the following characteristics: the ability to formulate a long-term vision and translate it into actionable strategic plan for the IT function, the ability to link the defined IT strategy with the operational delivery, ensuring that necessary financial and other resources are allocated and, the capability to design and deploy solutions that fulfils business requirements and opportunities.

The weak relation identified with Relationship Asset Management (RAM), Business Process Management (BPM) and Funding & Financial (FF) capabilities suggest that SMEs achieving Digital Business Value are also supported -at least in a minimal way- by: the ability to analyze, plan and enhance relationship between IT function and the rest of the business; the capability to design, monitor and optimize the execution of both existing and new organizational processes and; the ability to determine and allocate the funding level for the IT function.

For the remaining IT capabilities: Relationship Asset Management (RAM), Sourcing (SRC), Service Provisioning (SRP) and User Experience Design (UED); there was no empirical evidence supporting their direct relation with the achievement of Digital Business Value. This suggests that the ability to evaluate and manage IT suppliers, the ability to manage the life cycle of IT services; or the ability to consider the needs of users at all stages in the life cycle of IT solutions had a minor relevance at the time of achieving business objectives by Digital Technologies.

It is worth to mention that the ideal state for the capability maturity of IT capabilities is not to achieve full maturity for all the 10 IT capabilities. Each organization usually should identify the target state based on the importance and maturity gap between AS-IS maturity and TO-BE maturity in order to prioritize any improvement initiative.

Chapter Six: Results of the combined effect of the perspectives

This chapter describes the analysis and results of the combined effect between the perspectives and Digital Business Value.

6.1 The combined effect of Knowledge Creation and Strategic Decision Making perspectives

6.1.1 Hypothesis testing

[H7a] KCC leverages the effect of Strategic Decision Making (OIQ) on Digital Business Value

Linear Regression was done to validate the isolated effects on Digital Business Value first by Strategic Decision Making (OIQ), and later on to explore the isolated effects of Knowledge Creation. Finally, the combination of both using General Linear Model analysis was done. The results indicated a minor modifier effect of Knowledge Creation. The models are described below and results are included in Table 6-1.

$$DI\_BV = \alpha + \beta \times OIQ + (\text{controls: industry, years of operation}) \quad (1)$$

$$DI\_BV = \alpha + \beta \times KCC + (\text{controls: industry, years of operation}) \quad (2)$$

$$DI\_BV = \alpha + \beta \times OIQ + \gamma \times KCC + \delta \times (OIQ \times KCC) + (\text{controls: industry, years of operation}) \quad (3)$$

The controls for industry and years of operation are conducted as follows.

- Industry.- the two groups for the industry are represented in the model with a dummy coding for the Industries with high use of advanced technologies “Industry_AdvTech_High”, the point of reference are industries in the low use of advanced technologies (refer to section 4.2.3).
- Years of operation.- based on the number of years of operation of the organizations, the SMEs were classified into three groups: recent, middle and old SMEs (refer to section 4.2.3). The groups were coded using dummy variables and are represented by two variables in the model: “Years_of_Operation_Recent” and “Years_of_Operation_Middle”. The dummy coding used for Years_of_Operation_Recent is recent:1, middle: 0, old: 0), while the coding for Years_of_Operation_Middle is recent:1, middle: 1, old: 0. Hence, the coefficients reported in the regression tables for Years_of_Operation_Recent represents the difference between recent (new) organizations versus middle and old organizations. The coefficients reported for Years_of_Operation_Middle represent the difference between recent (new) and middle organizations versus old organizations.

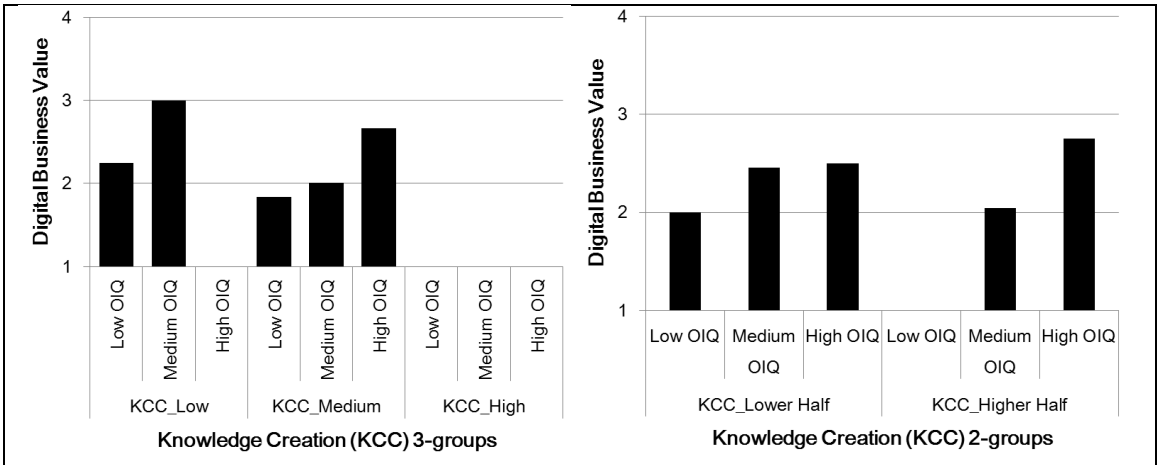
Table 6-1: Regression and GLM Results for Digital Business Value

Model	(1)	(2)	(3)
Constant	**2.500*** (.269)**	**2.549*** (.310)**	**2.404*** (.326)**
Strategic Decision Making (OIQ)	**0.119*** (.040)**		**0.103* (.053)**
Knowledge Creation (KCC)		-0.139 (.150)	-0.120 (.149)
Strategic Decision Making (OIQ) x Knowledge Creation (KCC)			0.063 (.061)
Industry_AdvTech_High	0.302 (.263)	0.201 (.303)	0.348 (.247)
Years_of_Operation_Recent	0.126 (.277)	0.135 (.322)	0.071 (.302)
Years_of_Operation_Middle	**-0.494* (.269)**	-0.514 (.310)	-0.386 (.257)
R^2	.401	.204	.483
Adj. R^2	.297	.065	.335
No. observations	28	28	28

OIQ = Organizational Intelligence Quotient
KCC = Knowledge Creating Capability (KCC)

- Standard errors are reported in parenthesis.
- *, **, *** indicates significant at 10%, 5%, and 1% respectively.
- Predictors: Strategic Decision Making (OIQ) used standardized scores. Knowledge Creation (KCC) was centered at its mean.

Models (1) and (2) in Table 6-1 present the isolated effect of Strategic Decision Making (OIQ) and Knowledge Creation (KCC) on Digital Business Value. Model (3) shows their combined effect. The Adjusted R^2 in Model (3) actually increased from Model (1) and Model (2) hence it suggests that the combined model is a better predictor for Digital Business Value. The results from the GLM supporting Model (3) can be appreciated in Figure 6-1 and Figure 6-2.



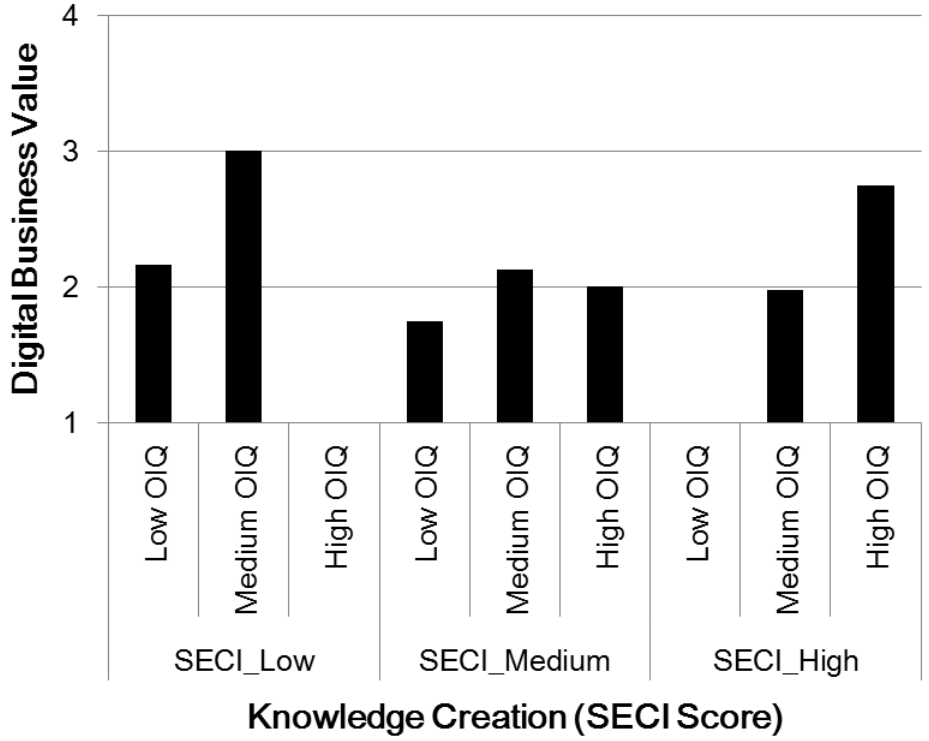
(a) (b)

Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies, scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

Figure 6-1: Combined effects of Knowledge Creation (KCC) and Strategic Decision Making (Organizational IQ) on Digital Business Value

The charts (a) and (b) in Figure 6-1 indicate that the variable that accounts for Digital Business Value is Organizational IQ and the level of Knowledge Creation capabilities does not have a major influence and, could actually account for a decrease on the Digital Business Value.

The view at the aggregated SECI score shows similar results (Figure 6-2).



Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies. Scale: Not Achieved (1), Partially (2), Highly (3) and Fully Achieved (4).

Figure 6-2: Combined effects of Knowledge Creation (SECI Score) and Strategic Decision Making (Organizational IQ) on Digital Business Value

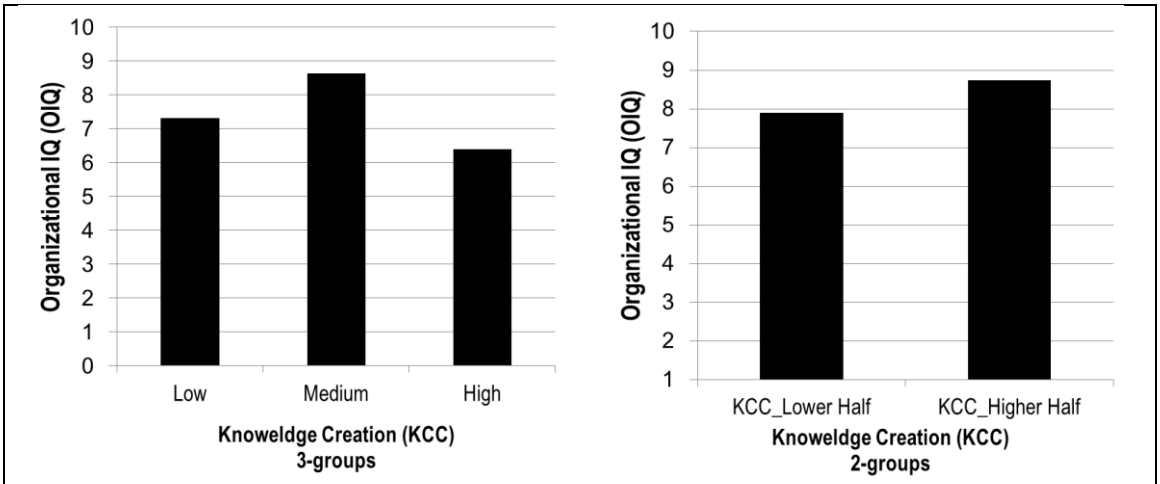
[H7b] KCC has a positive effect on Strategic Decision Making (OIQ)

The effect of Knowledge Creation Perspective (Knowledge Creating Capabilities) on Strategic Decision Making (Organizational IQ) was tested at a high level. The correlation analysis identified a weak relationship ($r_s(31) = .380$, $p = .029$). In addition a moderate relationship between the score of SECI process with Organizational IQ was found ($r_s(31) = .465$, $p = .005$).

The differences according to Knowledge Creating Capabilities level are presented below followed by component analysis between the four Knowledge Creation Processes from SECI Model and the dimensions of Organizational IQ.

Differences in Strategic Decision Making (OIQ) according to the level of Knowledge Creating Capabilities

It was verified by ANOVA ($F(2, 30) = 6.003$, $p = .006$) that SMEs with higher levels of Knowledge Creating Capabilities demonstrated higher levels of Organizational IQ than their peers with lower Knowledge Creating Capabilities. The analysis was done with group categorization of "Low / Medium / High" for Balanced SECI (KCC) and SECI aggregated score. As the previous category only had one organization considered as High KCC, the categorization for Balanced SECI (KCC) was also extended onto "Lower Balanced KCC" and "Higher Balanced KCC" groups. The results were similar confirming the relationship of KCC with Organizational IQ. The difference between the groups is presented in Figure 6-3 (a) and (b) charts.



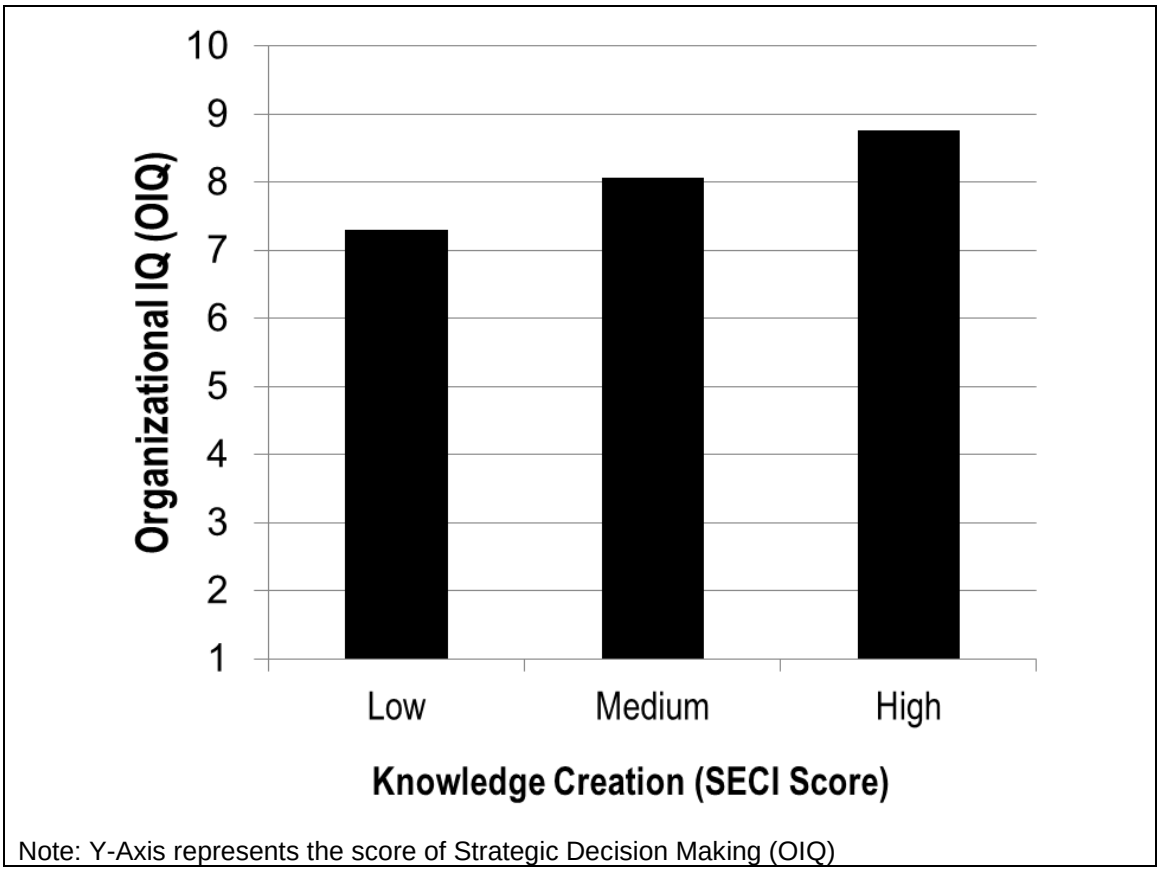
Note: Y-Axis represents the score of Strategic Decision Making (OIQ)

Figure 6-3: Knowledge Creation (KCC) and Strategic Decision Making (Organizational IQ)

The charts (a) and (b) in Figure 6-3 show first that SMEs with lower levels of Knowledge Creation tend to have lower Organizational IQ scores (chart (a): Low vs. Medium groups, chart (b): Low vs. High groups). Figure (a) would suggest in addition that a higher focus of a balanced knowledge creation processes (chart (a): Medium vs. High groups) would actually have a negative impact on Organizational IQ.

However, a deep observation of the categories confirmed that the High Balanced Knowledge Creating group only had one organization. Chart (b) is a representation of the same data but with a different grouping pattern. In this case, the organizations were classified either in low or high- groups to allow a reasonable comparison. Here the findings confirmed that Knowledge Creation Capabilities have a positive effect on Organizational IQ.

Moreover, the analysis of the aggregated SECI score yielded similar results. Analysis of variance confirmed the difference between the groups ($F(2,30) = 5.494$, $p = .009$), which is shown in Figure 6-4.



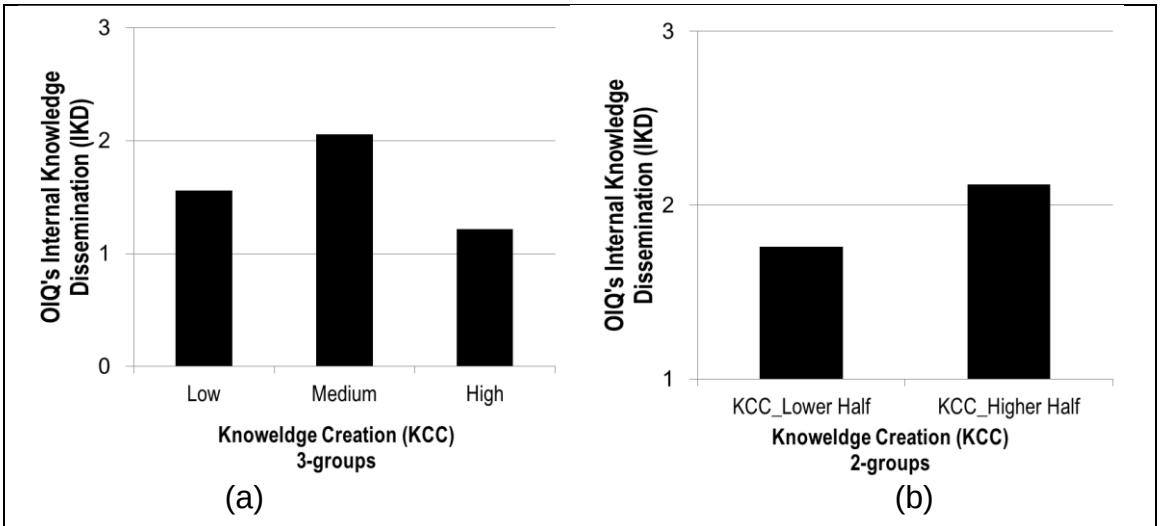
Note: Y-Axis represents the score of Strategic Decision Making (OIQ)

Figure 6-4: Knowledge Creation Capabilities (SECI Score) and Strategic Decision Making (Organizational IQ)

The effect of Knowledge Creating Capabilities also observed in detail for each of the dimensions in Organizational IQ (Spearman results are reported).

- A weak relationship between KCC and Internal Knowledge Dissemination (IKD) ($rs(30) = .477$, $p = .010$).
- A "weak to moderate" relationship between SECI's Internalization and Organizational IQ ($rs(31) = .363$, $p = .038$).

Analysis of variance tests confirmed the results for KCC - IKD ($F(2, 29) = 5.1615$, $p = .012$). The analysis of differences between the groups of SECI's Internalization (Low, Medium and High) and Organizational IQ was not confirmed. The difference between the groups for KCC - IKD is presented in Figure 6-5 (a) and (b) charts.



Note: Y-Axis represents the score of Internal Knowledge Dissemination (IKD)

Figure 6-5: Strategic Decision Making (Organizational IQ) and Business Process Management Capability (SME IT-CMF: BPM)

A summary of the results for hypothesis [H7b] is included in Table 6-2.

Table 6-2: Summary of Results for [H7b]: Knowledge Creation (KCC) and Strategic Decision Making (OIQ)

Relationship between KCC and OIQ		**Corr. Analysis**	**Analysis of Variance.** Groups: L/M/H OIQ
Analysis at the overall level of KCC			
KCC (min. of 4 processes)	· Organization IQ	Weak	"Low" and "High" KCC groups show different Organizational IQ score. Higher KCC show high OIQ score
	· Internal Knowledge Dissemination	Weak	
SECI (aggregate value of 4 SECI processes)	· Organization IQ	Moderate	"Low" and "High" SECI groups show different Organizational IQ score. Higher SECI show high OIQ score
Analysis at SECI's process level			
SECI's Internalization	· Organizational IQ	Weak to Moderate	none

Only relationships validated by both correlation analysis and analysis of variance are highlighted in the overall framework.

6.1.2 Hypothesis results

Figure 6-6 shows the results for these two hypotheses.

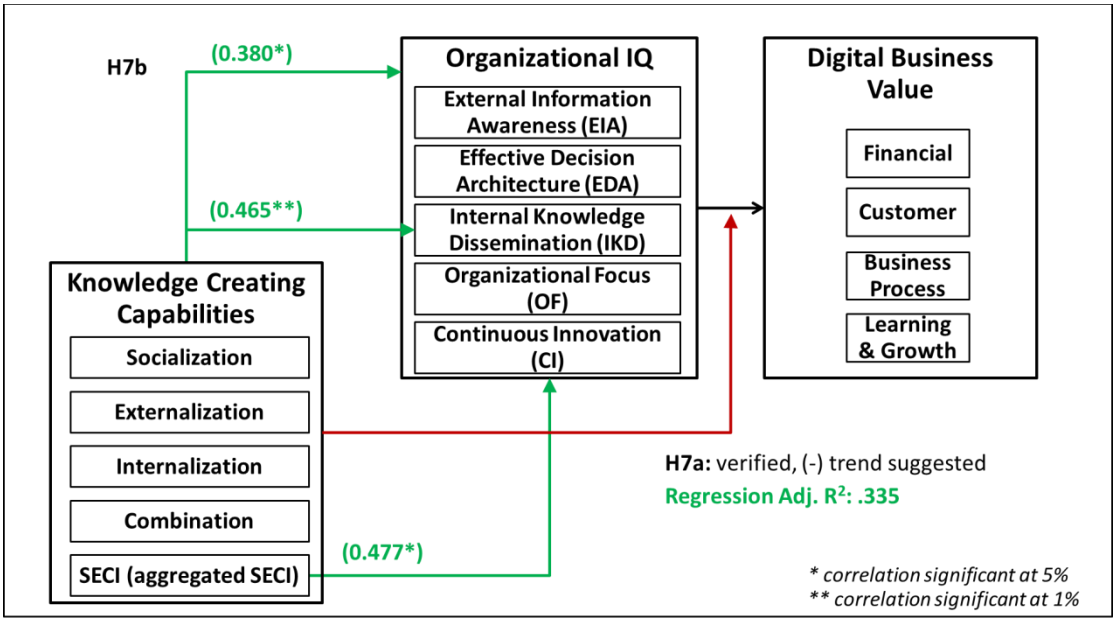


Figure 6-6: [H7a, H7b] Results: Combined effect of Knowledge Creation perspective and Strategic Decision Making (OIQ)

6.1.3 Discussion and Interpretation of Quantitative results

Hypothesis [H7a] was verified and suggests that Knowledge Creation (KCC) is a minor moderating factor (negative) on the relationship between Strategic Decision Making (Organizational IQ) and Digital Business Value. Although knowledge creation routines could actually generate new organizational knowledge that results in digital-based services and products, the relationship with Digital Business Value seems not to be direct. Hypothesis [H7b] explored a possible indirect relationship of KCC with Digital Business Value through a direct relationship with Strategic Decision Making (Organizational IQ).

The results from hypothesis [H7b] confirmed an overall relationship between Knowledge Creation (KCC) and Strategic Decision Making (Organizational IQ) perspectives. Hence it first suggests that SMEs with a balanced knowledge conversion cycle (balance between the four SECI model processes) will have higher OIQ level. The relationship was “weak to moderate” thus it can be expected that a balanced knowledge process is not sufficient to ensure the organizations are able to efficiently assimilate external and internal information and use them in order to take effective decisions (OIQ). Since the results are also supported when considering the aggregated value for all the SECI processes, this suggests that the balance itself may not be a critical factor but instead the behaviors that facilitate knowledge creation are important.

The analysis at a component level showed that the KCC has a direct influence on the OIQ's Internal Knowledge Dissemination. Contrary to the expected, there was no direct relationship confirmed with the other OIQ's dimensions. In particular, External Information Awareness and Continuous Innovation are two OIQ's dimensions where a direct relationship with KCC or routines with knowledge creation could have been expected.

6.2 The combined effect of Knowledge Creation and Technological Capability perspectives

6.2.1 Hypothesis testing

[H8a] KCC leverages the effect of Technological Capability perspective (SME IT-CMF) on Digital Business Value

Linear Regression was done to validate the isolated effects on Digital Business Value first by Technological Capability perspective (SME IT-CMF), and later on by Knowledge Creation. Finally, the combination of both using General Linear Model analysis was done. Similarly to Hypothesis H7a, the results indicated a minor modified effect of Knowledge Creation. The models are described below and results are included in Table 6-3.

$$DI\_BV = \alpha + \beta \times IT\_Cap\_Maturity + (\text{controls: industry, years of operation}) \quad (1)$$

$$DI\_BV = \alpha + \beta \times KCC + (\text{controls: industry, years of operation}) \quad (2)$$

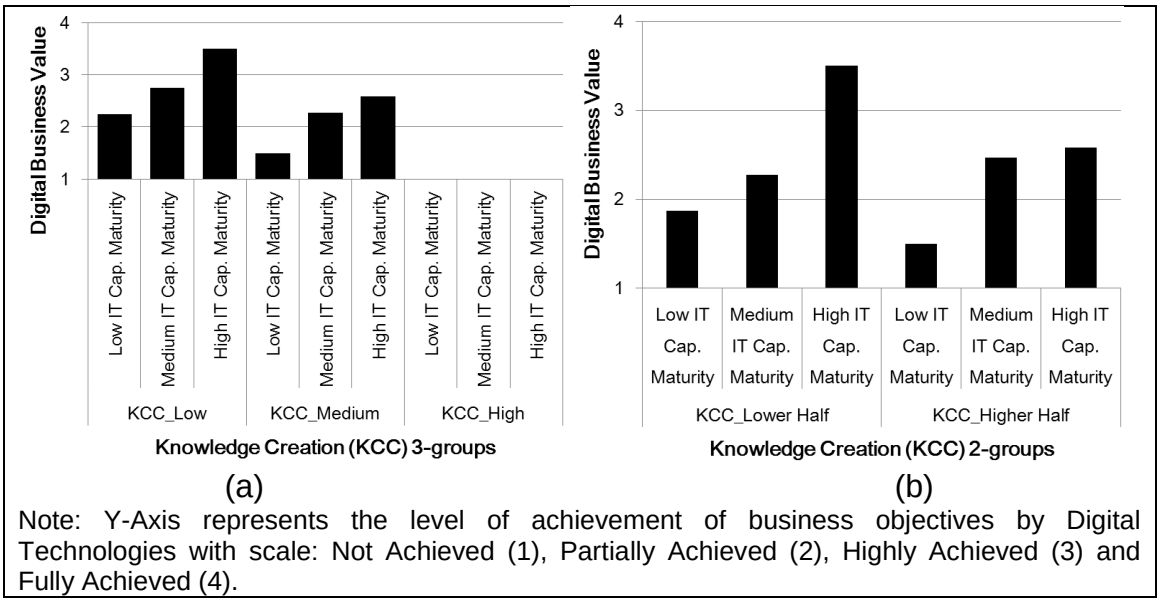
$$DI\_BV = \alpha + \beta \times IT\_Cap\_Maturity + \gamma \times KCC + \delta \times (IT\_Cap\_Maturity \times KCC) + (\text{controls: industry, years of operation}) \quad (3)$$

Similarly to [H7a] in Section 6.1, the analysis included controls for industry and years of operation.

Table 6-3: Regression and GLM Results for Digital Business Value

Model	**(1)**	**(2)**	**(3)**
Constant	**2.316*** (.258)**	**2.549*** (.310)**	**2.339*** (.312)**
IT Cap_Maturity (SME IT-CMF)	**0.639*** (.172)**		**0.666*** (.207)**
Knowledge Creation (KCC)		-0.139 (.150)	-0.043 (.140)
IT Cap_Maturity (SME IT-CMF) x Knowledge Creation (KCC)			0.197 (.163)
Industry_AdvTech_High	0.416 (.249)	0.201 (.303)	0.403 (.237)
Years_of_Operation_Recent	-0.006 (.259)	0.135 (.322)	-0.165 (.291)
Years_of_Operation_Middle	-0.243 (.261)	-0.514 (.310)	-0.130 (.263)
R^2	.483	.204	.527
Adj. R^2	.393	.065	.392
No. observations	28	28	28
SME IT-CMF = Small Medium Enterprise IT-Capability Maturity Framework; KCC = Knowledge Creating Capability (KCC)			
- Standard errors are reported in parenthesis. - *, **, *** indicates significant at 10%, 5%, and 1% respectively. - Predictors: IT Capability Maturity (SME IT-CMF) and Knowledge Creation (KCC) were centered at their mean.			

Models (1) and (2) in Table 6-3 present the isolated effect of Technological Capability perspective (SME IT-CMF) and Knowledge Creation (KCC) on Digital Business Value. Model (3) shows their combined effect. The Adjusted R^2 in Model (3) did not improve compared to Model (1) and Model (2) hence the hypothesis cannot be verified. The negative coefficient for Knowledge Creation rather suggests that the influence is negative. The results from GLM supporting Model (3) are however not visible in Figure 6-7 and Figure 6-8.

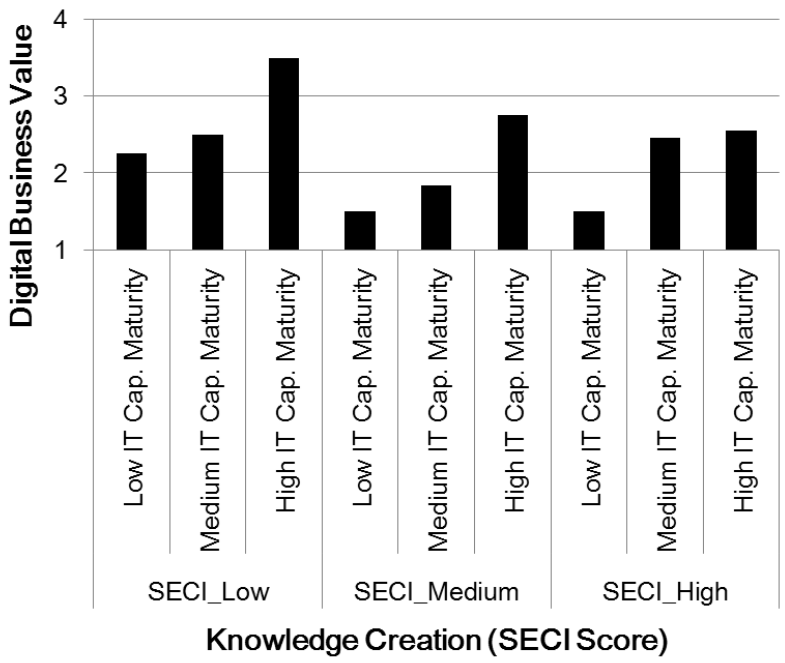


Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies with scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

Figure 6-7: Combined effects of Knowledge Creation (KCC) and Technological Capability perspective (SME IT-CMF) on Digital Business Value

The charts (a) and (b) in Figure 6-7 show that the variable that accounts for Digital Business Value is IT Capability Maturity (SME IT-CMF). The level of Knowledge Creation capabilities actually shows a negative influence.

The view at the aggregated SECI score shows similar results (Figure 6-8).



Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies with scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

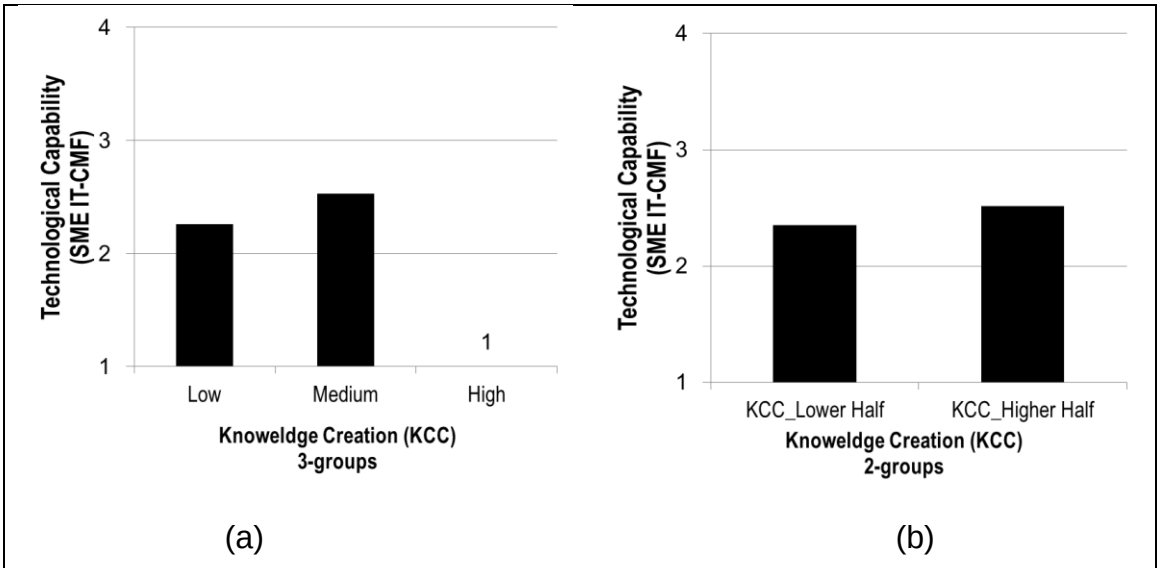
Figure 6-8: Combined effects of Knowledge Creation (SECI Score) and Technological Capability perspective (SME IT-CMF) on Digital Business Value

[H8b] KCC has a positive effect on Technological Capability perspective (SME IT-CMF)

The effect of Knowledge Creation Perspective (Knowledge Creating Capabilities) on Technological Capability perspective (SME IT-CMF) was tested at a high level first with correlation analysis (non-parametric: Spearman). No relationship was identified between KCC and the IT capability maturity score (SME IT-CMF) of the organizations.

Differences in Technological Capability perspective (SME IT-CMF) according to the level of Knowledge Creating Capabilities

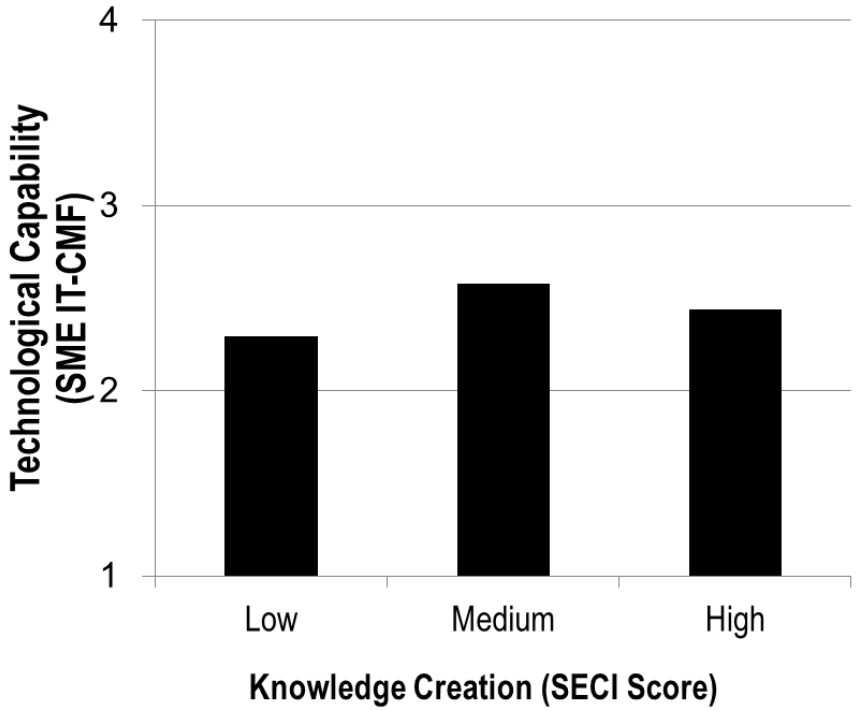
It was not confirmed that SMEs with higher levels of Knowledge Creating Capabilities demonstrated higher levels of Technological Capability perspective (i.e. higher IT capability maturity) than their peers with lower Knowledge Creating Capabilities. Similarly to hypothesis [H7b], the analysis was done with group categorization of "Low / Medium / High" for Balanced SECI (KCC) and SECI aggregated score; and also onto "Lower Balanced KCC" and "Higher Balanced KCC" groups. No difference was confirmed between the groups. The mean for each group is presented in Figure 6-9 (a) and (b) charts and Figure 6-10 as reference only.



Note: Y-Axis represents the score of IT capability maturity of the 10 IT critical capabilities from Technological Capability perspective (SME IT-CMF).

Figure 6-9: Knowledge Creation (KCC) and Technological Capability perspective (SME IT-CMF): not verified statistically

The charts (a) and (b) in Figure 5-35 show a potential positive trend but was not verified statistically.

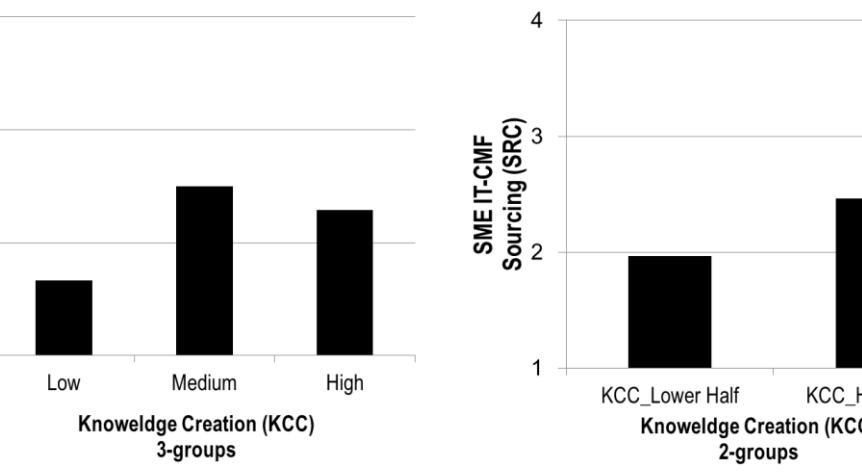


Note: Y-Axis represents the score of IT capability maturity of the 10 IT critical capabilities from Technological Capability perspective (SME IT-CMF).

Figure 6-10: Knowledge Creation Capabilities (SECI Score) and Technological Capability perspective (SME IT-CMF): not verified statistically

The exploration on a component level suggested a weak ($r_s(28) = .370$, $p = .044$) relationship between the Knowledge Creation Capabilities and one IT Capability: Sourcing (SRC). This was verified also when comparing the group means using non-parametric tests (Kruskal-Wallis).

The difference between the groups is presented in Figure 6-11 (a) and (b) charts.



Note: Y-Axis represents the capability maturity score of Sourcing (SRC) critical capability. The scale is: 1 – Disagree, 2 - Partially Agree, 3 – Strongly Agree and 4 - Fully Agree to maturity statements.

Figure 6-11: Knowledge Creation Capabilities (KCC) and Technological Capability perspective (SME IT-CMF): verified statistically

A summary of the results for hypothesis [H8b] is included in Table 6-4.

Table 6-4: Summary of Results for [H8b]: Knowledge Creation (KCC) and Technological Capability perspective (SME IT-CMF)

Relationship between KCC and Technological capability perspective		**Corr. Analysis**	**Analysis of Variance.** Groups: L/M/H KCC
Analysis at the overall level of KCC			
KCC (min. of 4 processes)	· Sourcing (SRC)	Weak	Confirmed

6.2.2 Hypothesis results

Figure 6-12 shows the results for these hypotheses.

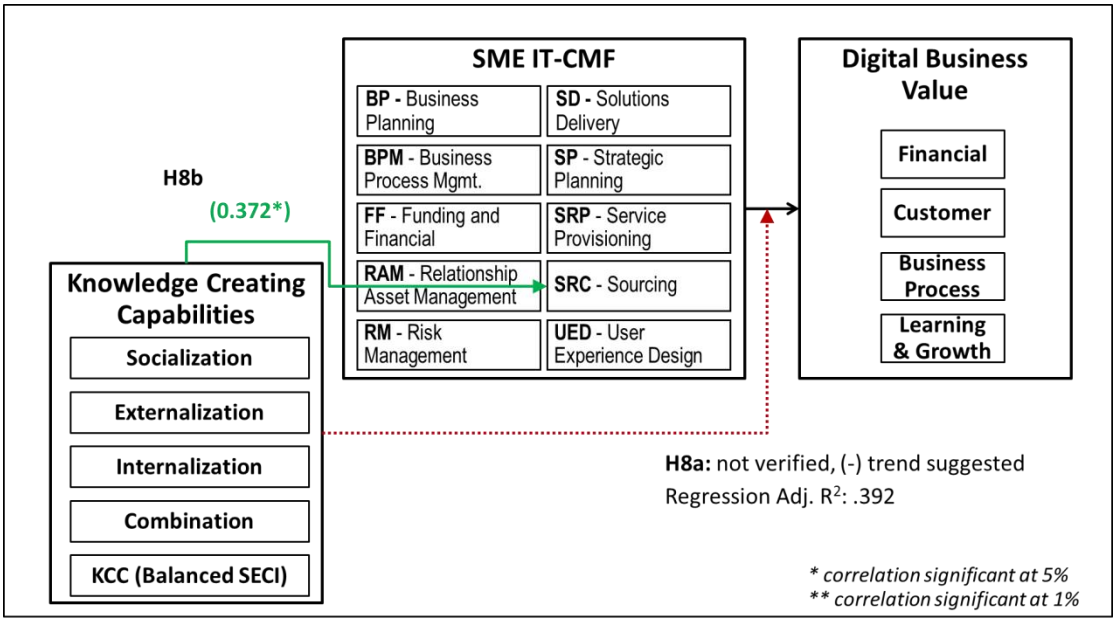


Figure 6-12: [H8a, H8b] Results: Combined effect of Knowledge Creation perspective and Technological Capability perspective (SME IT-CMF)

6.2.3 Discussion and Interpretation of Quantitative results

Hypothesis [H8a] wasn't verified statistically. The combined effect could not be observed in the graphs either. This suggests that Knowledge Creation (KCC) is not a major leveraging factor on the relationship between Technological Capability perspective (IT Capability Maturity: SME IT-CMF) and Digital Business Value. The minor but negative trend showed by the role of KCC in the Technological Capability perspective / Digital Business Value relationship would suggest that a high focus on Knowledge Creation routines and processes would actually decrease the Digital Business Value achieved even when Technological Capability perspective increases. This requires further attention at a granular level, as it was demonstrated in hypothesis [H2] that the differentiation of objective categories (such as Financial, Customer,

Business Process and Learning & Growth) makes a difference when addressing the impact of Knowledge Creation with Digital Business Value.

[H8b] explored the relationship between KCC and Technological Capability perspective (SME IT-CMF). The results from hypothesis [H8b] did not identify a direct relationship between the Knowledge Creation perspective (KCC) and the Technological Capability perspective (SME IT-CMF) perspective. This suggests that the focus that organizations have on knowledge creation is not directly related to the maturity of IT Capabilities at an overall level.

The results of the analysis of specific IT capabilities showed an exception for one capability: Sourcing (SRC). Sourcing represents the ability to evaluate, select, and integrate IT service providers according to a defined strategy and sourcing model. The identified relationship could reflect the need that the efficient integration of providers (either if the sourcing in question relates to human resources, applications or infrastructure) can be leveraged by knowledge creation processes. The right knowledge integration is not only needed when a provider starts the collaboration but also relevant for example for provider improvement. Since the relationship found for Sourcing was with KCC and not with the aggregated score of the four SECI processes; the findings emphasize the balance between the four knowledge creation conversion processes in the SECI model.

It is worth to note the lack of relationship between KCC and the other nine IT critical capabilities. This could be considered unexpected as for example Risk Management IT critical capability could actually benefit from knowledge conversion routines and practices in the SECI model processes.

6.3 The combined effect of Strategic Decision Making and Technological Capability perspectives

6.3.1 Hypothesis testing

[H9a] Strategic Decision Making (OIQ) leverages the effect of Technological Capability perspective (SME IT-CMF) on Digital Business Value

Linear Regression was done to validate the isolated effects on Digital Business Value first by IT Capability Maturity (SME IT-CMF) and later by Organizational IQ. Finally, the combination of both using General Linear Model analysis was done. The results indicated a positive relationship in each of the cases but with greater impact when both IT Capability Maturity and OIQ were part of the model as described in Table 6-5.

$$DI\_BV = \alpha + \beta \times IT\_Cap\_Maturity + (\text{controls: industry, years of operation}) \quad (1)$$

$$DI\_BV = \alpha + \beta \times OIQ + (\text{controls: industry, years of operation}) \quad (2)$$

$$DI\_BV = \alpha + \beta \times IT\_Cap\_Maturity + \gamma \times OIQ + \delta \times (IT\_Cap\_Maturity \times OIQ) + (\text{controls: industry, years of operation}) \quad (3)$$

Similarly to [H7a] in Section 6.1, the analysis included controls for industry and years of operation.

Table 6-5: Regression and GLM Results for Digital Business Value

Model	(1)	(2)	(3)
Constant	**2.316*** (.258)**	**2.500*** (.269)**	**2.386*** (.289)**
IT Cap_Maturity (SME IT-CMF)	**0.639*** (.172)**		**0.538** (.210)**
Organizational Capability (OIQ)		**0.119*** (.040)**	**0.081* (.042)**
IT Cap_Maturity (SME IT-CMF) X Organizational Capability (OIQ)			-0.053 (.059)
Industry_AdvTech_High	0.416 (.249)	0.302 (.263)	**0.437* (-.222)**
Years_of_Operation_Recent	-0.006 (.259)	0.126 (.277)	-0.127 (-.261)
Years_of_Operation_Middle	-0.243 (.261)	**-0.494* (.269)**	-0.148 (-.251)
R^2	.483	.401	.578
Adj. R^2	.393	.297	.458
No. observations	28	28	28

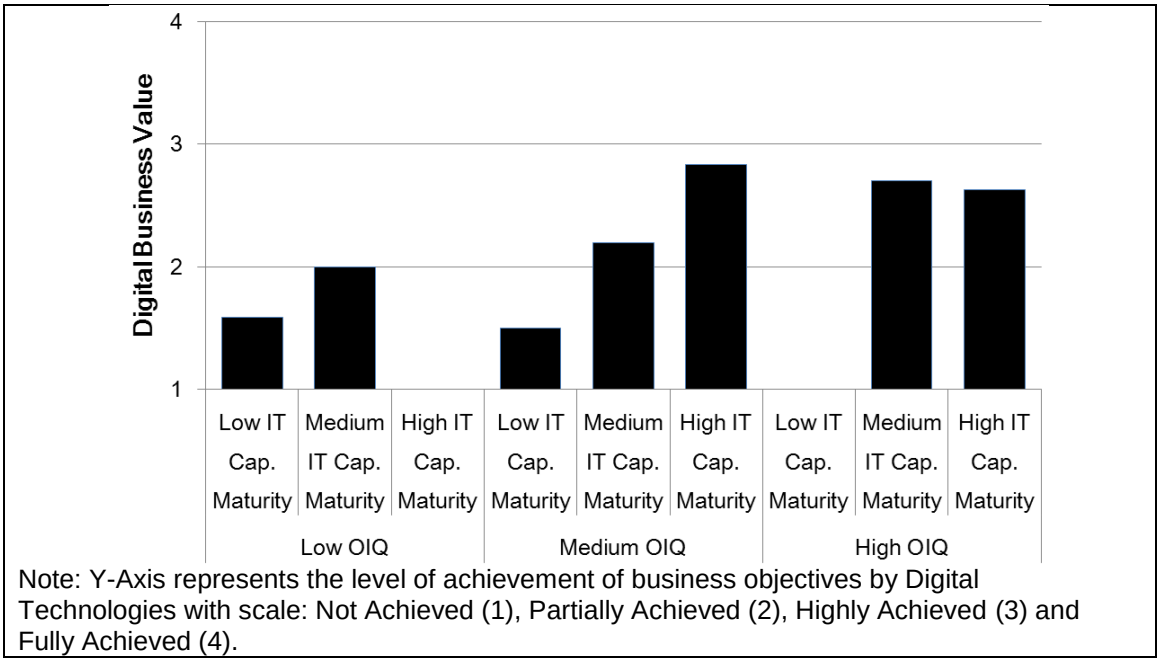
SME IT-CMF = Small Medium Enterprise IT-Capability Maturity Framework;
OIQ = Organizational Intelligence Quotient

- Standard errors are reported in parenthesis.
- *, **, *** indicates significant at 10%, 5%, and 1% respectively.
- Predictors: IT Capability Maturity (SME IT-CMF) was centered at its mean. Strategic Decision Making (OIQ) used standardized scores.

Models (1) and (2) in Table 6-5 present the isolated effect of SME IT-CMF and OIQ on Digital Business Value. Model (3) shows the combined model and it can be observed that Adjusted R^2 increased, although the coefficient was not significant. This confirms the aggregated effect of both Organizational and IT capabilities for the achievement of Digital Business Value.
Multicollinearity tests indicated there was no collinearity (VIF=1.121) between the dependent variables: IT Capability (SME IT-CMF) and Organizational Capability (OIQ). The minimal but negative coefficient for the combined effects in Model C suggested a small impact on the Digital Business Value. This motivated to further explore the effect of IT Capability Maturity and OIQ on Digital Business Value. A positive trend from the relationship of IT Capability Maturity and OIQ as can be observed in Figure 6-13.

It can be observed in Figure 6-13 that SMEs with Low Organizational Capabilities (Low OIQ scores) had lower achievement levels of Digital Business Value than their peers with Medium and High Organizational Capabilities (medium or high OIQ scores). The effect of higher IT Capabilities (Higher IT capability maturity as of SME IT-CMF) can be also seen as an enabler of Digital Business Value. As the level of IT capability increased, the level of achievement of Digital Business Value also increased. This was observed in particular for SMEs with Medium OIQ; where the actual achievement was between partially and highly achieved levels (scale 2 and 3 from Figure 5-39). The group of SMEs with High Organizational Capabilities (high OIQ) showed a small decrease between Medium and High IT Capability Maturity but still kept a similar achievement level between partially and highly achieved.

Statistically significant differences were found in the group of Medium OIQ between SMEs with Low and High IT Capabilities.



Note: Y-Axis represents the level of achievement of business objectives by Digital Technologies with scale: Not Achieved (1), Partially Achieved (2), Highly Achieved (3) and Fully Achieved (4).

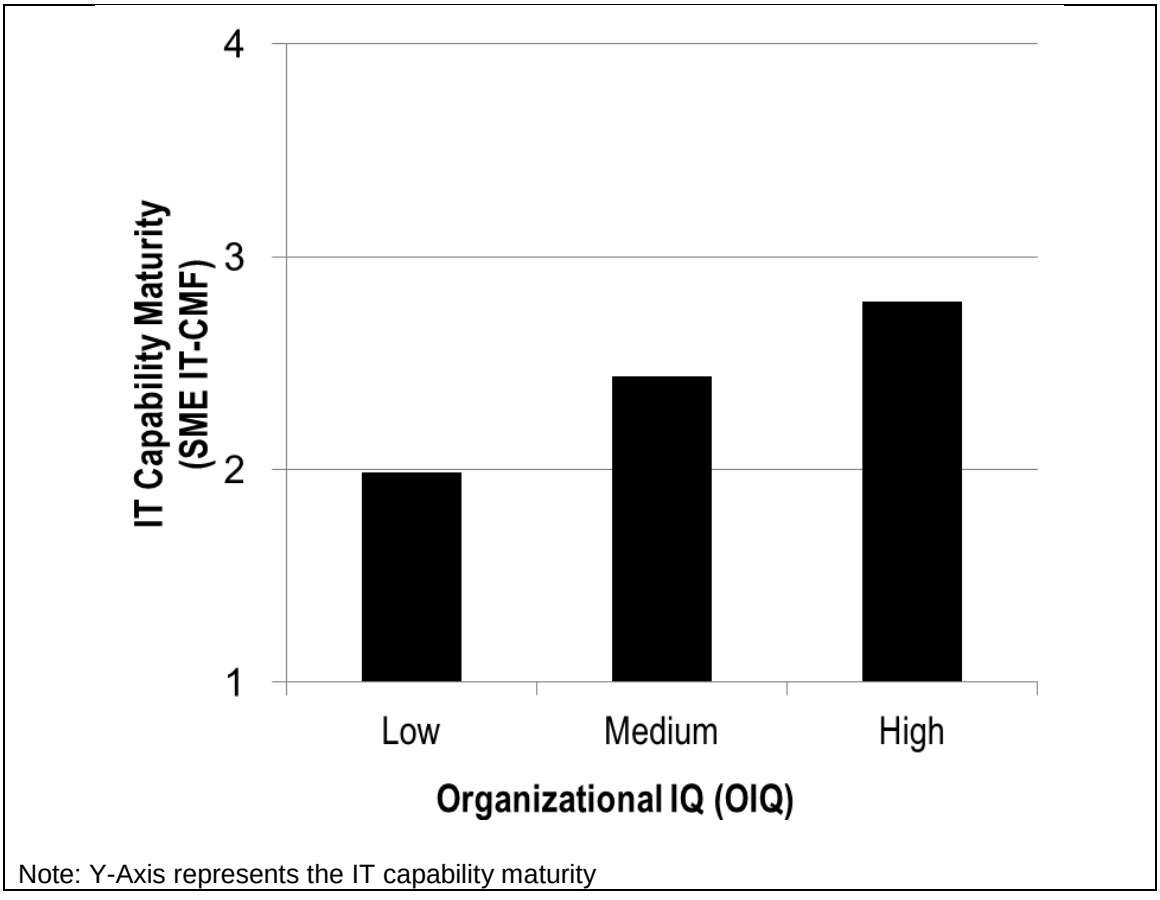
Figure 6-13: Combined effects of Strategic Decision Making (Organizational IQ) and Technological Capability perspective (SME IT-CMF) on Digital Business Value

[H9b] Strategic Decision Making (OIQ) has a positive effect on Technological Capability perspective (SME IT-CMF)

The relationship was tested first on an overall level (non-parametric: Spearman) and did not confirm a direct relationship between the score of Organizational IQ and the score of IT capability maturity (SME IT-CMF).
The differences according to OIQ level is presented below followed by a component analysis between the five dimensions of OIQ and the 10 critical capabilities from SME IT-CMF. Such component analysis yielded positive results.

Differences in Technological Capability perspective (SME IT-CMF) according to the level of Organizational IQ

A positive trend between the levels of Organizational IQ and the level of Technological Capability perspective was observed. SMEs with high OIQ score demonstrated higher levels of IT capability maturity than their peers with lower OIQ scores. The difference between the groups is presented in Figure 6-14.



Note: Y-Axis represents the IT capability maturity

Figure 6-14: Strategic Decision Making (Organizational IQ) and Technological Capability perspective (SME IT-CMF)

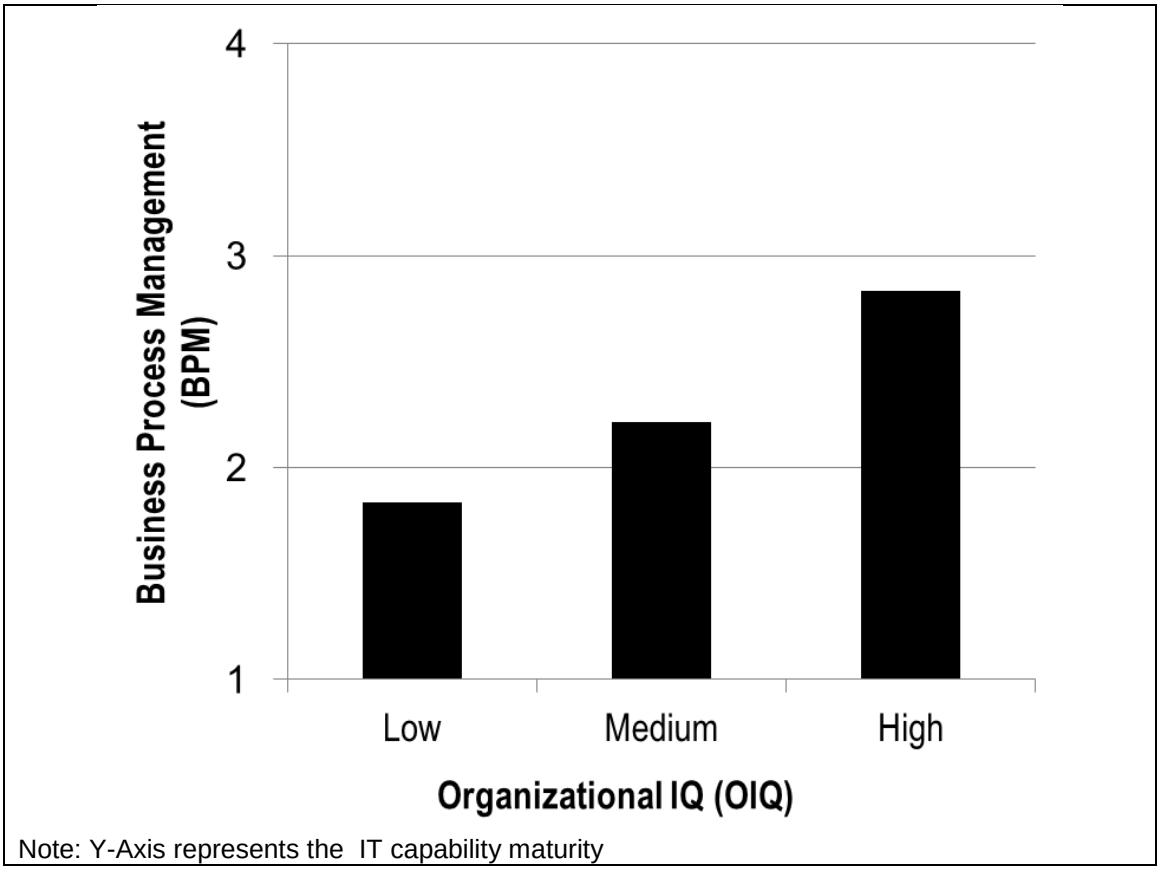
Figure 6-14 shows that SMEs with higher OIQ scores show a higher level of IT capability maturity.

The effect of OIQ was also observed in detail (non-parametric: Spearman) for each of the IT critical capabilities in SME IT-CMF:

- A "weak to moderate" relationship between OIQ and Business Process Management (BPM) and Relationship Asset Management (RAM) (BPM: $r_s(27) = .456$, $p = .013$; RAM: $r_s(29) = .445$, $p = .010$).

- A weak relationship between OIQ and Solutions Delivery (SD) and Service Provisioning (SRP) (SD: $r_s(28) = .364$, $p = .048$); SRP: $r_s(28) = .388$, $p = .034$).

Non-parametric tests (Kruskal-Wallis) on analysis of variance between the groups verified RAM ($p = .011$) and reported a boundary-limit for BPM ($p = .052$). Figure 6-15 shows that SMEs with higher OIQ scores show a higher level of Business Process Management (BPM) capability. Similar figures were obtained for all the other 9 IT capabilities.



Note: Y-Axis represents the IT capability maturity

Figure 6-15: Strategic Decision Making (Organizational IQ) and Business Process Management Capability (SME IT-CMF: BPM)

The exploration (non-parametric: Spearman) per each OIQ dimension found a direct relationship with below IT critical capabilities from SME IT-CMF:

- A moderate relationship between Internal Knowledge Dissemination (IKD) with Business Process Management (BPM) and a weak relationship with Relationship Asset Management (RAM) (BPM: $r_s(27) = .502$, $p = .006$; RAM: $r_s(29) = .413$, $p = .021$).

- A weak relationship between External Information Awareness (EIA) and Solutions Delivery (SD) and Service Provisioning (SRP) capabilities (SD: rs(28) = .387, p = .035; SRP: rs(28) = .370, p = .044).
- A weak relationship between Continuous Innovation (CI) and Relationship Asset Management (RAM), Solutions Delivery (SD) and User Experience Design (UED) capabilities (RAM: rs(29) = .474, p = .007; SD: rs(28) = .467, p = .009; UED: rs(29) = .464, p = .009).
- There was no difference in score for Organizational Focus (OF) for the organizations thus it was excluded from the analysis.

The analysis of variance with non-parametric tests (Kruskal-Wallis) verified the differences for Internal Knowledge Dissemination (IKD) with BPM (p = .030), RAM (p = .022).
A summary of the results for hypothesis [H9b] is included in Table 6-6.

Table 6-6: Summary of Results for [H9b]: Strategic Decision Making (OIQ) and Technological Capability perspective (SME IT-CMF)

Relationship between OIQ and IT capability maturity (SME IT-CMF)		**Corr. Analysis**	**Analysis of Variance.** Groups: L/M/H OIQ
Analysis at the overall level of OIQ			
OIQ	· IT Capability Maturity	n/a	none but (+) trend observed
	· Business Process Mgmt. (BPM) · Relationship Asset Mgmt. (RAM)	Weak to Moderate	"Low" and "High" OIQ groups show different IT capability maturity. Higher OIQ show higher IT capability maturity (BPM boundary-limit p = .052)
	· Service Provisioning (SRP) · Solutions Delivery (SD)	Weak	none
Analysis at OIQ dimension level			
EDA - Effective Decision Architecture	none	-	none
EIA - External Inf. Awareness	· Solutions Delivery (SD) · Service Provisioning (SRP)	Weak	none
IKD - Internal Knowledge Dissemination	· Business Process Mgmt. (BPM)	Moderate	"Low" and "High" IKD groups show different IT capability maturity level. Higher IKD show higher BPM and RAM
	· Relationship Asset Mgmt. (RAM)	Weak	
CI - Continuous Innovation	· Relationship Asset Mgmt. (RAM) · Solutions Delivery (SD) · User Experience Design (UED)	Weak	none

Only relationships validated by both correlation analysis and analysis of variance are highlighted in the overall framework.

6.3.2 Hypothesis results

Figure 6-16 shows the results for hypotheses [H9a] and [H9b].

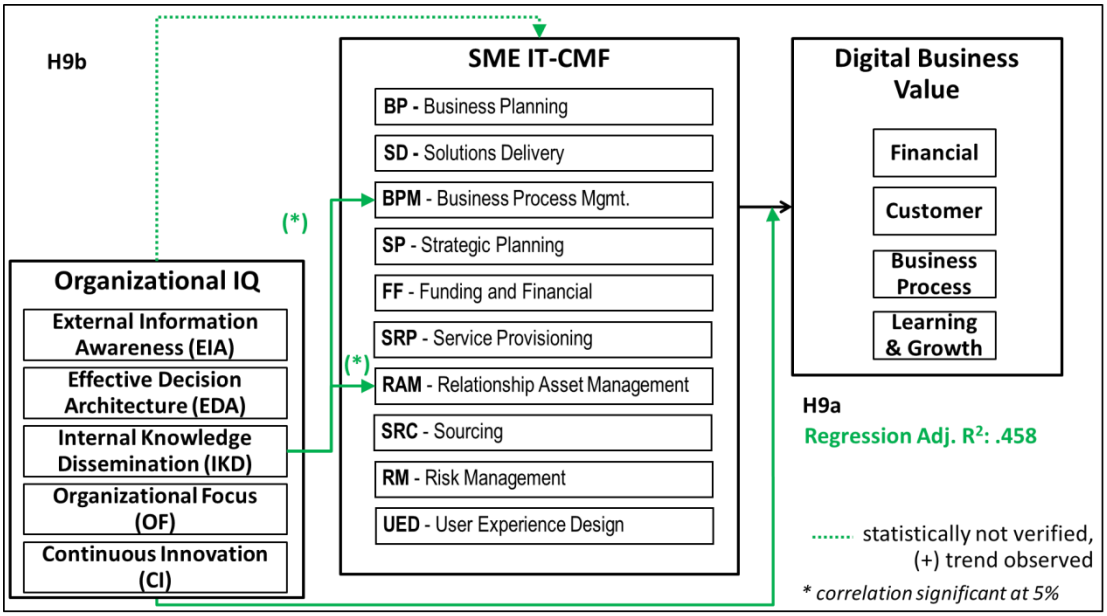


Figure 6-16: [H9a, H9b] Results: Combined effect of Strategic Decision Making (Organizational IQ) and Technological Capability perspective (SME IT-CMF)

6.3.3 Discussion and Interpretation of Quantitative results

Findings from hypothesis [H9a] indicate that organizational capabilities (OIQ) leverage the effect that higher IT capability maturity (SME IT-CMF) has on the achievement of Digital Business Value. This could be evidence that while IT capabilities can ensure that the business objectives/strategic vision are translated and incorporated on IT and that the actual delivery of IT services or products supports that vision; IT capabilities by themselves cannot ensure the right business strategy or objectives are defined. Instead, organizational capabilities (OIQ) can ensure business strategy is defined by leveraging both external and information and knowledge in a way that its products and services remain competitive by continuous innovation.

The results position Strategic Decision Making (Organizational IQ) as a moderating factor in the relationship between Technological Capability perspective (IT Capability Maturity: SME IT-CMF) and Digital Business Value.

The results from hypothesis [H9b] show first an overall relationship between Strategic Decision Making (Organizational IQ) and Technological Capability perspective (SME IT-CMF). This indicates that organizations that

effectively assimilate and manage information and use it to make effective decisions would most likely be able to develop IT capabilities that will enable them to dynamically adapt to changing circumstances and strategy.

From the verification at a component level, the dimensions of Organizational IQ that accounted for a direct relationship with IT Capabilities are Internal Knowledge Dissemination (IKD) and Continuous Innovation (CI). In particular, IKD showed a major impact on several IT capabilities: BPM and RAM hence suggesting that organizations that are able to have the right information at the right level would develop higher maturity capability in these areas. Having the right knowledge at the right level of the organization would definitely have a positive impact to maintain organizational knowledge on business processes (BPM) and to enhance the relationship between IT and the rest of the business with the right engagement level (RAM).

6.4 Framework for Digital Business Value with Dynamic Capabilities

Figure 6-17 shows the results for the direct relationships of the three perspectives with Digital Business Value. Figure 6-18 shows the combined effect of the perspectives on Digital Business Value. Later on, Figure 6-19 shows the updated framework which contains both direct and combined effects.

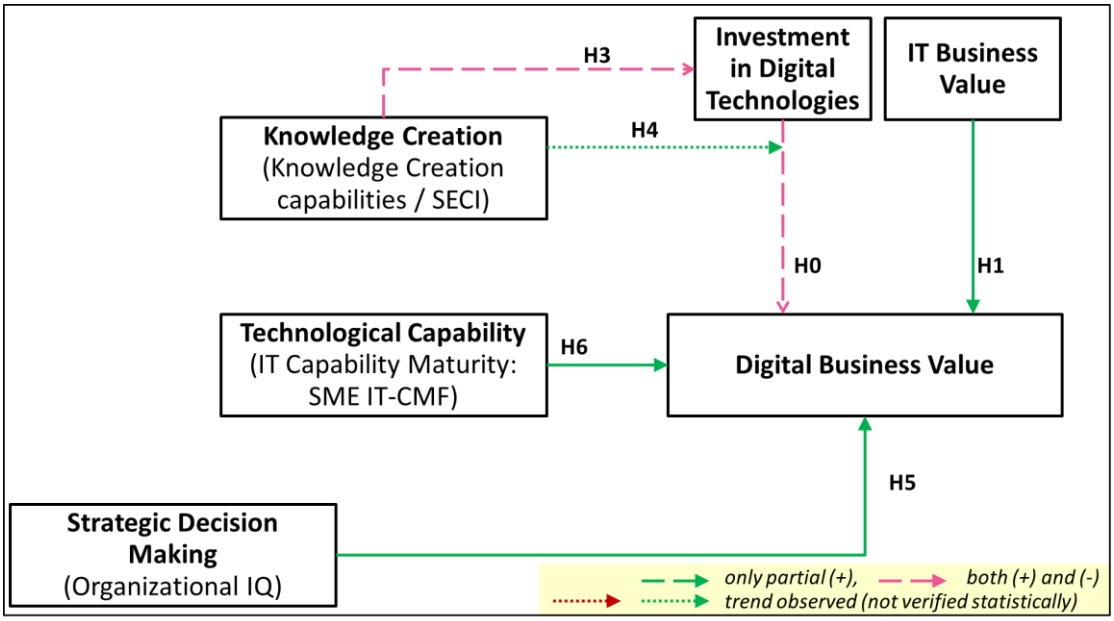


Figure 6-17: Results: Direct Relationships of the Perspectives with Digital Business Value

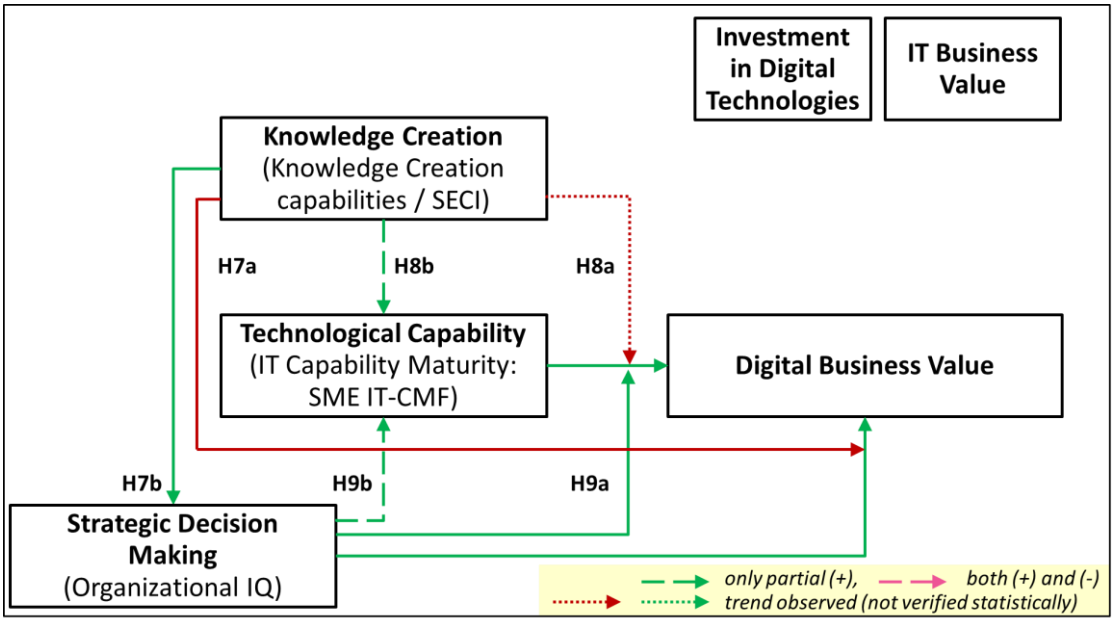


Figure 6-18: Results: Combined Effect of the Perspectives with Digital Business Value

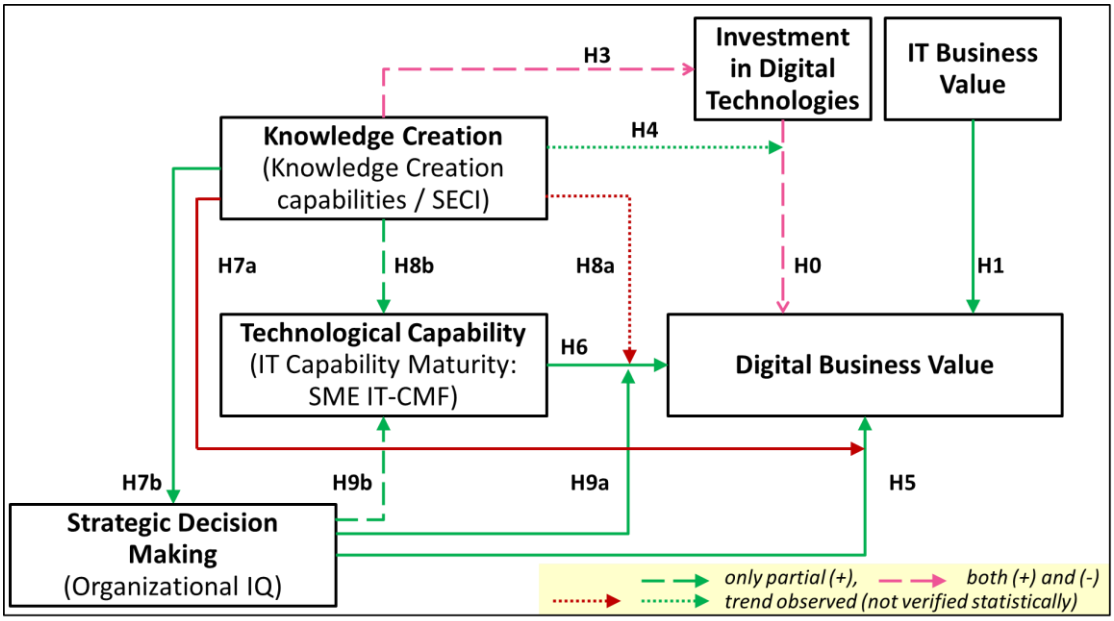


Figure 6-19: Framework for Digital Business Value with Dynamic Capabilities

Chapter Seven: Conclusions and Future work

7.1 Conclusions

The research question for this dissertation is:

> *What are the organizational capabilities that Small and Medium Enterprises need to develop in order to achieve Business Value from Digital Technologies ("Digital Business Value")?*

The suggested answer is:

> *Based on the empirical data collected in this dissertation, capabilities from two perspectives: Technology Capability (IT Capability Maturity: SME IT-CMF), Strategic Decision Making (Organizational IQ) and their combined effect are linked to Digital Business Value.*
>
> *The third perspective: Knowledge Creation has a dual role. First acts as an influencer factor on the other two perspectives: Strategic Decision Making and Technology Capability. Secondly, Knowledge Creation acts as a moderator of the relationship of Strategic Decision Making with Digital Business Value. Knowledge Creation proved to be both positive and negative depending on which type of business objectives (i.e. Financial-related, Customer-related, Business Process-related, and Learning & Growth-related objectives).*
>
> *The evidence also showed that organizations that are able to effectively use "traditional IT" to accomplish business objectives may also be successful with Digital Technologies.*

This research provides practical insights that SMEs can refer in order to prepare themselves to overcome the challenges and seize the opportunities ahead of the adoption of Digital Technologies. The results provided empirical evidence that dynamic capabilities (not only IT capabilities but the combination with other Organizational capabilities) enable the business value achieved using Digital Technologies.

The results are consolidated into the framework. The three perspectives: Strategic Decision Making, Technological Capability perspective and Knowledge Creation could be defined as the Dynamic Capabilities for Digital Business Value.

The exploration started in Hypothesis [H0] by considering if the investment in Digital Technologies itself can provide such value. The results provided a positive answer but only for a particular type of business objective: Learning & Growth.
Hypothesis [H1] verified the close relationship between the achievement of objectives using IT and Digital Technologies. The relationship was observed at an overall level and also between each of the four types of business objectives. These results contribute with evidence of the close relationship between success on implementation of IT and success implementing digital technologies. This suggests that organizations that are able to efficiently apply

IT towards the achievement of business objectives have also the potential to experience similar results while applying Digital technologies. Another way to interpret the results is also to consider that in order to be successful for the implementation of digital technologies; an initial foundation would be the successful delivery of IT to achieve business objectives.

The Knowledge Creation perspective was explored first on hypotheses [H2], [H3] and [H4].

Hypothesis [H2] tested the relationship between Knowledge Creating Capabilities and the achievement of business objectives by the use of digital technologies. The exploration didn't yield statistically significant results but some trends were observed. They were negative for Financial, Customer and Business Processes objective achievement and positive for Learning & Growth objectives.

Hypothesis [H3] considered if Knowledge Creation Process influenced the level of investments in Digital Technologies. The answer to the second investigation was positive for two types of business objectives: Financial and Learning & Growth.

Hypothesis [H4] analyzed the combined effects of Knowledge Creation Process and Investment in Digital Technologies on Digital Business Value. The response this time was negative.

The Strategic Decision Making perspective was explored on hypothesis [H5]. The evidence showed a positive relationship with Digital Business Value. SMEs with higher Organizational IQ were more successful in achieving their objectives using Digital technologies than their peers with lower Organizational IQ.
This dissertation identified two dimensions from Organizational IQ relevant to Digital Business Value: Internal Knowledge Dissemination (IKD) and Continuous Innovation (CI).

The last perspective explored independently was Technological Capability perspective. This was represented by IT Capability Maturity and measured by SME IT-CMF. Hypothesis [H6] was positive as the evidence showed that SMEs with a higher level of IT capability maturity had better performance than their peers with lower IT capability maturity.
The specific IT capabilities related to Digital Business Value were identified. SMEs with higher capability maturity levels of Risk Management (RM), Strategic Planning (SP), Business Planning (BP), Solutions Delivery (SD), Business Process Management (BPM) and Funding & Financial (FF) capabilities showed higher achievement of Digital Business Value than the organizations with lower IT capability maturity levels.

Finally, the combined or integrated effect was tested by the remaining hypotheses.

Hypotheses [H7a] and [H7b] explored the effect of Knowledge Creation perspective (KCC) on Strategic Decision Making (Organizational IQ).
Hypothesis [H7a] verified that the Knowledge Creation perspective (KCC) has a minor moderating role in the relationship between Strategic Decision Making (Organizational IQ) and Digital Business Value. The effect was suggested negative. Hypothesis [H7b] found that KCC was indeed related to Organizational IQ hence KCC could indirectly support Digital Business Value through Organizational IQ.

Hypotheses [H8a] and [H8b] explored the effect of Knowledge Creation perspective (KCC) on Technological Capability perspective (SME IT-CMF).
Hypothesis [H8a] did not provide evidence that Knowledge Creation perspective (KCC) is a moderating factor in the relationship between Technological Capability perspective (SME IT-CMF) and Digital Business Value. However, it suggested a negative trend actually reducing the impact that Technological Capability perspective had on Digital Business Value. Hypothesis [H8b] was only able to identify a relationship between KCC with one particular IT capability: Sourcing.

The last set of hypotheses [H9a] and [H9b] explored the effect of Strategic Decision Making (Organizational IQ) on Technological Capability perspective (SME IT-CMF).
Hypothesis [H9a] confirmed that the aggregated effect of the perspectives provided a better result in terms of achievement of Digital Business Value. The regression and General Linear Model results showed that the combination of both Organizational IQ and IT Capability Maturity explained better the achievement of business objectives using Digital Technologies. Hypothesis [H9b] showed a positive trend between Organizational IQ and the IT Capability Maturity (SME IT-CMF) of the organizations. It was identified that one dimension from Organizational IQ had a direct relationship with IT capabilities. Organizational IQ's Internal Knowledge Dissemination (IKD) had a direct relationship with Business Process Management (BPM) and Relationship Asset Management (RAM) capabilities.

The results contribute with valuable insights on how SMEs can prepare in order to achieve the opportunities that Digital Technologies like SMACIT offer. They also extend the Digital Transformation literature in particular how dynamic capabilities can work together in order to enable Digital Business Value.

This research also unveiled the relationship between the three perspectives and the Digital Business Value under four categories of business objectives. The findings indicated the importance of considering the type of business objectives that Digital Technologies support. In this dissertation, four types of business objectives were used and the results indicated there were some differences between the four types. An additional contribution is considering the Digital Investments not as technology assets by themselves but actually linking such investments with business goals they are meant to support.

7.1.1 Implications for Researchers

This dissertation builds on Dynamic Capabilities theory and Knowledge-based view and explores the role of three different perspectives covering both Organizational and IT capabilities towards the achievement of business objectives enabled by Digital Technologies.

The “Digital Investment Paradox” concern is raised throughout the work of this dissertation bringing opportunities for a new research line that, -leveraging the experiences from the IT Productivity Paradox- can provide insights on how dynamic capabilities work together to enable the organizations to achieve their objectives supported by the recent Digital Technologies.

The “Digital Investment Paradox” becomes a rather expected phenomenon as the attention and effort that both academia and organizations invest in digital initiatives increase. Together with the focus increase, the scrutiny on the benefits from Digital Technologies will increase in the same manner as its predecessor: the “IT Productivity Paradox” emerged.

This dissertation initiates the debate around the “Digital Investment Paradox” when exploring if investments on Digital Technologies yield Business Value. This dissertation proposed three perspectives from Dynamic capabilities: Knowledge Creation perspective, Strategic Decision Making perspective and Technological Capability perspective as enabling dynamic capabilities to achieve business value from Digital Technologies.

The results from the quantitative analysis provide initial evidence of the relationship between the three perspectives with Digital Business Value, in summary:

- A direct relationship between Strategic Decision Making perspective and Digital Business Value.
- A direct relationship between Technological Capability perspective and Digital Business Value.
- Leveraging role of Strategic Decision Making on the relationship between Technological Capability and Digital Business Value.
- Negative role of Knowledge Creation perspective on the relationship between Strategic Decision Making and Digital Business Value.
- The results also show which components from each perspective are related to Digital Business Value.

The framework with the key findings is proposed as a model to solve the Digital Investment Paradox, and; the perspectives are proposed as the dynamic capabilities for Digital Business Value.

Nevertheless, it is still too early to consider the Digital Investment Paradox solved and research in the field has the potential to grow. For example, below are some of the factors that could lead to the expansion of the research frontier.

- The results from the quantitative analysis showed that Digital Business Value differs according to the category of organization objectives (financial, customer, business process and, learning & growth).
- The study provides evidence of the complex relationship between Digital Business Value with organizational capabilities and that the relationships between the perspectives are worth to consider for additional research (i.e. hypotheses H7b, H8b, H9b).
- Limitation of the work such as specific population, small sample size and further combination of quantitative and qualitative approaches offer opportunities for research expansion to refine and provide further evidence of the framework.
- The discussion about the applicability of the framework took the first steps under this dissertation (section 7.1.2). However, the opportunities to enrich this aspect from a research perspective are also appealing.

7.1.2 Implications for SMEs and practitioners

The Small and Medium Enterprise Agency in its 2018 White Paper on Small and Medium Enterprises in Japan highlights that the gap between the productivity of SMEs compared with larger organizations is expanding and calls for urgent productivity improvement (SME Agency, 2018). As such the SME Agency focuses on items with the aim to "provide clues for SMEs and small enterprises in improving productivity" (SME Agency, 2018).

The framework proposed in this dissertation may become a reference for SMEs that look to embrace Digital Technologies. The implications presented in this section are based on information from the SME Agency (SME Agency, 2018) on its whitepaper, the findings from the quantitative study as well as the input from the qualitative exploration on one organization hereinafter referred as Organization "S". In addition, some recommendations are included in each of the subsections.

(1) The drivers for the implementation of digital technologies, the role of IT function, local IT and SME advisors

Organization "S" reported that while the IT function drives the mandatory technological initiatives (i.e. upgrade to MS Office 365), currently the driving force for the implementation of Digital Technologies relies on the business side. The IT function currently lacks the leading power for such initiatives and each initiative is run individually by the business (under business' budget). This pattern is expected to continue as the business side is currently interested in topics such as Analytics or IoT.

The role of the business is aligned with findings reported by the SME Agency (*2016 Survey of Conditions in Information Processing*) (SME Agency, 2018) in which the staff from the management department was engaged in planning for IT attempting to realize not only cost reductions but also increased sales and

added value ("*offensive IT use*") in SMEs. In large enterprises, the staff tasked with such responsibilities belonged to the Information Systems department.

The role that Local IT vendors play on the promotion of IT utilization in SMEs is important since they are often the advisors to SMEs (SME Agency, 2018). SMEs may not have resources with a deeper level of specialization (Carcary et al., 2014).

On the other hand, the whitepaper provides evidence that the effects of IT improve considerably through collaboration among different business units and between enterprises (SME Agency, 2018). In particular, SMEs that have some kind of alliance for the implementation of "offensive IT" present better productivity (i.e. sales per capita) that the organizations which do not have such alliances (SME Agency, 2018).

Organization "S" reported that the IT division should provide a safe environment and tools that support new working style allowing employees to collaborate regardless of location and time. IT division and technology can contribute to productivity by offering tools that enable employees to focus on core activities by the reduction of meetings, elimination of unnecessary reports. One clear potential for technology (e.g. Business Intelligence) in Organization "S" was reported as the data consolidation and sharing across the enterprise: "one input, multi-use" concept. Technology can provide the middle layer between the information generated at the field and the information required by management and in this way reduce the time needed for reporting.

- **Recommendation #1:** SMEs need to increase their focus on IT and Technologies that can produce increased sales and added value ("offensive IT"). In order to do that, the partnership between the management layer of the SME and the IT function (either own IT function, their local IT or SME advisors) is required so they can increase the time spent on value-added activities by the decrease of non-value-added activities (e.g. elimination, outsourcing, automatization).

- **Recommendation #2:** the IT function in the SMEs -if existing- can apply a similar approach for increasing the time spent on value-added-activities in order to become a leader and partner to the business and the organization for the introduction and utilization of digital technologies.

- **Recommendation #3:** External parties (local IT of SME advisors) can become the expertise hub for the introduction and utilization of IT and Digital Technologies. They can also facilitate the alliance and collaboration between SMEs.

(2) Achieving and Measuring Business Value from Digital Technologies

A study done by Mitsubishi UFJ Research and Consulting Co. (*Survey on Initiatives for Increasing Productivity to Address Labor Shortages)* (SME Agency, 2018) on 3,851 organizations identified that only 12.6% obtained the expected benefit, 50.8% obtained a certain degree of benefit but about 36.6% had experienced either no benefits, were unaware of any benefit, or considered IT as not required. The study (SME Agency, 2018) identified that one of the top 3 key issues encountered when attempting to introduce and utilize IT was "*do not understand and could not evaluate the benefits of IT introduction*".

Organization "S" reported that some of the results for the application of technology could be directly perceived on financial indicators such as sales but not all the time. Since their services and operations involved staff going to the field or customer side, the success of digital technologies could be perceived if staff working in the field or staff whose work requires to be outside the office are able to collaborate and communicate remotely. Similarly, the perceived benefits from implementing a collaboration tool (MS Office 365) were appropriate for their user based visiting the customer side as they value being able to connect and communicate wherever they go. That was not the case however for the back office users whose major interaction is with their managers, for such cases, their work does not require digital communication tools.

- **Recommendation #4:** SMEs and SMEs advisors can refer to the approach presented in this dissertation on how to define and measure the benefits of IT and Digital Technologies in order to address this concern. This could support SMEs management for the introduction and utilization of IT and Digital Technologies.

(3) Building capabilities for Digital Transformation

The Digital Transformation literature points out the difference between Digitization and Digitalization. Digitization refers to the need to standardize business processes with benefits related to operational excellence (efficiency, reliability, predictability) (Ross et al., 2017). Digitalization refers to "becoming digital", delivering additional customer value and can deliver revenue generation and growth as benefits. It considers that an organization needs to become both Digitized and Digital; and acknowledges that Digitization can be an important enabler of Digitalization (Ross et al., 2017).

Such foundation is aligned with the results from Hypothesis [H1], in which the success that SMEs experienced in achieving their business objectives with IT was highly related with the success they achieved by using Digital Technologies. IT supports basically Digitization, while Digital Technologies can become the vehicle in which SMEs can deliver new value to customers.

On the other hand, this focus on providing new value to customers through Digital Technologies seems not to be spread across the SMEs. Although the terms Digital Technologies or new technologies are not found in the SME Agency whitepaper (SME Agency, 2018), such study referred to Artificial Intelligence (AI), big data and Internet of Things (IoT) as "*Advanced Technologies*" and showed that only 10.8% from the SMEs have established a dedicated organization, project team or appointed staff to plan and review strategic IT use making use of advanced technologies. Although the SMEs are aware of such technologies their use rate is quite low (5.3% for IoT, 1.2% for AI, 2.1% for Big Data and 1% for Robotics Process Automation "RPA" on the surveyed organizations) (SME Agency, 2018). Embracing such advanced technologies becomes relevant to SMEs since the same study reported that the ratio of increasing sales and current income was higher on organizations utilizing at least one of such technologies.

Organization "S" reported that there is no differentiation between traditional IT and the new digital technologies in the organization. At the moment there is no plan to create a specific workforce for digital initiatives. Such could be considered if the projects delivering digital technologies are successful. For example, if significant revenue is created by using IoT such initiative could be expanded to become a company-wide initiative.

Organization "S" showed a certain level of specialization on Knowledge Creation Capabilities; in particular, focus on Externalization and Combination knowledge processes. One of the concerns they faced years before was related to the accumulation of knowledge on their experienced employees. In order to decentralize it, a knowledge-base and sharing system was developed. Such initiative was later extended and was included as one of their product portfolio to other organizations. Organization "S" also understood that the system could handle explicit knowledge and that the tacit knowledge is shared between employees through practice in the field (i.e. the level of tightness on a specific screw). In the case of Organization "S", knowledge sharing in a systematic way enabled the organization to hire younger / junior staff and achieve cost savings.

Such specialization in the combination of knowledge can reflect the findings of hypothesis [H3], in which there was a positive relationship between SECI's Combination process and the investment in Digital Technologies for Learning & Growth objectives. In the case of Organization "S", their dependency on the knowledge and expertise of their staff (e.g. field technicians) made the organization to invest in IT solutions supporting the Learning & Growth objectives. Hence [H3] could depend on the type of business operations that the SMEs are engaged in.

Organization "S" was in the group of SMEs with an overall low score on Strategic Decision Making (OIQ) and had a small advantage on OIQ's Continuous Innovation dimension. The organization reported to use basic tools for exchange of ideas and collaboration within the projects. OIQ's Internal Knowledge Dissemination was mainly supported by the Knowledge Sharing system. Although employees in the organization were aware of

external information (OIQ's External Information Awareness); the efforts seemed not to be integrated at an organizational level. The connection of such knowledge or technologies to the business was not strong. For example, it was mentioned that the executive level of the organization was interested in Artificial Intelligence but it was not clear at the time of the interview how to use such it at the middle level or at business operations. The organization uses defined authorization rules which allow that the right decisions are taken at the right level of the organization (OIQ's Effective Decision Architecture). Such authorization rules are reviewed on a needed basis. For example, a recent review was started as the handling of a new product line did not fit the current thresholds of authorization amounts; the rules are being revised in order to allow the required speed on decision making.

In Technological Capability perspective (SME IT-CMF), Organization "S" was between the low and medium scores of capability maturity at an overall level and had a Risk Management (RM) capability above the average. The interview revealed that the organization had a basic level of risk management in place to minimize the risk to the business. For example when a new provider is selected, or controls and practices based on order amount. However, it was considered still basic and it followed a passive rather than a proactive approach. When inquiring how Risk Management is applied for the consideration of new technologies like Mobile, the organization considered the rules and system securities were in place for that particular technology. The IT strategy was reported as aligned with the Organizational Strategy (Strategic Planning capability: SP). There was no formalized catalogue of the services provided by IT shared with the business and used for aligning the business expectations towards IT (Business Planning - BP). Nevertheless, some expectations from the business are received and incorporated by IT. The delivery of the current solutions that IT provides is shifting to package and vendor solutions (SD). The business process documentation follows ISO9001 (Quality Management System) (Business Process Management: BPM), standards and flows for key operations such as design and construction flows are available.

- **Recommendation #5:** SMEs need to define the function(s) or team (s) accountable in the organization for digital transformation. This could stay with the business or use a hybrid approach involving both business and IT.

- **Recommendation #6:** SMEs need to gradually increase their engagement on Digital Technologies (or "Advanced Technologies"). A similar approach to increase the time spent on value-added activities by the decrease of non-value-added activities needs to be executed in partnership with the management of the organization and its IT function (either own function, their local IT or SME advisors).

- **Recommendation #7:** for organizations, it may not be easy to differentiate between the management of traditional IT and Digital Technologies such as Social, Mobile, Analytics, Cloud, Internet of Things and emerging technologies. It may be helpful to remember that the use of any technology by itself can be replicated by competitors thus don't

necessarily translate into a competitive advantage. As researchers from MIT suggest, "the key is *differentiating your business* by offering customers something new and compelling, enabled by the vehicle that digital offers, and creating a destination customers want to visit." (Weill and Woerner, 2018).

- **Recommendation #8:** SMEs need to focus on strengthening their capabilities that enabling them to deliver business value with traditional IT. This will support the status of Digitizing in the organization first and can become the foundation for transforming the organization into Digital.

- **Recommendation #9:** SMEs can either look inside or outside their organization for the introduction of IT and Digital Technologies. However, it is recommended first to understand and improve their organizational capabilities since those will provide the environment in which any technology will be selected, delivered and most importantly accounted to generate value to the organization. The three perspectives presented by this dissertation can serve for this purpose. *Strategic Decision Making* perspective can become the orchestrating capability as it supports the organization to assimilate and manage information and use it to make effective decisions. Hence it will support the right integration of the technologies with the business processes, the right selection of products or services based on the new technologies, the right delivery and later on the utilization of technologies.

- **Recommendation #10:** SMEs need to define how digital technologies would be able to enhance their organizations' assets and capabilities to create new customer value (Ross et al., 2017).

- **Recommendation #11:** Finally, the Japanese Government and institutions such as the Small and Medium Enterprise Agency may continue the promotion of IT as a way to realize increased labor productivity through the use of IT and therefore address labor shortages. It is recommended that such promotion covers both traditional IT and Digital technologies with an increasing focus on what could be named "*offensive use of advanced technologies*" approach. That would mean that SMEs start to gradually focus more on Advanced Technologies (Social, Mobile, Analytics and Big Data, Cloud, IoT and emerging technologies) in a way that such technologies combined with the organization's characteristics produce increased value added.

(4) Applicability of the Framework

The framework for Digital Business Value proposed in this dissertation was presented to Organization "S". The discussion aimed to understand the potential of the framework, its applicability and possible first steps for an organization.

This framework and similar tools that could support the organization to achieve benefits from Digital Technologies was considered to be of interest mainly to middle and higher levels of the organization.

The feedback revealed that the concepts presented in the framework like Strategic Decision Making, Technological capability perspective, etc. could be a little abstract to the management thus work would be needed to create awareness and gain their understanding for such initiative.

Based on the organizational culture of Organization "S", the initiative to become a Digital organization or efforts to embark into Digital Transformation should be owned and lead by executive level (e.g. board members) in order to get support and engagement from all levels of the organization. Under such direction, several functions (IT, finance, business, etc.) could be orchestrated and move the initiative forward.

- **Recommendation #12:** SMEs executive level needs to gain awareness of the benefits and risks of embracing Digital Technologies to create Digital Business Value. Only after such awareness and sense of urgency is obtained such initiative to become Digital could be integrated as part of the organization's vision and strategic plan.

The organization revealed that at an organizational level the current operating mode is passive, dedicated more to execution rather than to drive new initiatives. Nevertheless, at a team level, there are some activities that in cooperation with universities are taking place, although still at an early phase.

The current status could be classified as "surviving mode", in where the financial results of the organization have a direct impact on the ability to improve and innovate. For instance, currently, there is no ongoing initiative at an organizational level to drive business processes improvement. Furthermore, the organization seems to value a multi-role culture where their staff takes care of activities in several areas by themselves (technical, sales, invoicing, etc.). Such culture could be related to the nature of the telecommunications industry and also the business practices in Japan where from a customer's perspective it is valued to have one point of contact driving all aspects of a project.
Such mode or environment has also a direct impact on the applicability of this or any other initiative to approach Digital Technologies.

The key recommendations proposed were also reviewed with Organization "S" and the feedback was positive. The recommendations were acceptable from a practitioner's viewpoint. These recommendations can be considered as the first steps to embrace Digital Technologies but even the start of the journey could be quite ambitious. For example, improving a technical capability is a journey that requires effort at several layers of the organization.

Therefore the initial steps and recommendations could be prioritized and derived into an action plan aligned with the status of each organization. For

this to be successful, the plan to embrace digital technologies should be owned and sponsored by the executive level and then embraced and actioned by the whole organization.

A potential action plan based on the above recommendations is presented in Table 7-1.

Table 7-1: Potential Action Plan for SMEs to embrace Digital Technologies

Action		Recomm. #
1. Increase "offensive use of advanced technologies"		#1, #6, #2
	Gradually focus more on Advanced Technologies (Social, Mobile, Analytics and Big Data, Cloud, IoT and emerging technologies) in a way that such technologies combined with the organization's characteristics produce increased value added.	
2. Define & measure the benefits of Digital Technologies		#4, #12
3. Define accountability for Digital Transformation		#5
4. Strengthen capabilities		
	1. To deliver value with traditional IT	#8
	2. To become Digital	#9
5. Define Digital Strategy		#7, #10
	Define how technologies would enhance organizations to deliver new customer value	
	Offer customers something new and valuable, enabled by digital technologies	
6. Leverage external partners		
	Alliance with local IT vendors or SME advisors to reach hub for Digital Technologies	#3

7.2 Limitations and Future Work

The future work may be driven either by addressing limitations of the present dissertation as well as by expanding the findings of this study.

7.2.1 Future Work based on limitations

This study is vulnerable to several limitations that could be grouped into two categories. Improvements could derive to future work

The first group of limitations relates to the target population, size and data itself.

Target Population: the target population for this study is a very specific population. All organizations belong to a selected population embed in a country (Japan), culture and business practices which could affect the answers.
Cultural behavior could have some implications for their responses. For example, the focus on Risk Management capability or the reported achieved level. This can be overcome in the future by expanding the number of organizations in scope in order to include non-Japanese SMEs as well.

It is worth to mention that although the sample used for the empirical evaluation has such specific characteristics, it served as a case study how the perspectives were positively related to Digital Business Value and offered practical implications to the industry.

Sample Size: the number of observations could be considered small for a quantitative study. This fact was acknowledged when the study was designed but it was considered that the benefits of selecting such a group would actually enrich the study and its findings. This is because the organizations were part of a list of organizations selected by the Ministry of Economy in Japan due to their effective use of technology. The benefits were that such organizations could represent best-practices and also the study may receive a high response rate.

The second group of limitations resides on the accuracy of the data collected.

Collected Data: the collected data is as much as reliable as the reliability of the participants. The data used in this dissertation was collected by a self-reported questionnaire. This study tried to minimize the risk by addressing the survey to the company registered representative and included a cover letter explaining the motivation and objective of the study. The actual responders were IT representative in some cases and business representative in others, which is appropriate and minimizes possible bias since the survey intended to measure digital technologies contribution to achieve business objectives.

7.2.2 Future Work to expand and refine the framework and findings

Additional further work could be derived from the findings yielded by this dissertation.

Mixed-Methods Approach: although a qualitative exploration was conducted after the quantitative analysis; combining this with a further deep qualitative study may refine the findings and lead to additional insights. The proposed framework may be further verified and adjusted based on a deeper qualitative study. With such approach, the framework can be enriched by the iteration of quantitative and qualitative studies.

Further exploration of findings: it is possible to take a deeper exploration of the findings on each perspective.

For example in case of Strategic Decision Making perspective, a deeper analysis regarding the findings on Internal Knowledge Dissemination (IKD) and Continuous Innovation (CI) could provide insights on how knowledge is shared and combined with the knowledge existing already inside the organization (e.g. knowledge creation or management) in order to take the right decisions for selection and implementation of digital initiatives.
Regarding the Technological Capability perspective, one way to provide further aid to the SMEs to improve their capabilities could be the execution of deep-dive analysis for the key IT capabilities identified by this study. This would help to understand on a detailed level how to develop such capabilities.

Additional exploration of the trends that the empirical analysis provided (both positive and negative trends) could lead to further insights on the interaction of the perspectives towards the achievement of Digital Business Value.

Since the qualitative exploration in Organization “S” could indicate that many SMEs are operating under a “surviving mode” which limits their capability to innovate. Further work could be conducted to understand which elements, practices, and behaviors within each capability (Strategic Decision Making’s IKD/CI, Technical Capabilities’ RM, SP, SD, etc.) are minimally required in order to support Digital initiatives. Such clarification will help SMEs to get the highest benefits with limited effort/resources.

REFERENCES

Alpar, P., and Kim, M. A. (1998). "A microeconomic approach to the measurement of information technology value," *Journal of Management Information Systems,* 7(2), pp. 55-69.

Amit, R. and Schoemaker, P.J.H. (1993)."Strategic assets and organizational rent," *Strategic Management Journal,* 14(1), pp. 33-46.

AXELOS (2019). Glossary. Retrieved from https://www.axelos.com/Corporate/media/Files/Glossaries/ITIL_2011_Glossary_GB-v1-0.pdf on June 6, 2019.

Bakos, Y. (1998). "The Productivity Payoff of Computers, A Review of The Computer Revolution: An economic perspective by Daniel E. Sichel," *Science*, 281, pp. 52.

Barney, J. (1986). "Strategic factor markets: Expectations, luck, and business strategy," *Management Science*, 32(10), pp. 1231-1242.

Barney, J. (1991). "Firm Resources and Sustained Competitive Advantage," *Journal of Management*, 17, pp.99-120.

Barua, A., Kriebel, C.H., and Mukhophyay, T. (1991). "An economic analysis of strategic information technology investments," *MIS Quarterly,* 15(3), pp. 313-332.

Beutel, S. (2018), "The Relationship Between Digital Orientation and Firm Performance," *Proceedings of the 39th International Conference on Information Systems (ICIS 2018).*

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A., and Venkatraman, N. (2013). "Digital business strategy: toward a next generation of insights," *MIS Quarterly,* 37(2), pp. 471-482.

Bresnahan, T.F., Brynjolfsson, E., and Hitt, L.M. (2002). "Information technology, workplace organization and the demand for skilled labor: Firm-level evidence," *Quarterly Journal of Economics,* 117(1), pp. 339-376.

Brynjolfsson, E. (1993). "The Productivity Paradox of Information Technology: Review and Assessment," *Communications of the ACM,* 36(12), pp. 67-77.

Brynjolfsson, E. (1996) "The contribution of information technology to consumer welfare," *Information Systems Research,* 7(3), pp. 281-300.

Brynjolfsson, E. and Hitt, L. M. (1995). "Information technology as a factor of production: The role of differences among firms," Economics of Innovation and New Technology, 3(3), pp. 183-199.

Brynjolfsson, E. and Hitt, L. M. (1996). "Paradox lost? Firm-level evidence on the returns to information systems spending," *Management Science*, 42(4), pp. 541-558.

Brynjolfsson, E., and Hitt, L. M. (1998). "Beyond the productivity paradox," *Communications of the ACM,* 41(8), pp.49-55.

Brynjolfsson, E., Hitt, L. M., and Yang, S. (1998). "Intangible assets: How the interaction of information systems and organizational structure affects stock market valuation," *Proceedings of the International Conference on Information Systems.*

Budiono, F., Lau, S., and Tibben, W. (2018). "Cloud Computing Adoption for E-Commerce in Developing Countries: Contributing Factors and Its Implication for Indonesia," *Proceedings of the 22nd Pacific Asia Conference on Information Systems (PACIS 2018)*.

Carcary, M. (2011). “Design science research: the case of the IT Capability Maturity Framework (IT-CMF),” *Electronic Journal of Business Research Methods*, 9(2), pp.109-118.

Carcary, M., Doherty, E. and Conway, G., (2014). “The Adoption of Cloud Computing by Irish SMEs - an Exploratory Study,” *The Electronic Journal Information Systems Evaluation*, 17(1), pp. 003-014.

Carcary, M., and McLaughlin, S. (2014). “Driving SME Competitiveness in a Dynamic Business Landscape - Leveraging an IT Capability Mindset,” *Innovation Value Institute,* White Paper.

Chen, D. Q., Mocker, M., Preston, D. S., and Teubner, A. (2010). “Information Systems Strategy: Reconceptualization, Measurement, and Implications,” *MIS Quarterly,* 34(2), pp. 233-259.

Curley, M. (2008). “The IT capability maturity framework: A theory for continuously improving the value delivered from IT capability,” Ph.D. National University of Ireland, Maynooth.

Curley, M., Kenneally, J. and Carcary. M. (2016). *IT Capability Maturity Framework (IT-CMF) - The Body of Knowledge Guide - Second Edition*. Van Haren Publishing: Zaltbommel/Netherlands.

Dedrick, J., Gurbaxani, V., Kraemer, K. L. (2003). “Information Technology and Economic Performance: A Critical Review of the Empirical Evidence,” ACM Computing Surveys, 35(1), pp. 1-28.

Devaraj, S. and Kohli, R. (2002). “Information technology payoff in the health care industry: A longitudinal study,” J*ournal of Management Information Systems*, 16(4), pp. 41-68.

Doherty, E., Carcary, M., Ibbotson, P. and Ramsey, E. (2015). “The importance of ‘e’ in mixed methods research - development of an SME framework to leverage value from IT,” *Proceedings of 14th European Conference on Research Methodology for Business and Management Studies*. Academic Conferences and Publishing International Limited Reading: UK, pp. 177-186.

Doherty, E., Carcary, M., Downey, U., McLaughlin, S. (2013). “Enhancing IT Capability Maturity – Development of an SME Framework to Maximize the Value Gained from IT,” *Innovation Value Institute*, White Paper.

Donnellan, B., and Helfert, M. (2010). “The IT-CMF: a practical application of design science,” *Proceedings of the 5th International Conference on Global Perspectives on Design Science Research (DESRIST'10)*. Springer-Verlag: Berlin, Heidelberg.

Dos Santos, B. L., Peffers, K., and Mauer, D (1993). “The Impact of Information Technology Investment Announcements on the Market Value of the Firm,” *Information System Research,* 4(1), pp. 1-23.

Eisenhardt, K.M., Martin, J. (2000). “Dynamic Capabilities: What Are They?,” *Strategic Management Journal*, 21, pp. 1105-1121.

Francalanci, C. and Galal, H. (1998). “Information technology and worker composition: Determinants of productivity in the life insurance industry,” *MIS Quarterly*, 22(2), pp. 227-241.

Grant, R. M. (1996). “Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration,” *Organization Science*, 7(4), pp. 375-387.

Greenan, N., Mairesse, J., and Topiol-Bensaid, A. (2001). “Information technology and research and development impacts on productivity and

skills: Looking for correlations on French firm level data", *Information Technology, Productivity, and Economic Growth: International Evidence and Implications for Economic Development*, M. Pohjola, Ed. Oxford University Press, Cambridge, U.K., pp. 119-148.

Hansen, D. (2003). "Leveraging Organizational IQ to Improve Management Processes," *SRI Consulting Business Intelligence*, Insight D03-2440.

Harris, S., and Katz, J. (1991). "Firm size and information technology investment intensity of life insurers," *MIS Quarterly,* 15(3), pp. 333-352.

Helfat, C.E, and Peteraf, M.A. (2003). "The dynamic resource-based view: capability lifecycles," *Strategic Management Journal,* 24(10), pp. 997-1010.

Hirano, M. (2005). "Informational Investments and Their Performance: A Mission of Management Informatics," *Collection of the 51st National Conference of Japan Society for the Study of Office Automation*, 11, pp. 35-38.

Hirano, M., Stoffels, A., and Suzuki, K. (2006). "A study on high-IQ organizations: comparative analysis of Japan and US," *Journal of the Japan Society for Management Information*, 15(1), pp. 31-52.

Hirano, M. and Goodman, R. (2016). "Does IT augment organisational capabilities (or vice versa)? - implications from Japanese data," *Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS 2016)*.

Hitt, L., and Brynjolfsson, E. (1994). "The three faces of information technology value: theory and evidence," Proceedings of the 15th International Conference on Information Systems, Vancouver, pp. 263-277.

Hitt, L., and Brynjolfsson, E. (1996). "Productivity, Profit, and Consumer Welfare: Three Different Measures of Information Technology," *MIS Quarterly,* 20(2), pp. 121-142.

ISACA (2019). Glossary. Retrieved from https://www.isaca.org/Pages/Glossary.aspx?tid=1490&char=I on June 6, 2019.

Issa, T., Isaias, P.T. and Kommers, P. (2013). "Guest Editors' Introduction-Special Issue on Digital Society and E-Technologies," *Pacific Asia Journal of the Association for Information Systems*, 5(3), pp. i-ii.

IVI Innovation Value Institute (2018). "How to approach Digital Transformation in your Organization," Retrieved from https://ivi.ie/wp-content/guides/How-to-approach-Digital-Transformation-in-your-Organisation.pdf on July 18, 2018.

Kaplan, R. and Norton, D. (1996). *The Balanced Scorecard - translating strategy into action*. Harvard Business Review Press: Boston.

Lewin, A., and Massini, S. (2004). "Knowledge Creation and Organizational Capabilities of Innovating and Imitating Firms". In: "Organizations as Knowledge Systems", Palgrave Macmillan. UK, pp. 209-237.

Li Y., Huang J. and Tsai M. (2009). "Entrepreneurial orientation and firm performance: The role of knowledge creation process," *Industrial Marketing Management*, 38, pp. 440–449.

Lichtenberg, F. R. (1995). "The output contributions of computer equipment and personnel: a firm level analysis," *Economic Innovations and New Technology,* 3, pp. 201-217.

Loveman, G. W. (1994). “An assessment of the productivity impact of information technologies,” *Information Technology and the Corporation of the 1990s: Research Studies*, T. J. Allen and M. S. Scott Morton, Eds. Oxford University Press, Cambridge, U.K., pp. 84-110.

Mahmood, M. A., and Mann, G. J. (1993). “Measuring the Organizational Impact of Information Technology Investment: An Exploratory Study,” *Journal of Management Information Systems*, 10(1), pp. 98-122.

Melville, N., Kraemer, K., and Gurbaxani, V. (2004). “Review: Information Technology and Organizational Performance: An Integrative Model of IT Business Value,” *MIS Quarterly,* 28(2), pp. 283-322.

Mendelson, H. (2000). “Organizational Architecture and Success in the Information Technology Industry,” *Management Science*, 46(4), pp. 513-529.

Mendelson, H., and Ziegler, J. (1999). Survival of the Smartest: Managing Information for Rapid Action and World-Class Performance. Wiley: New York.

Mendelson, H. and Pillai, R. (1999), “Information Age organizations, dynamics and performance,” *Journal of Economic Behavior & Organization*, 38(3), pp. 253-281.

METI Ministry of Economy, Trade and Industry of Japan (2017). “Competitive IT Strategy SME Selection 100,” Retrieved from http://www.meti.go.jp/english/press/2017/0531_003.html, in English, from http://www.meti.go.jp/policy/it_policy/investment/it_keiei/100sen.html in Japanese on July 18, 2018.

Microsoft Asia News Center (2018a). “Digital transformation of manufacturing to add US$387 billion to Asia Pacific’s GDP by 2021,” Retrieved from https://news.microsoft.com/apac/2018/04/23/digital-transformation-of-manufacturing-to-add-us387-billion-to-asia-pacifics-gdp-by-2021-2/ on January 7th, 2019.

Microsoft Asia News Center (2018b). “Asia Pacific’s FSI sector to add US$292 billion to GDP by embracing digital transformation,” Retrieved from https://news.microsoft.com/apac/2018/10/22/asia-pacifics-fsi-sector-to-add-us292-billion-to-gdp-by-embracing-digital-transformation/ on January 7th, 2019.

Mithas, S., Ramasubbu, N., and Sambamurthy, V., (2011). “How information management capability influences firm performance,” *MIS Quarterly*, 35(1), pp. 237-256.

Mitra, S., and Chaya, A.K. (1996). “Analyzing cost-effectiveness of organizations: the impact of information technology spending,” *Journal of Management Information Systems,* 13(2), pp. 29-57.

Motohashi, K. (2006). “The IT Revolution's Implications for the Japanese Economy, in Japan: Moving Toward a More Advanced Knowledge Economy,” *World Bank Institute*, Washington DC.

Nonaka, I., and Takeuchi, H. (1995). *The Knowledge-Creating Company*, Oxford University Press, New York.

Nonaka, I., Byosiere, P., Borucki, C., and Konno, N. (1994). “Organizational Knowledge creation Theory: A First Comprehensive Test,” *International Business Review*, 3(4), pp. 337-351.

Nonaka, I., Toyama, R., and Konno, N. (2000). "SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation," *Long Range Planning* 33(1), pp. 5-34.

Oz, E. (2005). "Information technology productivity: in search of a definite observation," *Journal of Information & Management,* 42(6), pp. 789-798.

Rai, A., Patnayakuni, R., and Patnayakuni, N. (1997). "Technology investment and business performance," *Communications of the ACM,* 40(7), pp. 89–97.

Ramirez, R., Kraemer, K. L., and Lawler, E. (2001). "The contribution of information technology investments to firm performance: Influence of management practices," *Center for Research on Information Technology and Organizations*, University of California, Irvine, Irvine, CA.

Rana, N., Luthra, S. and Rao, H.R. (2018). "Developing a Framework using Interpretive Structural Modeling for the Challenges of Digital Financial Services in India," *Proceedings of the 22nd Pacific Asia Conference on Information Systems (PACIS 2018).*

Rezaei Dolat Abadi, H., Allameh-Haery, F., Borandegi, F., and Fatehi, F. (2013). "Investigating the Relationship between Knowledge Creation Process and Organizational Performance in a Service-Sector Organization," *International Journal of Academic Research in Progressive Education and Development*, 2(3).

Riera, C. (2007). "A study on the relationship between IT Investment and Firm Performance based on Organizational Characteristics" M.Eng. Tokyo Institute of Technology, Tokyo.

Riera, C., and Iijima, J. (2007). "A Study of the Effect of Organizational IQ on IT Investment and Productivity," *IEEE International Conference on Wireless Communications, Networking and Mobile Computing*.

Riera, C., and Iijima, J. (2017). "Linking Knowledge Creating Capabilities, IT Business Value and Digital Business Value: An Exploratory Study in Japanese SMEs," *Proceedings of the 9th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management*.

Riera, C., and Iijima J. (2018). "Does Investment in Digital Technologies Yield Digital Business Value? The Digital Investment Paradox and Knowledge Creation as Enabling Capability," *Proceedings of the 10th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management*.

Riera, C., and Iijima, J. (2019a). "How Do Japanese SMEs Generate Digital Business Value from SMACIT Technologies with Knowledge Creation?," *In: Fred A. et al. (eds) Knowledge Discovery, Knowledge Engineering and Knowledge Management. IC3K 2017.* Communications in Computer and Information Science (976). Springer: Cham.

Riera, C., and Iijima, J. (2019b). "The Role of IT and Organizational Capabilities on Digital Business Value," *Pacific Asia Journal of the Association for Information Systems*, 11(2), pp. 67-95.

Riera, C., Senoo, D., and Iijima, J. (2009). "A study of the effect of Knowledge Creating Capabilities on corporate performance," *International Journal of Knowledge Management Studies*, 3(1-2), pp. 116 - 133.

Ross, J., Beath, C., and Sebastian, I. (2017). "Digital ≠ Digital," Research Briefing, 17(10). *Centre for Information Systems Research, Massachusetts Institute of Technology.*

Ross, J., Sebastian, I., Beath, C., Mocker, M., Moloney, K. and Fonstad, N. (2016a). "Designing and Executing Digital Strategies," *ICIS 2016 Thirty-Seventh International Conference on Information Systems*.

Ross, J., Sebastian, I., Beath, C., Scantlebury, S., Mocker, M., Fonstad, N., Kagan, M., Moloney, K., Krusell, S.G., and the Technology Advantage Practice of The Boston Consulting Group (2016b). "Designing Digital Organizations," Working paper No.406. *Centre for Information Systems Research, Massachusetts Institute of Technology*.

Ross, J., Sebastian, I., Fonstad, N. (2015). "Define Your Digital Strategy - Now," Research Briefing, 15(6). *Centre for Information Systems Research, Massachusetts Institute of Technology.*

Rossmann, A. (2018), "Digital Maturity: Conceptualization and Measurement Model," *Proceedings of the 39th International Conference on Information Systems (ICIS 2018).*

Sandulli, F.D., Lopez-Sanchez, J.I., Rodriguez-Duarte, A., and Fernandez-Mendez, J. (2007), "Analysing the IT Paradox in the Supply Chain," Retrieved from https://ssrn.com/abstract=1105687 on January 24th, 2019.

Sebastian, I., Ross, J., Beath, C., Mocker, M., Moloney, K. and Fonstad, N. (2017). "How Big Old Companies Navigate Digital Transformation," *MIS Quarterly Executive*, 16(3), pp.197-213.

SME Agency (2016). "White Paper on Small and Medium Enterprises in Japan," Retrieved from http://www.chusho.meti.go.jp/pamflet/hakusyo/H28/download/2016hakushopanflet_eng.pdf on January 24th, 2019.

SME Agency (2018). "White Paper on Small and Medium Enterprises in Japan," Retrieved from https://www.chusho.meti.go.jp/pamflet/hakusyo/H30/PDF/2018hakusho_eng.pdf on June 3rd, 2019.

Stockhinger, J., and Teubner, R.A. (2018), "How Management Consultancies Make Sense of Digital Strategy," *Proceedings of the 39th International Conference on Information Systems (ICIS 2018).*

Stoffels, A., Suzuki, K., and Hirano, M. (2006). "A study on high-IQ organizations: comparative analysis of Japan and US," *Journal of the Japan Society for Management Information,* 15(1), pp. 31-52.

Strassmann, P. (1997). "Will big spending on computers guarantee profitability?," *Datamation,* 43(2), pp. 75-82.

Suzuki, K., and Mori, T. (2005). "Causality among Information and Resource Related Factors in Japanese High Technology Industries- Pathway Analysis of Organizational IQ Principles-," *Journal of the Japan Society for Management Information*, 13(4).

Synesis (2001). "Organizational IQ". Accessed on January 24th, 2019. Retrieved from http://www.synesis.com/OrganizationalIQ-Principles.html.

Tai, J.C.F., Wang, E.T.G and Wang, K. (2017). "Investigating the Impact of IT Ambidexterity on Digital Innovation Capability," *Proceedings of the 21st Pacific Asia Conference on Information Systems (PACIS 2017).*

Tallon, P., Kraemer, K. L., and Gurbaxani, V. (2000). “Executives perspectives on the business value of information technology,” *Journal Management Information Systems*, 16(4), pp. 145-173.

Tanniru, M., Khuntia, J. and Weiner, J. (2018). “Hospital Leadership in Support of Digital Transformation,” *Pacific Asia Journal of the Association for Information Systems*, 10(3), pp. 1-24.

Teece, D. J. (2007). “Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance,” *Strategic Management Journal*. (28), pp. 1319 - 1350.

Teece, D. J. (2018). “Business models and dynamic capabilities,” *Long Range Planning*. (51), pp. 40 - 49.

Teece, D. J., Pisano, G. and Shuen, A. (1997). “Dynamic capabilities and Strategic Management,” *Strategic Management Journal*, 18(7), pp. 509-534.

Tim, Y., Pan, S.L. and Ouyang, T. (2018). “Museum in the Age of Digital Transformation,” *Proceedings of the 22nd Pacific Asia Conference on Information Systems (PACIS 2018).*

Törmer, R.L. (2018). “The Architectural Enablement of a Digital Platform Strategy,” *Proceedings of the 22nd Pacific Asia Conference on Information Systems (PACIS 2018)*.

Weill, P. (1992). “The Relationship between Investment in Information Technology and Firm Performance: A Study of the Value Manufacturing Sector,” *Information Systems Research*, 3(4), pp. 307-333.

Weill, P., and Aral S. (2004). “IT Assets, Organizational Capabilities and Firm Performance: Asset and Capability Specific Complementarities,” *Centre for Information Systems Research, Massachusetts Institute of Technology*, pp. 1-12.

Weill, P., and Aral S. (2005). “IT Assets, Organizational Capabilities and Firm Performance: Do Resource Allocations and Organizational Differences Explain Performance Variation?,” *Centre for Information Systems Research, Massachusetts Institute of Technology*, pp. 1-38.

Weill, P. and Aral S. (2007). “IT Assets, Organizational Capabilities and Firm Performance: Do Resource Allocations and Organizational Differences Explain Performance Variation?,” *Organization Science,* 18(5), pp. 763-780.

Weill, P. and Woerner, S.L. (2013). “Companies with Better Digital Business Models Have Higher Financial Performance,” Research Briefing, 13(7). *Centre for Information Systems Research, Massachusetts Institute of Technology.*

Weill, P. and Woerner, S.L. (2016). “Succeeding at Digital Requires More Infrastructure,” Research Briefing, 16(10). *Centre for Information Systems Research, Massachusetts Institute of Technology.*

Weill, P. and Woerner, S.L. (2018). What’s your Digital Business Model?: Six Questions to Help You Build the Next-Generation Enterprise. Harvard Business Review Press: Boston.

West, S. G., Finch, J. F, and Curran, P. J. (1995) “Structural equation models with no-normal variables: problems and remedies,” in Rick H. Hoyle (ed.), Structural Equation Modeling: Concepts, Issues and Applications, 1995, pp. 56-75.

Wilson, D. (1993). “Assessing the Impact of Information Technology on Organizational Performance,” in *Strategic Information Technology Management*, R. D. Banker, R. J. Kauffman, and M. A. Mahmood, Eds. Idea Group Strategic Information Technology Management Series. Idea Group Publishing, Hershey, PA, pp. 471-514.

Ye, Q., Wu, P., Alam, S.L. and Campbell, J. (2016). “PAJAIS special issue on Social Media and Social Commerce,” *Pacific Asia Journal of the Association for Information Systems,* 8(4), pp.i-vi.

Zhu, X., Ma, C., Su, F. and Mao, Ji. (2018). “How do IT capabilities support fast delivery of big data services to clients across industries?,” *Proceedings of the 22nd Pacific Asia Conference on Information Systems (PACIS 2018).*

APPENDIX SECTION

APPENDIX 1

QUESTIONNAIRE (QUANTITATIVE)

APPENDIX 1 - Questionnaire

デジタル化時代の組織特性と IT に関するアンケート調査

－ 調 査 票 －

◎情報収集の目的

本調査票では、企業調査を目的に、貴社の組織特性と情報化に関わる情報を収集します。企業調査以外の目的での情報収集、利用は行いません。

◎ご回答の方法

ご回答は本冊子に直接ご記入下さい。回答方法には、１つだけ選ぶもの、複数を選ぶもの、記入していただくものの３種類がございますので、ご注意下さい。

◎ご回答の期限

本調査票にご記入いただいた内容は、到着後 2 週間程度にて返信してくださいますようご協力お願い申し上げます。調査票及び返信用封筒を同封しておりますので、ご返信の程よろしくお願いいたします。

◎ご回答結果の取り扱い

本調査票にご記入いただいた内容は、統計的な処理を行うことのみに用い、個別の情報を公表することはございません。

◎お問い合わせ先

本調査票についてご不明な点やご質問事項がございましたら、下記までご連絡を頂戴できればと存じます。

東京工業大学・工学院　経営工学系　●●●●●●
連絡先（E-mail）:　●●●●●●
連絡先（携帯電話）:　●●●●●●
住所：　〒152-8552 東京都目黒区大岡山●●●●

ご回答者のご連絡先

貴社名	
ご所属部署・役職名	
ご回答者名	
電話番号	（　　）　　－
E-mail アドレス	@
さらに深い分析に参加することにご興味がありますか　　1　はい　　2　いいえ	

ご連絡先については差し支えない範囲でご記入下さい。ご回答いただいた内容に不明な点があった場合に限り、連絡を差し上げ、確認させて頂くためのものです。また、上記のご連絡先に分析結果のレポートを送付させていただきたいと存じます。

以下の質問内容は貴社の特性に関するものでございます。なるべく全社レベル（関連会社は含まない）での特性をお答え下さい。全社レベルでの特性を答えることが難しい場合には、ご担当部門における特性をお答え下さい。

Ⅰ．貴社における意思決定の形態についてお伺いいたします。

問１　貴社において事業部長の予算権限を 100 とした場合、以下の役職レベルの予算権限はどの程度に設定されていますか。

部長（　　）　　課長（　　）　　係長（　　）

問２　貴社で最も予算規模の大きな事業をお考えいただき、当てはまるものを a～e の中から各々１つずつお選び下さい。

---

①　新しい商品･サービスのアイデアの話が提案されてから、実行計画の作成が承認（指示）され、事業プロジェクトが始まるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

いくつの承認（稟議書の場合は、印鑑）が必要でしょうか。　（　　）個

---

②　期中に事業部予算の 10%に当たる金額の変更が必要となったとき、変更が決定されるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

---

③　期中にプロジェクト予算の 10%に当たる金額の変更が必要となったとき、変更が決定されるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長

d. プロジェクトリーダー　e. プロジェクトサブリーダー

④　環境が変化し、事業プロジェクトの中止が必要となったとき、中止が提案されてから決定されるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長

d. プロジェクトリーダー　e. プロジェクトサブリーダー

---

⑤　主原材料について、変更によるコストが少ない場合に、より有利な条件を提示するサプライヤーが現れてから取引相手の変更が決定されるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

---

⑥　主原材料コストの変動や競争相手の価格変更が生じてから、価格見直しが必要な場合に実際に新価格が決定されるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

---

⑦　不良品の報告があってから、調査期間を経て回収・返金などの対策が講じられるまでの期間は、どの程度でしょうか。

a. １週間未満　b. １週間～１ヶ月　c. １ヶ月～３ヶ月未満　d. ３ヶ月以上～６ヶ月未満　e. ６ヶ月以上

また、その実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

---

⑧　人事採用の方針について、実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員・事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

---

⑨　製品仕様について、実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長

d. プロジェクトリーダー　e. プロジェクトサブリーダー

---

⑩　主要業務（生産販売等）における各作業のペースについて、実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長　d. 課長･係長・班長　e. 一般社員

---

⑪　プロジェクト内での作業の分配や方法の決定について、実質的な意思決定をされるのは、どなたでしょうか。*(注 1)

a. 社長　b. 役員･事業部長･工場長　c. 部長･ライン長

d. プロジェクトリーダー　e. プロジェクトサブリーダー

---

*(注 1)　実質的な意思決定者とは、最終承認者ではなく、すべての情報を勘案した上で最終結論に近い決断を行う人のことです。例えば、課長が原案を作り、部長が討議を経て答申案を決定し、社長が最終承認する場合、部長が実質的意思決定者となります。経営会議で決定される場合でも、社長のイニシアティブが強い場合には社長を、合議でのイニシアティブの場合には役員を、それぞれ選択して下さい。

Ⅱ．貴社の全般的業務活動についてお伺いいたします。

問３　貴社の知識創造活動について、当てはまるものをお選び下さい。

	はい	いいえ	どちらともいえない
① 商品開発は、販売・製造・他製品部門・サプライヤーなど幅広い関連部門から意見を吸い上げて進めている。	1	2	3
② 大学などの外部機関から技術指導を受けたり、共同研究を実施したりしている。	1	2	3
③ 技術や事業開発等に外部コンサルタントを活用している。	1	2	3
④ 他企業に対するベンチマーキング（他企業といろいろな経営指標について比較・分析すること）は定期・不定期で実施され、手法としても社内で定着している。	1	2	3
⑤ 供給先や提携先と積極的に技術開発や事業開発を行っている。	1	2	3
⑥ 業務に関係する講演会やシンポジウムなどに参加することが奨励されている。	1	2	3
⑦ 業界紙や専門誌などから業務に関する知識を獲得することが奨励されている。	1	2	3

問４　貴社の顧客ニーズ情報の収集方法と成果について、当てはまるものをお選び下さい。

	はい	いいえ	どちらともいえない
① コールセンターや消費者モニターなどは顧客サービスのみならず、顧客ニーズ情報獲得のために利用している。	1	2	3
② 集められた顧客情報は、外部ではなく社内の専門家・アナリストによって分析される。	1	2	3
③ サプライヤーや顧客と直に接する部署では、市場動向や技術動向などの情報収集活動も行うように奨励されている。	1	2	3
④ 顧客に関するプレス発表や各種ニュースを組織的に入手することを業務とする部署がある。	1	2	3
⑤ 貴社製品のエンドユーザーの購入理由を把握している。	1	2	3
⑥ 現在の非顧客がなぜ貴社から購入しないか分かっている。	1	2	3
⑦ 元顧客であった非顧客について、何が原因で貴社からの購入を止めたか分かっている。	1	2	3
⑧ 先進的ユーザーがどちらの方向に向かっているか分かっている。	1	2	3

問５　貴社の競合企業に関する情報の収集方法と成果について、当てはまるものをお選び下さい。

	はい	いいえ	どちらともいえない
①　コールセンターや消費者モニターなどは顧客サービスのみならず、競合企業の情報獲得のために利用している。	1	2	3
②　集められた競合企業の情報は、外部ではなく社内の専門家・アナリストによって分析される。	1	2	3
③　サプライヤーや顧客と直に接する部署では、競合企業の情報収集活動も行うように奨励されている。	1	2	3
④　競合企業に関するプレス発表や各種ニュースを組織的に入手することを業務とする部署がある。	1	2	3
⑤　競合企業の売上高の変化を把握している。	1	2	3
⑥　競合企業の市場シェアの変化を把握している。	1	2	3
⑦　競合企業の原価を把握している。	1	2	3
⑧　競合企業の生産性の変化を把握している。	1	2	3

問６　貴社の情報共有のあり方について、当てはまるものをお選び下さい。

	はい	いいえ	どちらともいえない
① 管理職の人事評価では、コミュニケーション能力が他の評価項目に比べ最も重視されている。	1	2	3
② 自社の業績情報は社内で常に表示されている。	1	2	3
③ 他部門の業績や技術等の最新情報を事業部門の末端にまで浸透させる機会や手段がある。	1	2	3
④ クロスファンクショナルチームのメンバーの評価には、チームの業績が反映される。	1	2	3
⑤ 社内外の成功事例やモデルケースは、表彰式や報告会、イントラネット等で共有するようにしている。	1	2	3
⑥ 外部から入手した市場や技術の動向等（顧客の個人情報は含まない）をイントラネット等で共有するようにしている。	1	2	3
⑦ 業務ノウハウや情報の共有、変化へのすばやい対応を目的とした職場内チーム制を導入している。*(注 2)	1	2	3
⑧ 複数の職場から構成員が集まり、具体的な目標や計画にもとづいて品質やサービスの向上・原価低減・納期確保等を目指す、職場横断的な小集団活動がある。	1	2	3
⑨ 職場内ローテーションなど、技能の幅を広げるための施策を行っている。	1	2	3

*(注 2)　職場内チーム制とは、職場の構成員が仕事の進め方を自主的に決めながら共同で業務を遂行する制度を指します。

問７　クロスファンクショナルチームによるプロジェクトにおいて、各職能はどの部分に関与しますか。当てはまるもの全部に丸をつけて下さい。

	仕様決定	設計	検査・テスト
①　マーケティング	1	2	3
②　製造	1	2	3
③　購買	1	2	3
④　サプライヤー	1	2	3

問８　製品またはサービスの仕様が最終的に決定されるのはどの段階ですか。

a. 仕様書段階　b. 設計段階　c. 生産段階　d. 検査・テスト段階

問９　主要サプライヤーへの品質等のフィードバックはどのような頻度でされますか。

a. 常に　b. 問題が発生したとき　c. なし

問１０　主要ビジネスパートナーに一部の意思決定を委譲していますか。

a. 委譲している項目がある　b. 委譲していない

問１１　以下の戦略（a. b. c.）を、貴社にとって重要な順に並び替えて下さい。また、すべての戦略が同等に重要である場合は、d. に丸をつけて下さい。

a. 事業や製品･サービスの絞り込み　b. 製品･サービスの差別化　c. コスト削減　　d. 同等

（1 位：　　, 2 位：　　, 3 位：　　）

問１２　貴社の社員間のコミュニケーションについて、当てはまるものをお選び下さい。

	はい	いいえ	どちらともいえない
①　職場単位で従業員と管理者が仕事の進め方や職場環境等について話し合うための場がある。	1	2	3
②　他部門や他チームで働く人々同士のコミュニケーションを活性化させるためのしくみがある。	1	2	3
③　トップマネージャーやミドルマネージャーも定期的に現場に訪れる。	1	2	3

問１３　貴社の社内制度や社内風土について、当てはまるものをお選び下さい。

	はい	いいえ	どちらともいえない
①　社内に常に新しいものを生み出そうとする風土がある。	1	2	3
②　社内ではリスクをとって新しいことにチャレンジするように奨励されている。	1	2	3
③　ブレインストーミングについて、研修などで方法を教えたりその場所が用意されているなど重視されている。	1	2	3
④　新しいアイデアを評価する基準が明確になっている。	1	2	3
⑤　製品やサービス等にアイデアが具体化された場合には何らかの報酬が与えられる。	1	2	3
⑥　創造活動をするための時間が特別に用意されている。	1	2	3
⑦　新製品（サービス）の開発に際し、エンドユーザーのニーズを取り込む制度がある。	1	2	3
⑧　新製品（サービス）の開発に際し、リードユーザーの動向を取り込む制度がある。	1	2	3
⑨　あらゆる業界のベストプレーヤーをベンチマークして学ぶ制度がある。	1	2	3
⑩　主要サプライヤーの技術計画を、組織として把握している。	1	2	3
⑪　各プロジェクトの終了後、当初目的と実績との差異を評価し、原因を検討する制度がある。	1	2	3

Ⅲ．貴社の知識共有体制についてお伺いいたします。

問１４　貴社における社員の行動について、重要であると思うものを選択肢の中から上位半数を選び、通し番号に〇をつけて下さい。（〇は１２個程度）

1. 顧客と直接接してニーズや問題点を引き出す。
2. チャートや絵を活用しながらイメージを共有する。
3. 企画書、報告書、市場資料などの「ドキュメント」を作成する。
4. 体感した顧客ニーズや市場トレンドを言葉やコンセプトとして表現する。
5. 新たな事態や展開に直面した場合モデルケースを想定して実験的に業務を試みる。
6. 分析した情報、データを用いて新しい考えを構築していく。
7. 対話や議論を通じて新しい考えを構築していく。
8. 外部の専門家との共同体験や対話を通じてノウハウや視点を体得する。
9. 新たなノウハウやマニュアルを作成し定着させる。
10. 新たな方針や戦略が業務に及ぼす影響を事前にシミュレーションする。
11. 問題を解決するために新しい考えを構築するために仮説やシナリオを作る。
12. コンセプトに基づいて具体化のための計画に展開する。
13. 自分の直感を「たとえ」となる言葉で表現する。
14. 関係部門と共同で情報、データを組み合わせながら新しい考えを構築していく。
15. 得られた情報、データを体系的に分析する。
16. 町や人々の観察を通じて新たな市場機会や戦略の方向性を感知する。
17. 言葉で表現しにくいビジョンや価値観を部下や同僚と共同体験を通じて共有する。
18. 社内外に散在している情報、データを業務目的に沿って収集する。
19. 経験のない試みの際には手本となる人を決めてそれに倣う。
20. 研修やマニュアルを通じて能力、知識を獲得、向上する。
21. ブレインストーミングによって多様なアイデアを生み出す。
22. 社内の成功例を部門部署やチーム、グループ内で共有する。
23. 社内の現場に足を運んで生きた情報を体験的に収集する。
24. 異業種の人々と交流を通じて新たな視点やニーズを感知する。

Ⅳ．貴社の IT(情報技術）活用力成熟度の状況についてお伺いいたします。

問１５　貴社の IT(情報技術）活用力成熟度について、当てはまるものをお選び下さい。（〇は各項目１つずつ）

	あてはまらない (0-15%)	あまりあてはまらない (16-50%)	ややあてはまる (51-85%)	あてはまる (86-100%)	重要性
事業の運営とビジネス上の変革活動の基礎となる、ビジネスニーズに整合した事業計画を、IT 組織が準備している。	1	2	3	4	高・中・低
IT の優先順位や、プログラムの目的、関連する財務計画、資源についてのコミットメントが、どのように IT 戦略全体の実現をサポートするかについて詳述されている事業計画を立てている。	1	2	3	4	高・中・低
組織を運営するためのプロセスが、どの程度共通した標準、手法、ガバナンスモデル、技術を用いて管理されている。	1	2	3	4	高・中・低
組織を運営するためのプロセスが、ビジネス上の価値を促進する優先順位に基づいて、オーナシップの明確化、測定、コントロール、改善、または自動化されている。	1	2	3	4	高・中・低
IT 組織が、方針やガバナンスのためのフレームワークを IT 関連リスク管理に適用している。	1	2	3	4	高・中・低
IT 組織が、多様なソース(例えば、事業の運営、法令遵守、情報セキュリティ、財務、ベンダー）から生じるリスクをどのように識別し、評価し、軽減している。	1	2	3	4	高・中・低
IT 戦略が確実にビジネスの優先事項に沿うよう、ビジネスサイドと IT サイドの整合性が保たれている。	1	2	3	4	高・中・低
すべてのステークホルダが連携できるように、IT の戦略的計画立案がその他の IT プロセスやビジネスプロセスと統合されている。	1	2	3	4	高・中・低
ソーシング戦略が存在し、ＩＴ戦略とビジネス戦略全体をサポートしている。	1	2	3	4	高・中・低
目的達成のために、IT 組織として内部と外部の最適なソーシングパートナー群を選定し管理できている。	1	2	3	4	高・中・低
IT 資金調達レベルと資金調達のソースは、柔軟で、IT 戦略とビジネス戦略に沿ったものとなっている。	1	2	3	4	高・中・低
IT に関する資金調達と財務諸表が、ビジネスと IT の業績目標を達成するよう、モニターされ、コントロールされている。	1	2	3	4	高・中・低

	あてはまらない (0-15%)	あまりあてはまらない (16-50%)	ややあてはまる (51-85%)	あてはまる (86-100%)	重要性
組織のすべてのレベルで、IT 組織がビジネスサイドなどのパートナーとの関係を能動的に管理している。	1	2	3	4	高・中・低
ビジネスサイドと IT 組織間での信頼関係が高いレベルで構築・維持されている。	1	2	3	4	高・中・低
IT ソリューションの要件定義、設計、実装が一貫している。	1	2	3	4	高・中・低
IT ソリューションの提供を通じ、合意されたコスト、品質、機能、スケジュールなどのビジネス要件が満たされている。	1	2	3	4	高・中・低
IT 組織は、ビジネスサイドが設定した要件にしたがって、信頼でき、効率的な IT サービスを提供している。	1	2	3	4	高・中・低
IT サービスの稼働状況が測定、コントロール、改善されている。	1	2	3	4	高・中・低
IT サービスのユーザエクスペリエンスを、ユーザニーズとビジネス要件（例：ユーザインタフェースの一貫性、ユーザビリティ）のバランスを図るように設計されている。	1	2	3	4	高・中・低
IT サービスの有用性と使いやすさがモニターされ、評価され、改善されている。	1	2	3	4	高・中・低

Ⅴ．貴社の IT の活用及びデジタル・テクノロジーによる目標の達成状況についてお伺いいたします。

問１６　貴社の過去３年間の IT 投資（費用・資産）の効果について、最も近いものをお選び下さい。

目標ベースの IT 投資				目標の達成率		各分類ごとに投資したデジタル・テクノロジーに〇をつけて下さい。							
目標		過去３年間のＩＴ予算をどの分類にどのくらい割り振りましたか。全体を１０として例えば、財務４、顧客１、業務プロセス４、学習と成長１のようにお答えください。	各分類におけるＩＴ投資のうち「デジタル・テクノロジー」に投資した割合はどのくらいですか（０～１０でお答えください）。	ＩＴ投資の目標（目的）はどの程度達成されましたか？	「デジタル・テクノロジー」への投資の目標（目的）はどの程度達成されましたか？	モバイル技術	クラウド技術	SNS	ビッグデータ・アナリティクス	IoT	人工知能（IA）	３Dプリンティング技術	その他
分類	内容												
財務	収益の拡大、生産性の向上、財務体質の健全化、その他			[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)	[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)								
顧客	顧客満足度の向上、顧客ロイヤリティの向上、新規顧客への売上拡大、その他			[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)	[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)								
業務プロセス	品質の向上、生産性の向上、その他			[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)	[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)								
学習と成長	人材確保、人材教育、創造力、開発力、人間力、等			[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)	[　] 達成されていない (0-15%) [　] 部分的に達成された (16-50%) [　] 大いに達成された (51-85%) [　] 完全達成済み (86-100%)								

合計１０

デジタル・テクノロジーとは、一つの技術を指すのではなく相互に繋がった技術の集合体を意味する。

「モバイル技術」：　スマートフォンやタブレット端末（いつでも、どこでも人々は“手のひら”の中であらゆる情報やサービスの恩恵を受けることができる）。

「クラウド技術」：　従来は利用者が所有して使っていたハードウェアやソフトウェア、データなどの「さまざまなコンピューター資源や機能」を、所有することなく「サービス」として、必要なときに、必要なだけ使える IT 環境、あるいは形態のことある。

「SNS（Social Networking Service）」：　登録された利用者同士が交流できる Web サイトの会員制サービス（Facebook、Twitter、Instagram、LINE 等）。

「ビッグデータ」：　従来 IT 部門が取り扱ってきた構造化データに加えて、Web ログやソーシャルメディアのデータ、さらにはセンサーデータなどの非構造化データを含めた大量のデータ群を指す言葉。ビッグデータを収集／分析して、ビジネス課題の解決や将来予を行うためには、ビジネスアナリティクスを活用する必要がある。

「IoT（Internet of Things）」：　モノのインターネットとは、様々な「モノ（物）」がインターネットに接続され、情報交換することにより相互に制御する仕組みである。

「人工知能」：　学習・推論・判断といった人間の知能のもつ機能を備えたコンピューターシステム。応用として，自然言語の理解，機械翻訳，エキスパートシステムなどがある。

「３Ｄプリンティング技術」：　レイヤーごとにオブジェクトを積み重ねて立体物にする積層造形工法。 お客様の要求する素材、外観、機械的特性、性能によってテクノロジーの種類が決まる。

以上で、アンケートは終了です。
ご協力いただきまして誠にありがとうございました。

APPENDIX 2

DESCRIPTIVE STATISTICS FOR THE KEY VARIABLES

APPENDIX 2 - Descriptive statistics and normality tests for key variables

	Descriptive Statistics									Tests of Normality					
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis		Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error	Statistic	df	Sig.	Statistic	df	Sig.
Digital Business Value															
DI_Ach_BP	24	1.00	4.00	2.500	.722	.378	.472	-.012	.918	.297	24	.000	.830	24	.001
DI_Ach_Cu	25	1.00	4.00	2.360	.757	-.107	.464	-.263	.902	.243	25	.001	.853	25	.002
DI_Ach_Fi	24	1.00	4.00	2.250	.794	.071	.472	-.349	.918	.249	24	.000	.864	24	.004
DI_Ach_LD	19	1.00	4.00	2.053	.970	.701	.524	-.199	1.014	.258	19	.002	.848	19	.006
DI_Ovr_Ach_AVG	28	1.00	4.00	2.289	.669	.271	.441	.823	.858	.155	28	.085	.961	28	.374
Digital Investment															
DI_Inv_BP	24	0.50	90.00	21.589	21.661	1.668	.472	3.384	.918	.165	24	.089	.836	24	.001
DI_Inv_Cu	26	0.00	49.00	14.049	12.815	1.130	.456	.798	.887	.162	26	.076	.888	26	.009
DI_Inv_Fi	26	0.00	20.00	4.567	4.924	1.667	.456	2.942	.887	.238	26	.001	.820	26	.000
DI_Inv_LD	24	0.00	16.00	2.351	3.545	2.824	.472	9.456	.918	.254	24	.000	.662	24	.000
c_DI_Inv_LD	24	-2.35	13.64	.000	3.545	2.824	.472	9.456	.918	.254	24	.000	.662	24	.000
DI_Inv_Tot	24	6.70	70.00	37.942	17.000	.255	.472	-.121	.918	.113	24	.200	.954	24	.327
IT Business Value															
IT_Ach_BP	28	2.00	3.00	2.536	.508	-.151	.441	-2.135	.858	.355	28	.000	.637	28	.000
IT_Ach_Cu	31	0.00	4.00	2.323	.832	-.689	.421	.842	.821	.244	31	.000	.853	31	.001
IT_Ach_Fi	29	1.00	3.00	2.414	.733	-.850	.434	-.566	.845	.340	29	.000	.735	29	.000
IT_Ach_LD	23	1.00	4.00	2.087	.793	.437	.481	.150	.935	.283	23	.000	.852	23	.003

IT_Ovr_Ach_AVG	32	1.50	3.50	2.347	.481	.206	.414	-.211	.809	.111	32	.200	.968	32	.458

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis		Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error	Statistic	df	Sig.	Statistic	df	Sig.
IT Investment															
IT_Inv_BP	29	0.00	90.00	36.336	21.488	.537	.434	.564	.845	.191	29	.008	.947	29	.150
IT_Inv_Cu	29	10.00	70.00	31.958	17.271	.574	.434	-.549	.845	.166	29	.040	.919	29	.029
IT_Inv_Fi	29	0.00	50.00	19.631	10.485	.489	.434	1.357	.845	.210	29	.002	.905	29	.013
IT_Inv_LD	29	0.00	50.00	12.076	10.818	1.555	.434	4.238	.845	.231	29	.000	.817	29	.000
Knowledge Creation Perspective															
Balanced_SECI_KCC	33	0.00	3.00	1.212	.857	-.120	.409	-1.033	.798	.245	33	.000	.844	33	.000
c_Balanced_SECI_KCC	33	-1.21	1.78	.000	.857	-.120	.409	-1.033	.798	.262	24	.000	.792	24	.000
C_raw	33	0.00	6.00	2.455	1.502	.388	.409	-.455	.798	.167	33	.020	.938	33	.060
Combination	33	-1.63	2.36	.000	1.000	.388	.409	-.455	.798	.167	33	.020	.938	33	.060
E_raw	33	0.00	5.00	2.091	1.331	.331	.409	-.164	.798	.164	33	.025	.932	33	.040
Externalization	33	-1.57	2.18	.000	1.000	.331	.409	-.164	.798	.164	33	.025	.932	33	.040
I_raw	33	0.00	5.00	2.303	1.311	-.072	.409	-.730	.798	.187	33	.005	.935	33	.050
Internalization	33	-1.76	2.06	.000	1.000	-.072	.409	-.731	.798	.187	33	.005	.935	33	.050
S_raw	33	0.00	5.00	3.061	1.298	-.758	.409	.273	.798	.209	33	.001	.902	33	.006
SECI_raw_sum	33	2.00	13.00	9.909	3.186	-1.165	.409	.011	.798	.320	33	.000	.764	33	.000
Socialization	33	-2.36	1.49	.000	1.000	-.758	.409	.273	.798	.209	33	.001	.902	33	.006

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis		Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error	Statistic	df	Sig.	Statistic	df	Sig.
Strategic Decision Making Perspective (OIQ)															
z_CI	32	-1.86	2.26	.0000	1.000	.451	.414	-.123	.809	.103	32	.200	.972	32	.559
z_EDA	33	-2.57	2.01	-.0001	1.000	-.366	.409	.412	.798	.067	33	.200	.985	33	.925
z_EIA	33	-2.03	1.49	.0000	1.000	-.295	.409	-1.163	.798	.131	33	.163	.941	33	.072
z_IKD	32	-2.29	2.00	.0001	1.000	-.212	.414	.048	.809	.102	32	.200	.979	32	.762
z_OIQ	33	-2.44	1.60	.0001	1.000	-.485	.409	-.055	.798	.114	33	.200	.969	33	.452
z_OIQ_Sum	33	-6.16	4.49	-.0001	2.692	-.376	.409	-.356	.798	.083	33	.200	.977	33	.686
Technological Capability Perspective (SME IT-CMF)															
BP_mat	31	1.00	4.00	2.516	.790	.052	.421	-.496	.821	.162	31	.036	.951	31	.162
BPM_mat	29	1.00	3.50	2.328	.827	-.014	.434	-1.226	.845	.171	29	.029	.913	29	.020
FF_mat	31	1.00	3.50	2.242	.740	-.329	.421	-.875	.821	.202	31	.002	.877	31	.002
IT_Mat_score	32	1.00	3.25	2.423	.618	-1.167	.414	.729	.809	.203	32	.002	.870	32	.001
c_IT_Mat_score	32	-1.42	0.827	.000	.618	-1.167	.414	.729	.809	.211	24	.007	.819	24	.001
IT_Mat_SUM	31	9.00	32.50	24.210	5.803	-1.086	.421	1.057	.821	.136	31	.149	.916	31	.018
RAM_mat	31	1.00	4.00	2.661	.860	-.539	.421	-.128	.821	.169	31	.024	.915	31	.018
RM_mat	31	1.00	4.00	2.355	.733	-.206	.421	.080	.821	.185	31	.008	.917	31	.020
SD_mat	30	1.00	4.00	2.683	.815	-.847	.427	-.038	.833	.251	30	.000	.881	30	.003
SP_mat	31	1.00	3.50	2.597	.700	-.913	.421	.160	.821	.234	31	.000	.869	31	.001
SRC_mat	30	1.00	3.50	2.200	.738	-.273	.427	-.903	.833	.161	30	.046	.904	30	.010
SRP_mat	30	1.00	3.50	2.550	.723	-.552	.427	-.399	.833	.200	30	.004	.914	30	.019
UED_mat	31	1.00	4.00	2.500	.683	-.084	.421	.274	.821	.168	31	.027	.931	31	.046

APPENDIX 3

GLOSSARY OF TERMS AND VARIABLES

APPENDIX 3 - Glossary of Terms and Variables

Categories

General
Digital Business Value
Digital Investment
IT Business Value
IT Investment
Knowledge Creation
Strategic Decision M.
Technological Capability

Glossary of terms:

Abbreviaion	Description	Category
ANOVA	Analysis of Variance	General
BP	Business Planning critical capability of IT-CMF	Technological Capability
BPM	Business Process Management critical capability of IT-CMF	Technological Capability
CI	Continuous Innovation dimension of Organizational IQ	Strategic Decision M.
CISR	Centre for Information Systems Research from Massachusetts Institute of Technology	General
EDA	Effective Decision Architecture dimension of Organizational IQ	Strategic Decision M.
EIA	External Information Awareness dimension of Organizational IQ	Strategic Decision M.
FF	Funding and Financial critical capability of IT-CMF	Technological Capability
GLM	General Linear Model	General
IKD	Internal Knowledge Dissemination dimension of Organizational IQ	Strategic Decision M.
IT	Information Technology	General
IT-CMF	IT Capability Maturity Framework	Technological Capability
IVI	Innovation Value Institute	General
KCC	Knowledge Creation Capabilities	Knowledge Creation
METI	Ministry of Economy, Trade and Industry in Japan	General
OF	Organizational Focus dimension of Organizational IQ	Strategic Decision M.
OIQ	Organizational Intelligence Quotient	Strategic Decision M.
RAM	Relationship Asset Management critical capability of IT-CMF	Technological Capability
RM	Risk Management critical capability of IT-CMF	Technological Capability
SD	Solutions Delivery critical capability of IT-CMF	Technological Capability
SECI	The SECI Model: Socialization, Externalization, Combination and Internalization	Knowledge Creation
SMACIT	Social, Mobile, Analytics, Cloud and Internet of Things	General
SME	Small and Medium Enterprise	General
SME IT-CMF	IT Capability Maturity Framework for Small and Medium Enterprises	Technological Capability
SP	Strategic Planning critical capability of IT-CMF	Technological Capability
SRC	Sourcing critical capability of IT-CMF	Technological Capability
SRP	Service Provisioning critical capability of IT-CMF	Technological Capability
UED	User Experience Design critical capability of IT-CMF	Technological Capability

Glossary of Variables:

Variable	Description	Category
Balanced_SECI_KCC	Minimum score among the four SECI processes	Knowledge Creation
BP_mat	Maturity score for Business Planning critical-capability	Technological Capability
BP_mat_LMH	Group Category: Low, Medium, High of Business Planning critical-capability (BP_mat)	Technological Capability
BPM_mat	Maturity score for Business Process Management critical-capability	Technological Capability
BPM_mat_LMH	Group Category: Low, Medium, High of Business Process Management critical-capability (BPM_mat)	Technological Capability
c_Balanced_SECI_KCC	Centered values of Balanced_SECI_KCC	Knowledge Creation
c_DI_Inv_LD	Centered values of DI_Inv_LD	Digital Investment
c_IT_Mat_score	Centered values of IT_Mat_score	Technological Capability
C_raw	Score of Combination Process from SECI Model	Knowledge Creation
Cap_JPY	Capital Amount	General
Cat_Capital	Group Category: Low, Medium, High of Standardized score of Capital (zCapital)	General
Cat_Size_Total_Emp	Group Category: Low, Medium, High of Total Employees	General
Cat_Yrs_activity	Group Category: New, Old of years of operation (Yrs_activity)	General
CI_raw	Raw score for Continuous Innovation (CI) dimension of OIQ	Strategic Decision M.
Combination	Standardized scores of C_raw	Knowledge Creation
Combination_LMH	Group Category: Low, Medium, High of Combination Process from SECI Model (Combination)	Knowledge Creation
DI_Ach_BP	Achievement of Business Process-related objectives by the use of Digital Technologies (average of the past 3 years)	Digital Business Value
DI_Ach_BP_Cat	Group Category: Low, Medium, High of Digital Business Value on Business Process objectives (DI_Ach_BP)	Digital Business Value
DI_Ach_Cat1_LMH	Group Category: Low, Medium, High of Digital Business Value (DI_Ovr_Ach_AVG)	Digital Business Value
DI_Ach_Cu	Achievement of Customer-related objectives by the use of Digital Technologies (average of the past 3 years)	Digital Business Value
DI_Ach_Cu_Cat	Group Category: Low, Medium, High of Digital Business Value on Customer objectives (DI_Ach_Cu)	Digital Business Value
DI_Ach_Fi	Achievement of Financial-related objectives by the use of Digital Technologies (average of the past 3 years)	Digital Business Value
DI_Ach_Fi_Cat	Group Category: Low, Medium, High of Digital Business Value on Financial objectives (DI_Ach_Fi)	Digital Business Value
DI_Ach_LD	Achievement of Learning & Growth-related objectives by the use of Digital Technologies (average of the past 3 years)	Digital Business Value
DI_Ach_LG_Cat	Group Category: Low, Medium, High of Digital Business Value on Learning & Growth objectives (DI_Ach_LD)	Digital Business Value
DI_Inv_BP	Investment in Digital Technologies for Business Process-related objectives (in % from IT investment over the past 3 years)	Digital Investment
DI_Inv_BP_raw	Raw score of investment in Digital Technologies for Business Process-related objectives (DI_Inv_BP)	Digital Investment
DI_Inv_Cu	Investment in Digital Technologies for Customer-related objectives by the use of Digital Technologies (in % from IT investment over the past 3 years)	Digital Investment

Variable	Description	Category
DI_Inv_Cu_raw	Raw score of investment in Digital Technologies for Customer-related objectives by the use of Digital Technologies (DI_Inv_Cu)	Digital Investment
DI_Inv_Fi	Investment in Digital Technologies for Financial-related objectives by the use of Digital Technologies (in % from IT investment over the past 3 years)	Digital Investment
DI_Inv_Fi_raw	Raw score of investment in Digital Technologies for Financial-related objectives by the use of Digital Technologies (DI_Inv_Fi)	Digital Investment
DI_Inv_LD	Investment in Digital Technologies for Learning & Growth-related objectives by the use of Digital Technologies (in % from IT investment over the past 3 years)	Digital Investment
DI_Inv_LD_LMH	Investment in Digital Technologies for Learning & Growth-related objectives by the use of Digital Technologies (in % from IT investment over the past 3 years)	Digital Investment
DI_Inv_LD_raw	Raw score of investment in Digital Technologies for Learning & Growth-related objectives by the use of Digital Technologies (DI_Inv_LD)	Digital Investment
DI_Inv_Tot	Investment in Digital technologies for each of the 4 types of business objectives (sum)	Digital Investment
DI_Inv_Tot_LMH	Group Category: Low, Medium, High of Investment in Digital Technologies (DI_Inv_Tot)	Digital Investment
DI_Ovr_Ach_AVG	Digital Business Value (average of the achievement of business objectives through Digital Technologies over the past 3 years)	Digital Business Value
E_raw	Score of Externalization Process from SECI Model	Knowledge Creation
EDA_raw	Raw score for Effective Decision Architecture (EDA) dimension of OIQ	Strategic Decision M.
EIA_raw	Raw score for External Information Awareness (EIA) dimension of OIQ	Strategic Decision M.
Externalization	Standardized scores of E_raw	Knowledge Creation
Externalization_LMH	Group Category: Low, Medium, High of Externalization Process from SECI Model (Externalization)	Knowledge Creation
FF_mat	Maturity score for Financial and Funding critical-capability	Technological Capability
FF_mat_LMH	Group Category: Low, Medium, High of Financial and Funding critical-capability (FF_mat)	Technological Capability
I_raw	Score of Internalization Process from SECI Model	Knowledge Creation
ID	Case ID	General
IKD_raw	Raw score for Internal Knowledge Dissemination (IKD) dimension of OIQ	Strategic Decision M.
Industry	Industry code	General
Industry_AdvTech_use	Group Category: Low, High rate of usage of advanced technologies (i.e. AI, big data, IoT and Robot Process Automation)	General
Internalization	Standardized scores of I_raw	Knowledge Creation
Internalization_LMH	Group Category: Low, Medium, High of Internalization Process from SECI Model (Internalization)	Knowledge Creation
IT_Ach_BP	Achievement of Business Process-related objectives by the use of IT (average of the past 3 years)	IT Business Value
IT_Ach_Cat1_LMH	Group Category: Low, Medium, High of IT Business Value (IT_Ovr_Ach_AVG)	Technological Capability
IT_Ach_Cu	Achievement of Customer-related objectives by the use of IT (average of the past 3 years)	IT Business Value
IT_Ach_Fi	Achievement of Financial-related objectives by the use of IT (average of the past 3 years)	IT Business Value
IT_Ach_LD	Achievement of Learning & Growth-related objectives by the use of IT (average of the past 3 years)	IT Business Value
IT_Inv_BP	Investment in IT for Business Process-related objectives (percentage from all IT spending, average of the past 3 years)	IT Investment

Variable	Description	Category
IT_Inv_Cu	Investment in IT for Customer-related objectives (percentage from all IT spending, average of the past 3 years)	IT Investment
IT_Inv_Fi	Investment in IT for Financial-related objectives (percentage from all IT spending, average of the past 3 years)	IT Investment
IT_Inv_LD	Investment in IT for Learning & Growth-related objectives (percentage from all IT spending, average of the past 3 years)	IT Investment
IT_Mat_Cat1_LMH	Group Category: Low, Medium, High of IT Maturity (IT_Mat_score)	Technological Capability
IT_Mat_score	Average Maturity score of the 10 critical-capabilities	Technological Capability
IT_Mat_SUM	The aggregated score of the 10 critical-capabilities	Technological Capability
IT_Ovr_Ach_AVG	IT Business Value (average of the achievement of business objectives through IT over the past 3 years)	IT Business Value
KCC_Cat_nmbr	Group Category: Low, Medium, High of Knowledge Creation Capabilities (Balanced_SECI_KCC)	Knowledge Creation
KCC_Cat_nmbr_half	Group Category: Lower half, Higher half of Knowledge Creation Capabilities (Balanced_SECI_KCC)	Knowledge Creation
Ln_Capital	Transformed Capital Amount (Ln)	General
OIQ_raw	Raw score of the aggregated score of the four dimensions of OIQ	Strategic Decision M.
RAM_mat	Maturity score for Relationship Asset Management critical-capability	Technological Capability
RAM_mat_LMH	Group Category: Low, Medium, High of Relationship Asset Management critical-capability (RAM_mat)	Technological Capability
RM_mat	Maturity score for Risk Management critical-capability	Technological Capability
RM_mat_LMH	Group Category: Low, Medium, High of Risk Management critical-capability (RM_mat)	Technological Capability
S_raw	Score of Socialization Process from SECI Model	Knowledge Creation
SD_mat	Maturity score for Solutions Delivery critical-capability	Technological Capability
SD_mat_fixed_LMH	Group Category: Low, Medium, High of Solution Delivery critical-capability (SD_mat)	Technological Capability
SECI_RAW_Cat_nmbr	Group Category: Low, Medium, High of Knowledge Creation Capabilities (SECI_raw_sum)	Knowledge Creation
SECI_raw_sum	The aggregated score for the four SECI processes	Knowledge Creation
Socialization	Standardized scores of S_raw	Knowledge Creation
Socialization_LMH	Group Category: Low, Medium, High of Socialization Process from SECI Model (Socialization)	Knowledge Creation
SP_mat	Maturity score for Strategic Planning critical-capability	Technological Capability
SP_mat_fixed_LMH	Group Category: Low, Medium, High of Strategic Planning critical-capability (SP_mat)	Technological Capability
SRC_mat	Maturity score for Sourcing critical-capability	Technological Capability
SRC_mat_LMH	Group Category: Low, Medium, High of Sourcing critical-capability (SRC_mat)	Technological Capability
SRP_mat	Maturity score for Service Provisioning critical-capability	Technological Capability
SRP_mat_LMH	Group Category: Low, Medium, High of Service Provisioning critical-capability (SRP_mat)	Technological Capability
txt_Industry	Industry name	General

Variable	Description	Category
UED_mat	Maturity score for User Experience Design critical-capability	Technological Capability
UED_mat_LMH	Group Category: Low, Medium, High of User Experience Design critical-capability (UED_mat)	Technological Capability
Yrs_activity	Years of operation	General
z_CI	Standardized score for Continuous Innovation (CI) dimension of OIQ	Strategic Decision M.
z_CI_Cat_num	Group Category: Low, Medium, High of standardized score for Continuous Innovation (CI) dimension of OIQ (z_CI)	Strategic Decision M.
z_DI_Inv_Tot	Standardized score of investment in Digital technologies (DI_Inv_Tot)	Strategic Decision M.
z_EDA	Standardized score for Effective Decision Architecture (EDA) dimension of OIQ	Strategic Decision M.
z_EDA_Cat_num	Group Category: Low, Medium, High of standardized score for Effective Decision Architecture (EDA) dimension of OIQ (z_EDA)	Strategic Decision M.
z_EIA	Standardized score for External Information Awareness (EIA) dimension of OIQ	Strategic Decision M.
z_EIA_Cat_num	Group Category: Low, Medium, High of standardized score for External Information Awareness (EIA) dimension of OIQ (z_EIA)	Strategic Decision M.
z_IKD	Standardized score for Internal Knowledge Dissemination (IKD) dimension of OIQ	Strategic Decision M.
z_IKD_Cat_num	Group Category: Low, Medium, High of standardized score for Internal Knowledge Dissemination (IKD) dimension of OIQ (z_IKD)	Strategic Decision M.
z_OIQ	Standardized score of the aggregated score of the four dimensions of OIQ	Strategic Decision M.
z_OIQ_Sum	The aggregated score of the four dimensions of OIQ	Strategic Decision M.
z_OIQ_Sum_Cat_num	Group Category: Low, Medium, High of standardized score of OIQ (z_OIQ_Sum)	Strategic Decision M.
zCapital	Standardized score of Capital	General

APPENDIX 4

DATA SET

APPENDIX 4 - Data

ID	Industry	txt_Industry	Cat_Size_Total_Emp	Cap_JPY	Yrs_activity	S_raw	E_raw	C_raw	I_raw	SECI_raw_sum	Balanced_SECI_KCC	IT_Inv_Fi	DI_Inv_Fi_raw	DI_Inv_Fi	IT_Inv_Cu	DI_Inv_Cu_raw
1	8	Construction	2	20000000	45	4	2	3	3	12	2	0	0	0	20	20
2	11	Manufacturing	3	40000000	67	5	3	2	2	12	2	20	20	4	30	40
3	11	Manufacturing	2	10000000	40	3	3	4	3	13	3	20			60	
4	11	Manufacturing	2	30000000	72	4	1	4	1	10	1	20	50	10	20	80
5	11	Manufacturing	1	35000000	57	1	1	6	4	12	1	30	30	9	20	50
6	11	Manufacturing	1		52	4	3	3	1	11	1	20	20	4	60	60
7	6	Transportation	1	66000000	23	0	1	4	2	7	0	30			10	
8	1	Service	1	10000000	15	3	4	3	2	12	2					
9	1	Service	2	30000000	52	3	2	3	4	12	2	10	30	3	50	40
10	4	Printing	3	20000000	13	4	1	3	5	13	1	20	30	6	40	70
11	9	Gravel sampling	2	10000000	52	1	2	3	1	7	1					
12	3	Other (dental technician)	3	50000000	50	3	2	3	4	12	2	0	0	0	10	0
13	8	Construction	2	50000000	41	4	5	1	2	12	1	10	10	1	10	20
14	5	Food & Beverage	2	3000000	15	4	1	1	3	9	1	20	30	6	60	60
15	1	Service	3	50000000	27	3	3	2	4	12	2	18.18	20	3.636364	54.55	40
16	7	Wholesale	2	46000000	63	4	2	3	3	12	2	20	10	2	20	30
17	11	Manufacturing	1	10000000	36	0	0	1	1	2	0					
18	4	Printing	1	3000000	19	3	2	5	2	12	2	30	30	9	70	70
19	11	Manufacturing	2	10000000	55	2	0	1	1	4	0	30	0	0	40	20
20	8	Construction	3	50000000	71	4	5	1	2	12	1	20	0	0	40	40
21	7	Wholesale	1	10000000	53	2	1	1	0	4	0					
22	2	Other	2	10000000	54	2	2	2	0	6	0	30	30	9	10	0
23	1	Service	2	3600000	31	2	3	4	3	12	2	20	20	4	20	20
24	7	Wholesale	3	100000000	33	4	3	1	1	9	1	30	10	3	30	10
25	1	Service	3	50000000	32	5	3	1	3	12	1	10	10	1	10	10
26	10	Information and communicat	1	10000000	35	3	1	0	0	4	0	10	10	1	40	70
27	11	Manufacturing	3	60000000	44	3	0	2	3	8	0	50	40	20	30	30
28	4	Printing	1	20000000	18	2	4	2	3	11	2	11.11	10	1.111111	22.22	20
29	11	Manufacturing	3	13000000	45	3	2	5	2	12	2	20	20	4	30	70
30	11	Manufacturing	2	360000000	70	4	0	0	1	5	0	10			30	
31	4	Printing	2	310000000	42	5	3	1	3	12	1	20	10	2	30	20
32	11	Manufacturing	2	20000000	61	3	2	4	3	12	2	30	50	15	20	40
33	1	Service	2	10000000	32	4	2	2	4	12	2	10	10	1	40	40

DI_Inv_Cu	IT_Inv_BP	DI_Inv_BP_raw	DI_Inv_BP	IT_Inv_LD	DI_Inv_LD_raw	DI_Inv_LD	DI_Inv_Tot	IT_Ach_Fi	DI_Ach_Fi	IT_Ach_Cu	IT_Ach_BP	DI_Ach_BP	IT_Ach_LD	DI_Ach_LD	z_DI_Inv_Tot	DI_Inv_Tot_LMH
4	30	10	3	50	10	5	12			1	2	1	2	1	-1.52569	1
12	30	40	12	20	40	8	36	3	4	3	3	4	3	4	-0.11414	2
	0			20				2	1	2			2	1		
16	50	80	40	10	30	3	69	2	2	2	2	2	2	2	1.82675	3
10	40	50	20	10	50	5	44	3	3	2	3	3	3	3	0.35638	2
36	10	10	1	10	10	1	42	2	2	1	2	2	1	1	0.23875	2
	50			10												
								2	2	3	3	3	2	2		
20	20	20	4	20	10	2	29	3	2	3	3	3	3	3	-0.52584	1
28	40	90	36	0	0	0	70	3		2	3				1.88556	3
								3	2	2	2	2	2	2		
0	90	100	90	0						2	2	2				
2	70	60	42	10	10	1	46	3	3	2	2	3	2	2	0.47401	3
36	10	5	0.5	10	5	0.5	43	1	1	2	2	2	1	1	0.29756	2
21.818182	18.18	20	3.636364	9.09	20	1.818182	30.9	1	1	3					-0.41356	2
6	30	40	12	30	10	3	23	3	3	2	3	2	3	3	-0.87873	1
								3	3	3	2	2	1	1		
49	0			0				1	1	3						
8	30	10	3	0	0	0	11	3		3	3	4			-1.58451	1
16	40	60	24	0	0	0	40	3		2	2	2			0.12112	2
										3	2		2			
0	40	70	28	20	0	0	37	3	3	0	2	2	2		-0.05532	2
4	40	40	16	20	20	4	28	2	2	2	3	3	2	2	-0.58466	1
3	30	80	24	10	0	0	30	3	2	3	3	2	1		-0.46703	2
1	80	80	64	0	0	0	66	1		1	3				1.6503	3
28	30	10	3	20	10	2	34	2	2	2	3	3	2	2	-0.23177	2
9	10	20	2	10	10	1	32	3	3						-0.3494	2
4.444444	55.56	50		11.11	10	1.111111	6.7	3	3	3	3	3	2	2	-1.83937	1
21	30	60	18	20	80	16	59	3	2	4	3	3	4	4	1.2386	3
	60			0				2		3	3					
6	40	60	24	10	10	1	33	3	3	3	2	2	1	1	-0.29058	2
8	40	80	32	10	0	0	55	2	2	2	3	3	3		1.00334	3
16	40	40	16	10	10	1	34	2	2	3	2	2	2	2	-0.23177	2

IT_Ovr_Ach_AVG	DI_Ovr_Ach_AVG	IT_Ach_Cat1_LMH	DI_Ach_Cat1_LMH	DI_Inv_LD_LMH	Ln_Capital	KCC_Cat_nmbr	SECI_RAW_Cat_nmbr	BP_mat	BPM_mat	RM_mat	SP_mat	SRC_mat	FF_mat	RAM_mat	SD_mat	SRP_mat
1.67	1	1	1	3	16.811	2	3	2	1.5	1	1.5	1.5	2	1	1.5	2
3	4	3	3	3	17.504	2	3	4	3.5	3	2.5	2.5	2	3	2.5	2
2	1	1	1		16.118	3	3	1	1	1	1	1	1	1	1	1
2	2	1	1	3	17.217	2	2	3	2	2	3.5	3	3.5	3	3	2.5
2.75	2.75	3	3	3	17.371	2	3	3.5	2	3	3	1.5	2	3	3.5	2.5
1.5	1.5	1	1	2		2	2	2.5	2	2	2	2.5	2	4	3	3
					18.005	1	1	3		3	3		3	2.5	3	
2.5	2.5	2	2	1	16.118	2	3	2.5	1.5	3	3.5	2	2	2.5	2	2
3	2.75	3	3	2	17.217	2	3	3	3	3	3	3	3	3	3	3
2.67		2		1	16.811	2	3	2	2.5	3.5	3.5	2	2	2	3.5	3
2.25	2	2	1		16.118	2	1	1.5	2	2.5	3	2.5	3	2	3	3
2	2	1	1		17.728	2	3	2.5	1	2	2	2.5	1.5	2	1.5	1.5
2.25	2.75	2	3	2	17.728	2	3	2	3	2.5	3	2	3	2.5	3.5	3
1.5	1.5	1	1	2	14.914	2	2	2	3	3	2.5	2	1	2.5	2	2
2	2	1	1	2	17.728	2	3	2	2	2.5	2.5	2	2	3.5	2.5	2
2.75	2.5	3	2	3	17.644	2	3	3	3.5	2.5	3	3	3	4	3.5	3.5
2.25	2.25	2	2		16.118	1	1	3.5	1.5	2	3	1	1	1	2.5	2
2	1.5	1	1		14.914	2	3	2	3.5	2	2.5	3	2	2	3	3
3	3.5	3	3	1	16.118	1	1	4	2.5	4	3.5	2	3	3	4	2.5
2.33	2	2	1	1	17.728	2	3	2		2.5	3	2	2	3	2.5	2.5
2.33		2			16.118	1	1									
1.75	2.5	1	2	1	16.118	1	1	3	1.5	2.5	2.5	1	2	3		3.5
2.25	2.25	2	2	3	15.096	2	3	2.5	2.5	2	2.5	3	3	3.5	3.5	3
2.5	2	2	1	1	18.421	2	2	2	2	2	1.5	2	2.5	3	3	3
1.67		1		1	17.728	2	3		1	1	1	1	1	1	1	1
2.25	2.25	2	2	2	16.118	1	1	1								
3	3	3	3	2	17.91	1	1	1.5	3.5	3	2.5	2.5	2.5	3.5	3	3.5
2.75	2.75	3	3	2	16.811	2	2	2.5	3	3	3	3	3	3	3	3
3.5	3	3	3	3	16.38	2	3	3	3.5	2	2.5	2	3	3.5	3	3.5
2.67		2			19.702	1	1	2	1.5	1	1.5	1	1	2.5	1	1.5
2.25	2.25	2	2	2	19.552	2	3	3.5	2	2	3	3.5	2.5	2.5	3.5	2.5
2.5	2.33	2	2	1	16.811	2	3	2.5	3	2	3	3	2	2.5	2.5	2.5
2.25	2.25	2	2	2	16.118	2	3	3.5	3	2.5	3	3	3	4	3	3.5

UED_mat	IT_Mat_score	IT_Mat_Cat1_LMH	IT_Mat_SUM	EDA_raw	EIA_raw	IKD_raw	CI_raw	OIQ_raw	z_EDA	z_EIA	z_IKD	z_CI	z_OIQ_Sum	z_OIQ	z_OIQ_Cat_num	z_OIQ_Sum_Cat_num
2	1.6	1	16	4.312	1.052	1.617	0.75	7.73	1.08	-0.854	-0.637	-1.147	-1.558	-0.483	2	2
2.5	2.75	2	27.5	3.87	1.349	2.867	1.833	9.919	-0.28	0.124	1.996	1.929	3.769	1.542	3	3
1	1	1	10	3.654	0.693	1.217	0.833	6.397	-0.946	-2.033	-1.479	-0.91	-5.368	-1.716	1	1
2	2.75	2	27.5	3.766	1.086	1.517	1	7.369	-0.6	-0.742	-0.847	-0.437	-2.626	-0.817	1	1
2	2.6	2	26	4.084	1.584	2.778	1.033	9.48	0.38	0.897	1.809	-0.342	2.743	1.135	3	3
2.5	2.55	2	25.5	4.058	1.262	2.033	1.146	8.5	0.3	-0.163	0.241	-0.023	0.355	0.229	2	2
3	2.93	3	20.5	3.125	0.908	1.167	0.917	6.116	-2.574	-1.327	-1.584	-0.673	-6.159	-1.975	1	1
3	2.4	2	24	4	1.111	2.2	1.104	8.415	0.12	-0.659	0.592	-0.141	-0.088	0.151	2	2
3	3	3	30	4.26	1.765	1.833	1.95	9.808	0.92	1.492	-0.18	2.26	4.492	1.439	3	3
2.5	2.65	2	26.5	3.867	1.721	1.75	1.563	8.9	-0.29	1.346	-0.356	1.16	1.86	0.599	3	2
2.5	2.5	2	25	3.477	1.083	2.125	0.5	7.186	-1.489	-0.75	0.434	-1.856	-3.662	-0.986	1	1
2	1.85	1	18.5	3.968	1.533	2.133	0.833	8.468	0.02	0.73	0.451	-0.91	0.291	0.199	2	2
2.5	2.7	2	27	4.422	1.267	2.117	1.694	9.5	1.42	-0.147	0.416	1.534	3.224	1.154	3	3
2	2.2	1	22	3.604	0.845	2.067	0.722	7.238	-1.099	-1.533	0.311	-1.225	-3.547	-0.938	1	1
2.5	2.35	2	23.5	3.948	1.679	2.667	1.688	9.982	-0.04	1.21	1.575	1.515	4.26	1.6	3	3
3	3.2	3	32	3.74	1.59	2	1.625	8.956	-0.679	0.918	0.171	1.337	1.746	0.651	2	3
2.5	2	1	20	4.026	1.194	1.556	0.833	7.609	0.2	-0.387	-0.765	-0.91	-1.862	-0.595	1	1
2.5	2.55	2	25.5	3.916	1.67	2.15	1.133	8.869	-0.14	1.179	0.486	-0.058	1.467	0.57	2	2
3	3.15	3	31.5	4.058	1.156	1.5	1.183	7.897	0.3	-0.513	-0.882	0.084	-1.011	-0.328	2	2
2	2.39	2	21.5	4.019	0.956	1.633	1.117	7.726	0.18	-1.168	-0.602	-0.106	-1.695	-0.487	2	2
				3.333	0.944		1.333	5.611	-1.932	-1.207		0.509	-2.63	-2.443	1	1
3.5	2.5	2	22.5	3.744	1.489	1.854	1.306	8.393	-0.667	0.584	-0.137	0.43	0.211	0.13	2	2
3.5	2.9	3	29	4.162	1.451	1.8	1.313	8.726	0.62	0.458	-0.251	0.45	1.278	0.438	2	2
3.5	2.45	2	24.5	4.343	1.581	1.979	1.383	9.286	1.176	0.886	0.127	0.651	2.841	0.957	3	3
1	1	1	9	4.438	1.629	0.833	0.944	7.844	1.467	1.043	-2.287	-0.595	-0.371	-0.378	2	2
	1			4.614	1.6	1.083		7.298	2.012	0.949	-1.76		1.201	-0.883	2	1
2	2.75	2	27.5	3.805	1.435	2.2	0.917	8.357	-0.48	0.406	0.592	-0.673	-0.155	0.097	2	2
3	2.95	3	29.5	3.97	0.948	2.417	0.583	7.919	0.029	-1.194	1.048	-1.62	-1.737	-0.308	1	2
2	2.8	3	28	4.104	1.635	2.233	1.083	9.055	0.44	1.064	0.662	-0.2	1.966	0.743	3	3
2	1.5	1	15	3.833	0.854	1.55	1.017	7.254	-0.393	-1.504	-0.777	-0.39	-3.064	-0.923	1	1
2	2.7	2	27	3.656	1.559	1.967	1.25	8.431	-0.939	0.813	0.1	0.273	0.247	0.166	2	2
3	2.6	2	26	4.156	1.244	2.167	1.104	8.671	0.6	-0.22	0.522	-0.141	0.76	0.388	2	2
4	3.25	3	32.5	4.377	1.403	2.4	1.233	9.413	1.28	0.302	1.013	0.225	2.82	1.074	3	3

DI_Ach_Fi_Cat	DI_Ach_BP_Cat	DI_Ach_LG_Cat	BP_mat_LMH	BPM_mat_LMH	RM_mat_LMH	SP_mat_fixed_LMH	SRC_mat_LMH	FF_mat_LMH	RAM_mat_LMH	SD_mat_fixed_LMH	SRP_mat_LMH	UED_mat_LMH	Socialization	Externalization	Combination	Internalization
	1	1		1	1	1	1	1	1	1	1	1	0.724	-0.0683	0.3632	0.5318
3	3	3	3	3	3	2	2	1	3	2	1	2	1.4946	0.6828	-0.3026	-0.2312
1		1	1	1	1	1	1	1	1	1	1	1	-0.0467	0.6828	1.029	0.5318
1	1	2	3	2	1	3	3	3	3	2	2	1	0.724	-0.8193	1.029	-0.9942
3	3	3	3	2	3	2	1	1	3	3	2	1	-1.588	-0.8193	2.3607	1.2948
1	1	1	2	2	1	1	2	1	3	2	3	2	0.724	0.6828	0.3632	-0.9942
			3		3	2		3	2	2		3	-2.3587	-0.8193	1.029	-0.2312
1	3	2	2	1	3	3	1	1	2	1	1	3	-0.0467	1.4339	0.3632	-0.2312
1	3	3	3	3	3	2	3	3	3	2	3	3	-0.0467	-0.0683	0.3632	1.2948
			1	2	3	3	1	1	1	3	3	2	0.724	-0.8193	0.3632	2.0577
1	1	2	1	2	2	2	2	3	1	2	3	2	-1.588	-0.0683	0.3632	-0.9942
	1		2	1	1	1	2	1	1	1	1	1	-0.0467	-0.0683	0.3632	1.2948
3	3	2	1	3	2	2	1	3	2	3	3	2	0.724	2.1849	-0.9685	-0.2312
1	1	1	1	3	3	2	1	1	2	1	1	1	0.724	-0.8193	-0.9685	0.5318
1			1	2	2	2	1	1	3	2	1	2	-0.0467	0.6828	-0.3026	1.2948
3	1	3	3	3	2	2	3	3	3	3	3	3	0.724	-0.0683	0.3632	0.5318
3	1	1	3	1	1	2	1	1	1	2	1	2	-2.3587	-1.5704	-0.9685	-0.9942
1			1	3	1	2	3	1	1	2	3	2	-0.0467	-0.0683	1.6948	-0.2312
	3		3	2	3	3	1	3	3	3	2	3	-0.8174	-1.5704	-0.9685	-0.9942
	1		1		2	2	1	1	3	2	2	1	0.724	2.1849	-0.9685	-0.2312
													-0.8174	-0.8193	-0.9685	-1.7572
3	1		3	1	2	2	1	1	3	3	3	3	-0.8174	-0.0683	-0.3026	-1.7572
1	3	2	2	2	1	2	3	3	3	3	3	3	-0.8174	0.6828	1.029	0.5318
1	1		1	2	1	1	1	2	3	2	3	3	0.724	0.6828	-0.9685	-0.9942
				1	1	1	1	1	1	1	1	1	1.4946	0.6828	-0.9685	0.5318
1	3	2	1										-0.0467	-0.8193	-1.6343	-1.7572
3			1	3	3	2	2	2	3	2	3	1	-0.0467	-1.5704	-0.3026	0.5318
3	3	2	2	3	3	2	3	3	3	2	3	3	-0.8174	1.4339	-0.3026	0.5318
1	3	3	3	3	1	2	1	3	3	2	3	1	-0.0467	-0.0683	1.6948	-0.2312
			1	1	1	1	1	1	2	1	1	1	0.724	-1.5704	-1.6343	-0.9942
3	1	1	3	2	1	2	3	2	2	3	2	1	1.4946	0.6828	-0.9685	0.5318
1	3		2	3	1	2	3	1	2	2	2	3	-0.0467	-0.0683	1.029	0.5318
1	1	2	3	3	2	2	3	3	3	2	3	3	0.724	-0.0683	-0.3026	1.2948

Socialization_LMH	Externalization_LMH	Combination_LMH	Internalization_LMH	z_EDA_Cat_num	z_EIA_Cat_num	z_IKD_Cat_num	z_CI_Cat_num	KCC_Cat_nmbr_half	DI_Ach_Cu	c_Balanced_SECI_KCC	c_IT_Mat_score	c_DI_Inv_LD	Industry_AdvTech_use	Cat_Yrs_activity	zCapital	Cat_Capital
3	2	3	3	3	1	2	1	2	1	0.787879	-0.8225	2.648779	1	2	-0.34798	2
3	3	2	2	2	2	3	3	2	4	0.787879	0.3275	5.648779	2	3	-0.09479	2
2	3	3	3	1	1	1	1	2		1.787879	-1.4225		2	2	-0.47457	1
3	1	3	1	1	2	1	2	1	2	-0.212121	0.3275	0.648779	2	3	-0.22138	2
1	1	3	3	2	3	3	2	1	2	-0.212121	0.1775	2.648779	2	3	-0.15808	2
3	3	3	1	2	2	2	2	1	1	-0.212121	0.1275	-1.351221	2	2		
1	1	3	2	1	1	1	1	1		-1.212121	0.5075		1	1	0.23436	3
2	3	3	2	2	2	3	2	2	3	0.787879	-0.0225		1	1	-0.47457	1
2	2	3	3	3	3	2	3	2	3	0.787879	0.5775	-0.351221	1	2	-0.22138	2
3	1	3	3	2	3	2	3	1		-0.212121	0.2275	-2.351221	1	1	-0.34798	2
1	2	3	1	1	1	2	1	1	2	-0.212121	0.0775		1	2	-0.47457	1
2	2	3	3	2	2	2	1	2		0.787879	-0.5725		1	2	0.03181	3
3	3	1	2	3	2	2	3	1	3	-0.212121	0.2775	-1.351221	1	2	0.03181	3
3	1	1	3	1	1	2	1	1	2	-0.212121	-0.2225	-1.851221	1	1	-0.56319	1
2	3	2	3	2	3	3	3	2	3	0.787879	-0.0725	-0.533039	1	1	0.03181	3
3	2	3	3	1	3	2	3	2	2	0.787879	0.7775	0.648779	1	3	-0.01883	2
1	1	1	1	2	2	1	1	1	3	-1.212121	-0.4225		2	2	-0.47457	1
2	2	3	2	2	3	2	2	2	2	0.787879	0.1275		1	1	-0.56319	1
1	1	1	1	2	2	1	2	1	3	-1.212121	0.7275	-2.351221	2	3	-0.47457	1
3	3	1	2	2	1	2	2	1	2	-0.212121	-0.0325	-2.351221	1	3	0.03181	3
1	1	1	1	1	1		3	1		-1.212121			1	2	-0.47457	1
1	2	2	1	1	2	2	2	1		-1.212121	0.0775	-2.351221	1	3	-0.47457	1
1	3	3	3	3	2	2	2	2	2	0.787879	0.4775	1.648779	1	1	-0.55559	1
3	3	1	1	3	2	2	3	1	2	-0.212121	0.0275	-2.351221	1	2	0.66478	3
3	3	1	3	3	3	1	2	1		-0.212121	-1.4225	-2.351221	1	1	0.03181	3
2	1	1	1	3	3	1		1	2	-1.212121	-1.4225	-0.351221	2	2	-0.47457	1
2	1	2	3	2	2	3	1	1		-1.212121	0.3275	-1.351221	2	2	0.1584	3
1	3	2	3	2	1	3	1	2	3	0.787879	0.5275	-1.240109	1	1	-0.34798	2
2	2	3	2	2	3	3	2	2	3	0.787879	0.3775	13.648779	2	2	-0.43659	2
3	1	1	1	2	1	1	2	1		-1.212121	-0.9225		2	3	3.95622	3
3	3	1	3	1	2	2	2	1	3	-0.212121	0.2775	-1.351221	1	2	3.32325	3
2	2	3	3	3	2	2	2	2	2	0.787879	0.1775	-2.351221	2	3	-0.34798	2
3	2	2	3	3	2	3	2	2	3	0.787879	0.8275	-1.351221	1	1	-0.47457	1

Industry_AdvTech_High	Industry_AdvTech_Low	Yrs_activity_new	Yrs_activity_middle
0	1	0	1
1	0	0	0
1	0	0	1
1	0	0	0
1	0	0	0
1	0	0	1
0	1	1	1
0	1	1	1
0	1	0	1
0	1	1	1
0	1	0	1
0	1	0	1
0	1	0	1
0	1	1	1
0	1	1	1
0	1	0	0
1	0	0	1
0	1	1	1
1	0	0	0
0	1	0	0
0	1	0	1
0	1	0	0
0	1	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	0	1
0	1	1	1
1	0	0	1
1	0	0	0
0	1	0	1
1	0	0	0
0	1	1	1