UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Dynamic Capabilities and Management Control in the Digital Era: Understanding Telework and Data-Driven Decision-Making under Environmental Dynamism

by Yi Li

Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

under the supervision of Assoc Prof Bernhard Wieder and Dr Maria-Luise Ossimitz

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Yi Li, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Accounting Discipline Group of Business School at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Yi Li

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Thesis by Compilation Declaration

This thesis by compilation consists of two interrelated papers that examine Dynamic Capabilities and Management Control in the Digital Era: Understanding Telework and Data-Driven Decision-Making under Environmental Dynamism. Each chapter is presented as a standalone paper that draws on a shared empirical dataset to address distinct but complementary research questions. As a result, some overlap, particularly in the research method sections, exists across the chapters.

The PhD candidate, Yi Li**,** is the lead author of both papers included in this thesis. The supervisory team provided guidance consistent with the standard role of a doctoral supervision panel. Yi Li was responsible for the conception and design of the research, the development and contribution of literature, data collection, analysis and interpretation, the drafting of all chapters, and the incorporation of feedback from the supervisory panel. The supervisors contributed primarily through critical review and academic guidance throughout the research and writing process.

Table 1 below summarises the authorship details and publication status of the included papers.

Table 1

Authorship and Publication Status

Chapter	Title	Authorship	Publication outlet	Status
2	Teleworking and Operational Performance: Exploring the Role of ICT Capabilities and Management Control	Mrs. Yi Li Assoc Prof Bernhard Wieder Dr Maria-Luise Ossimitz	International Conference on Enterprise Information Systems	Published

3	Enhancing Performance through Dynamic Capabilities: The Role of Data-Driven Decision-Making and Environmental Dynamism	Mrs. Yi Li Assoc Prof Bernhard Wieder Dr Maria-Luise Ossimitz	International Symposium on Accounting Information Systems	Accepted

Signature

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Dr Maria-Luise Ossimitz (Co-Supervisor)

Abstract

This thesis investigates how organizations improve operational performance in dynamic environments through telework (TW), information and communication technology (ICT) capabilities, business analytics (BA) capabilities, and management control (MC) mechanisms. Drawing on the dynamic capabilities view (DCV), the research examines two interrelated phenomena: the performance implications of mandated telework during the COVID-19 pandemic, and the role of data-driven decision-making (DDDM) in transforming ICT and BA capabilities into improved operational outcomes in dynamic environments.

Using a common dataset derived from a survey of senior managers in medium and large Australian organizations, the first study examines how TW, ICT capabilities, and MC jointly shape operational performance under varying degrees of environmental dynamism. The findings reveal that while mandated telework initially reduces operational performance, higher levels of telework increase the scope of use of MC mechanisms, which in turn improves performance. This study also finds moderating effects of ICT capabilities and environmental dynamism on the relationship between telework and operational performance.

The second study investigates how dynamic ICT and BA capabilities support DDDM practices and, in turn, contribute to operational performance. It highlights the mediating role of DDDM and the moderating influence of environmental dynamism, offering new insights into how organizations translate technological investments into strategic decision-making and performance gains in uncertain environments.

Overall, by integrating insights from TW, AIS, and MC research streams, this thesis offers a more holistic explanation of how organizations can maintain operational performance in increasingly flexible and dynamic working environments. It enriches theoretical understanding by

demonstrating that the performance consequences of TW depend critically on the organization's ICT capabilities, control configurations, and environmental context. It also refines and expands the DCV by illustrating the mechanisms through which technological and analytical capabilities translate into business value, emphasizing the role of DDDM as an intermediary capability in this process and revealing environmental dynamism as a critical boundary condition that governs the effectiveness of BA capabilities.

Chapter 1 Introduction

1.1 Background and Research Questions

Organizations today operate in increasingly complex, dynamic, and uncertain environments shaped by rapid technological innovation, globalization, and external disruptions such as the COVID-19 pandemic (Chenhall, 2003; Chenhall & Langfield-Smith, 1998; Otley, 2016). These dynamic conditions present both opportunities and challenges for organizations (Dubey et al., 2020; Li et al., 2024; Saeed et al., 2023). Organizations operating in highly dynamic environments are more likely to adopt proactive strategies, develop dynamic capabilities, and implement rapid adaptive processes to maintain competitiveness compared to those in relatively stable or less dynamic environments (Oreja-Rodriguez & Yanes-Estevez, 2010; Sharma et al., 2022; Surty & Scheepers, 2020). One major transformation arising from the pandemic has been the widespread adoption of telework (TW) to enable employees to work outside their regular office by using information and communication technology (ICT). As an efficient tool to monitor behaviour and minimize the need for direct supervision, management control (MC) practices can assist in coordinating appropriate organizational actions and processes and support managers in taking quick decisions and manage internal and external risks while facing the challenges of implementing telework (Bracci et al., 2021). Apart from that, in such rapidly evolving contexts, organizations must exhibit agility by continuously adapting their strategies and operations while developing dynamic capabilities to align with changing market conditions (Syed et al., 2020; Yayla & Hu, 2012). Dynamic capabilities enable organizations to respond effectively to uncertainty, transforming big data into actionable strategies and enhanced performance outcomes. Simultaneously, organizations have become increasingly reliant on data-driven decision-making (DDDM) as a means of translating insights generated from dynamic capabilities into competitiveness.

Despite the growing importance of these shifts, questions remain regarding how telework affects firm performance, especially in highly dynamic environments, and how organizations can leverage their digital and analytical capabilities to support DDDM and performance outcomes. The overall objective of this thesis is to investigate how organizations improve operational performance in highly dynamic environments through strategic initiatives and dynamic capabilities.

Chapter 2 is motivated by the controversy in the TW literature regarding whether TW is an efficient and productive work arrangement or not. While TW offers benefits such as flexibility and continuity of operations, it also presents managerial challenges, including reduced visibility into employee activities and greater reliance on virtual coordination (Bessa & Tomlinson, 2017; Harker Martin & MacDonnell, 2012). Moreover, the impact of TW on operational performance appears to be context-dependent, influenced by a range of internal and external factors including management control (MC) systems, ICT capabilities, and environmental dynamism. The analysis of implementing telework during a pandemic enables studying how MC operates in a unique and extreme context. However, little is known whether and how MC changes in line with increased TW and environmental uncertainty (Wang et al., 2020). Chapter 2 addresses these research gaps by posing critical research questions about how TW influences operational performance, and what roles ICT capabilities, MC mechanisms, and environmental dynamism play in this relationship.

At the same time, the role of dynamic capabilities—particularly ICT and business analytics (BA) capabilities—in enabling DDDM and supporting performance remains underexplored, especially under varying degrees of environmental uncertainty. Existing research has often treated these capabilities in isolation and failed to account for the complex interplay between technological infrastructure, decision-making processes, and the broader business environment. Despite the recognized importance of BA and ICT capabilities, existing research has yet to fully elucidate how these dynamic capabilities interact to influence operational performance and DDDM, particularly

in environments characterized by varying degrees of environmental dynamism. The research questions in chapter 3 respond to the call in the literature for more detailed research on how dynamic capabilities, particularly BA and ICT capabilities, support DDDM, and how environmental dynamism shapes this process and its impact on operational performance.

These research questions are investigated through two empirical studies grounded in the Dynamic Capabilities View (DCV)**.** A dataset was collected via a structured survey of senior financial managers in medium and large Australian organizations. The first research model examines the direct and indirect effects of telework on operational performance, with particular attention to the mediating role of MC mechanisms and the moderating effects of ICT capabilities and environmental dynamism. The second theoretical model, which focuses on the role of dynamic capabilities in supporting DDDM, explores how BA and ICT capabilities translate into operational performance through data-driven practices, and how environmental dynamism moderates these relationships.

1.2 Key Findings

Chapter 2 concludes that increasing TW may hamper operational performance. Using distinct capabilities of ICT (increased internal use, use for internal and external communication, and initiating and maintaining collaboration), the study demonstrates that higher ICT capabilities significantly increase the use of TW and increase operational performance. ICT capabilities also decrease (moderate) the negative effect of TW on operational performance. Following the control framework developed by Merchant and van der Stede (2007), the study finds that organizations use more MC mechanisms in TW environments. Moreover, higher levels of MC mechanisms should be deployed when environmental dynamism is high, and MC can mediate the relationship between environmental dynamism and operational performance. Finally, it reveals that the

negative impacts of implementing more TW on operational performance is lower when the level of environmental dynamism increases.

Chapter 3 concludes that DDDM serves as a mediating mechanism between dynamic capabilities and operational performance. The results reveal that BA capabilities positively influence operational performance beyond their impact on DDDM. ICT capabilities, while foundational for digital transformation, primarily enhance performance by supporting DDDM rather than exerting direct effects. Furthermore, environmental dynamism emerges as an external factor that can force organizations to leverage their dynamic capabilities to improve decision-making processes (Saeed et al., 2023; Singh et al., 2022). The results demonstrate that higher levels of environmental dynamism weaken the impact of BA capabilities on DDDM. This finding challenges the assumption that BA capabilities always enhance decision-making and suggests that their effectiveness depends on the degree of environmental uncertainty organizations face.

1.3 Contribution

This thesis makes several theoretical and practical contributions by investigating how organizations leverage dynamic capabilities, MC mechanisms, and DDDM to enhance operational performance in dynamic environments.

Theoretically, the study presented in chapter 2 provides empirical evidence that ICT capabilities are important to foster the work efficiency of employees in a TW environment and decrease (moderate) the negative effect of TW on operational performance. This study contributes to the literature on management accounting and control by considering the relationship between TW and MC during and after a pandemic and highlighting the importance of MC in high environmental dynamism. Finally, this study provides a systematic perspective on the role of environmental dynamism in shaping the value of organizational capabilities directly, and indirectly by reducing the negative impact of TW on performance.

Chapter 3 contributes to the literature on dynamic capabilities and DDDM by examining how DDDM interacts with technological and analytical capabilities to enhance performance. The findings refine and expand the DCV by illustrating the mechanisms through which technological and analytical capabilities translate into business value, emphasizing the role of DDDM as an intermediary capability in this process. No prior research has investigated the moderating role of environmental dynamism in this relationship. This study fills this gap by identifying the role of environmental dynamism as a boundary condition influencing the relationship between dynamic capabilities and DDDM. This study also provides a better understanding of how the impact of BA capabilities on operational performance is moderated by environmental context variables.

From the practical perspective, the results of chapter 2 and 3 in this thesis offer valuable insights for organizations seeking to enhance their operational performance in dynamic environments. TW is likely to continue in the future and poses significant challenges for organizations forcing them to develop more advanced MC mechanisms to reduce MC problems and nurture ICT capabilities to mitigate the negative impact of TW on operational efficiency. In addition, DDDM is an important driver of business success in an increasing data-driven business environment as it leverages the benefits of both ICT and BA capabilities. Environmental dynamism poses both opportunities and challenges to the organizations. Managers should remain proactive in monitoring external environment shifts, ensuring that they adjust their strategies accordingly.

1.4 Thesis Structure

The remainder of this thesis is structured as follows. Chapter 2 presents the first empirical study, which investigates the relationship between telework and operational performance, focusing on the mediating role of MC mechanisms and the moderating effects of ICT capabilities and environmental dynamism. Chapter 3 presents the second empirical study, which explores how DDDM mediates the relationship between dynamic capabilities (specifically BA and ICT

capabilities) and operational performance. It also demonstrates environmental dynamism as a contextual moderator. Chapter 4 concludes the thesis by discussing conclusions, highlighting limitations, and identifying potential opportunities for future research.

Chapter 2 Teleworking and Operational Performance:

Exploring the Role of ICT Capabilities and Management Control

Abstract

The aim of this study is to examine the relationship between telework and operational performance and to explore the impact of ICT capabilities and management control (MC) mechanisms on this relationship. More specifically, the study focuses on four management controls (action, outcome, personnel and cultural controls), and three dimensions of dynamic ICT capabilities (internal use, collaboration and communication). The results suggest that mandated use of telework in response to a crisis (COVID-19 pandemic) has a negative impact on operational performance. However, higher levels of telework increase the scope of use of MC mechanisms, which in turn improves performance. Furthermore, this study finds a moderating effect of ICT capabilities and environmental dynamism on the relationship between telework and operational performance. Overall, this study contributes to the growing body of telework research and enriches theoretical understanding by demonstrating that the performance consequences of TW depend critically on the organization's ICT capabilities, control configurations, and environmental context.

Keywords: Telework, management control, ICT capabilities, environmental dynamism, operational performance

2.1 Introduction

The COVID-19 pandemic and related government mandates forced organizations globally to introduce or expand telework (TW). In Australia, the pandemic resulted in nearly half (46%) of employees working from home regularly in 2022, representing a significant increase of 30% compared to pre-pandemic levels, and the trend towards TW has continued in the post-pandemic period (Australian Bureau of Statistics, 2023). Telework, which has been used interchangeably with telecommuting, is defined as an alternative working arrangement that enables employees to work outside their regular office by using information and communication technology (Diane E. Bailey & Nancy B. Kurland, 2002). Both employees and organizations expressed great interest in using TW even after the pandemic (Adekoya et al., 2022; Errichiello & Pianese, 2021). Despite many potential benefits associated with implementing TW, it is still a matter of discussion whether it is an efficient and productive work arrangement. On the other hand, using TW may pose some important challenges, such as employee isolation, work intensification, disengagement, reduced dedication and commitment, and employers' loss of control over employees' work processes, which hamper firm performance (Bessa & Tomlinson, 2017; Harker Martin & MacDonnell, 2012).

The widespread and continuous use of Information and Communication Technologies (ICT) enabled the development and expansion of TW (Haddon & Brynin, 2005). ICT is now used more frequently to achieve and maintain competitiveness, increase profitability and succeed in dynamic markets (Stanimirovic, 2015). Prior research has defined that ICT capabilities involves businesses' ability to use ICT functions or applications strategically in their business operations and incorporates the use of intranet, extranet, enterprise resource planning, supply chain management, e-commerce, and other related technological applications (Kannabiran & Dharmalingam, 2012). ICT capabilities are examined through the lens of the Dynamic Capabilities View (DCV), which argues that enterprises must evolve their resources and capabilities to secure sustainable competitive advantage. There are three distinct, but closely related, dimensions of ICT

capabilities, which can be used to adapt, integrate, reconfigure and recreate their internal and external competencies in TW environments: increased internal use (Fillis et al., 2003; Levy et al., 2001), initiate and maintain collaboration (Levy et al., 2001; Sarshar & Isikdag, 2004) and use for internal and external communication (Venkatraman, 1994). ICT's interactive functionality has transformed the workplace structure while enhancing job performance.

The profound challenges the COVID-19 pandemic imposed on organizations provided a unique setting to study how organizations respond to a pandemic by adapting management control mechanisms. Organizations were forced to adapt to the fast-changing environment and change their decisions and operations quickly. As an efficient tool to monitor behaviour and minimize the need for direct supervision, management control (MC) can assist in coordinating appropriate organizational actions and processes and support managers in taking quick decisions and manage internal and external risks while facing the challenges of implementing TW (Bracci et al., 2021). In order to navigate the pandemic, MC must manage short-term/operational and long-term/strategic goals (Kober & Thambar, 2022). The analysis of implementing TW during a pandemic enables studying how MC operates in a unique and extreme context. However, little is known whether and how MC changes in line with increased TW and environmental uncertainty (Wang et al., 2020).

Moreover, the organizational environment has become more complex, turbulent, and unprecedented over the past few decades, which provides new challenges for organizations to survive in in these conditions (Chenhall, 2003; Chenhall & Langfield-Smith, 1998; Otley, 2016). With increasing environmental dynamism, organizations need to identify, develop and maintain a variety of resources to sustain or increase organizational competitiveness (Wang et al., 2020). The COVID-19 pandemic is one of the dynamic contexts which requires the usefulness of broad scope information and timely information. However, few studies have so far examined, specifically, the

influence of environmental dynamism on the relationship between TW and operational performance.

Therefore, the *aim* of this study is to explore the effects of implementing or extending TW in the context of high environmental dynamism, with a focus on the use of resources and capabilities such as management controls and ICT. To shed more light on TW outcomes and the use of resources and capabilities in TW environments, the following three critical *research questions* are addressed: *1. How does telework affect operational performance in organizations? 2. How do organizations configure MC mechanisms to sustain operational performance under conditions of high TW intensity and environmental dynamism? 3. How do ICT capabilities and environmental dynamism influence the relationship between telework and operational performance?*

This study develops a theoretical model of the relationships between TW, ICT capabilities, MC, operational performance and environmental dynamism. The theoretical model is tested through survey data from CFOs and senior managers in median and large Australian organizations. The results of the Structural Equation Modelling (PLS-SEM) support the theorized relationships, thereby making *five* important contributions: First, it provides new insights into the ongoing debate about the effects of implementing or extending TW in organizations by concluding that higher levels of TW have a *negative* direct impact on operational performance. Second, this study advances AIS literature by examining distinct capabilities of ICT (increased internal use, use for internal and external communication, and initiating and maintaining collaboration), and by examining their direct, indirect and moderating effects on TW and operational performance. Third, this research adapts the Merchant and van der Stede (2007) framework for MC for analysing the performance impacts of TW in high and low-dynamic environments. The results suggest that bundling action, outcome, personnel and cultural controls helps organizations to adapt to dynamic environments when pursuing performance improvements. Forth, by examining the moderating influence of environmental dynamism, the study provides new insights into the boundary

conditions shaping the TW–performance relationship. The findings show that higher environmental dynamism reduces the negative impact of increased TW on performance, suggesting that TW may be less detrimental when firms already operate in contexts that require flexibility, decentralised decision-making, and rapid information flows. Lastly, the study offers *practical* guidelines for how to develop and deploy ICT capabilities and MC to improve firm performance in TW environments.

Overall, this study enriches theoretical understanding by demonstrating that the performance consequences of TW depend critically on the organization's ICT capabilities, control configurations, and environmental context. By integrating insights from TW, AIS, and MC research streams, the findings offer a more holistic explanation of how organizations can maintain operational performance in increasingly flexible and dynamic working environments.

The remainder of this paper is structured as follows: Section two presents the theoretical background and hypothesis development. Section three explains the research method followed by an analysis of the results in section four. Next, in section five, a discussion of the results and implications for theory and practice are presented. Finally, chapter 6 concludes with a discussion of limitations and possible future research avenues.

2.2 Hypotheses Development

2.2.1 Telework and Performance

Telework (TW)[1] is enabled by technology insofar as remote work, activities, and operations are facilitated by utilizing ICT and digital assistive technologies (Saludin et al., 2013). TW has rapidly expanded recently and become a common organizations' venture due to the changing social,

[1] The terms remote working, telecommuting and virtual working have been used interchangeably with TW recently.

environmental and economic challenges. The existing knowledge and research on TW have been generated primarily from contexts in which TW was only occasionally or infrequently practiced, rather than frequently or permanently. Before the COVID-19 pandemic, organizations implemented TW typically on a voluntary and time-limited basis (Bloom et al., 2015), such as one or two days per week (Diane E Bailey & Nancy B Kurland, 2002). Also, previous TW literature focuses on traditional teleworkers in information and communication services and knowledge-based services, where teleworkers are typically highly skilled and knowledgeable employees with more autonomous and investigative tasks, such as managers, product designers, software engineers and investment bankers (Diane E Bailey & Nancy B Kurland, 2002; Milasi et al., 2021). However, more recent advances in ICT and operational processes have enabled employees to increasingly perform administrative and routine tasks remotely too.

Numerous studies have been conducted on the relationship between TW and organizational performance, but the results are contradictory. One stream of research on TW has found a positive impact on productivity and organizational performance, both at the individual and organizational levels. At an individual level, TW can increase employee performance and satisfaction, if the TW environment is better tailored to employees and provides fewer distractions than the office (Bloom et al., 2015; Felstead et al., 2002; Gajendran & Harrison, 2007). TW also provides a more flexible work environment, which can reduce the work-family trade off (Felstead et al., 2002; Harker Martin & MacDonnell, 2012). Moreover, teleworkers often have more control over their work schedule, in terms of when and where they work, and the way and speed of doing their work (Peters & den Dulk, 2003). TW helps employees' transit between work and personal roles, which will increase productivity and job satisfaction of employees (Rau & Hyland, 2002). At an organizational level, TW helps organizations to conduct and manage business by reducing costs and decreasing employee turnover intention (Pinsonneault & Boisvert, 2001). The adoption of TW can increase firm-level productivity because of more satisfied and focused employees, by allowing

organizations to access a broader pool of geographically distant talent and reducing fixed asset costs. Moreover, TW enables changes in the organization's resources and capabilities, which may have a positive impact on organizational performance (Illegems & Verbeke, 2004). TW is also considered as a part of an overall strategy of organizations to increase workplace flexibility as it can promote transformation for organizations (Daniels et al., 2001) and enable better control (Robèrt & Börjesson, 2006).

Despite the suggested benefits of TW, researchers have also identified disadvantages of TW at the employee and organizational levels. From the individual perspective, some adverse results of TW include employee isolation, work intensification, disengagement, and reduced dedication and commitment, and employers' loss of control over employees' work processes (Bessa & Tomlinson, 2017; Harker Martin & MacDonnell, 2012). TW may negatively impact on job satisfaction because of a lack of interpersonal contacts, reduced face-to-face communication and increased self-discipline requirements (Cooper & Kurland, 2002; Wiesenfeld et al., 2001). It may lead to psychological and professional isolation, which has a negative impact on job performance and teamwork, and lead to higher turnover intentions (Golden et al., 2006). This is because teleworkers tend to be less confident in their skills and knowledge to complete their tasks, and less active in sharing information and co-learning because of physical distance. TW can also increase work-family conflicts which may cause teleworkers' moral hazard, thus decreasing their performance. TW may attract less productive new workers than those who were hired into on-site jobs (Emanuel & Harrington, 2021). Another critical finding is TW might not be suitable for everyone (Smite et al., 2023), because not everyone feels equally productive under a remote working environment.

At the organizational level, organizations face potential challenges when implementing TW, such as developing new performance measures, sustaining teamwork, managing safety and liability, providing adequate technology, ensuring information security, selecting suitable employees, and

addressing supervisor discomfort (Mello, 2007). Although TW benefits from advancements in ICT, many nonverbal communication cues are filtered out (Burgoon et al., 2002). It creates some new complexities in the workplace, which makes the connectivity of coordination and management more challenging and can creates more conflicts, and reduce managers' effectiveness in controlling, coaching, and setting goals for employees (Mahler, 2012). The lack of adequate ICT infrastructures may result in teleworkers not working as productively remotely as in traditional work arrangements. TW frequently reduces real-time manager-worker communication, which hinders managers' ability to quickly assist employees or recognize situations of employee dissatisfaction. Moreover, TW reduces social, non-task interaction and informal interaction, making it more difficult to build support and trust between managers and teleworkers, and detaches employees from managers, and other employees. (Hinds & Cramton, 2014). The productivity growth in the long run may be hampered because of limited communication and personal interactions, especially across different teams (Hertel et al., 2005).

In addition, it is argued that "the occasional, infrequent manner in which TW is practiced, likely has rendered mute many suspected individual-level outcomes for the bulk of the TW population" (Diane E. Bailey & Nancy B. Kurland, 2002) (p396). Since most employees chose working remotely voluntarily before the COVID-19 pandemic, some earlier TW research has been subject to self-selection bias (Lapierre et al., 2016). Therefore, the benefits of TW identified in previous studies may not fully apply to the recent pandemic-enforced situation. Overall, this study predicts that:

H1: Higher levels of telework lead to decreased operational performance.

2.2.2 Management Control (MC)

Management control (MC) is defined as all systems and processes supporting decision-making, coordinating, and integrating various parts of an organization to ensure that resources are obtained

and used effectively and efficiently in the accomplishment of the organization's objectives (Anthony, 1965; Otley & Berry, 1980). Several different frameworks for analyzing MC have been developed in prior literature: Ouchi's (1979) framework includes market, bureaucratic, and clan controls. Simons (1995) levers-of-control framework consists of a belief, boundary, diagnostic, and interactive control system, and specifically looks at how *positive* and *negative* MC elements can be used together to create *dynamic tensions*. Other MC conceptualizations include the *control package model* by Malmi and Brown (2008) and the *input, process, and output controls* framework (Cardinal, 2001; Jaworski, 1988). Finally, Merchant and Van der Stede (2007) distinguish four MC elements based on the objects they are intended to control, i.e., action, outcome, personnel and culture controls. This provides a conceptually clear and consistent taxonomy for investigating different MC elements within organizations and presents the various MC elements in a kind of *neutral* manner, which means it does not state explicitly whether these controls are positive or negative. Action controls are top-down methods which are used by superiors to monitor subordinates' action over time and reward employees for displaying appropriate work behaviours (Eisenhardt, 1988). Managers can observe work behaviours of employees directly through direct supervision, rules, formalizing work requirements, business policies and performance standards and communication (Kurland & Egan, 1999). Outcome controls include rewarding employees when their performance targets are met or exceeded (Eisenhardt, 1989). They are considered a backbone of MC in many organizations and designed to reduce the problems caused by a lack of direction or motivation (Merchant & Van der Stede, 2012; Otley, 2016). Outcome controls require well-defined performance measures. These control instruments are implemented to deliver requirements specified by the controller, monitor goal achievement, and provide feedback about the employees' performance (Van der Stede et al., 2006). Employees who are given clear goals could adopt appropriate behaviour to achieve the goals and they may bear respective punishment if they do not meet the targets (Cardinal, 2001).

Managers use personnel controls to monitor whether employees are qualified and possess the required knowledge, and to facilitate individual motivation (Campbell, 2012; Snell, 1992). Examples are educational programs, employee training, detailed guidelines, and the selection processes for employees. Personnel controls are a self-monitoring form of control, which can guide and motivate employees (Merchant & Van der Stede, 2017). In other words, personnel controls are intended to improve capabilities and resources so that workers may perform their duties more effectively. Culture controls are one of the most important internal resources for organizations to influence decision-making, control and evaluation processes (Chenhall, 2003). If organizations want to achieve their goals and have better control over their operations, it is important to change the mindsets of employees to improve the speed of the processes and reduce the costs. Culture controls provide indirect guidance through placing emphasis on the importance of norms and values and communicating expected behaviours, which are important indicators in determining organizational capabilities and performance (Merchant & Van der Stede, 2012). They use socialization between employees to align their interests and values with those of the organization (Merchant & Van der Stede, 2012). Managers use cultural controls to encourage mutual monitoring in a sense that organizational employees put *pressure* on each other (Merchant & Van der Stede, 2017). These are considered highly effective and stable management controls because they can promote loyalty, enthusiasm, diligence and even devotion (Merchant & Van der Stede, 2007; Ray, 1986).

Analyzing isolated MC practices may limit the validity and reliability of empirical research results and fail to adequately represent the complexity of MC (Barros & Ferreira, 2019; Chenhall & Moers, 2015). Assessing only specific elements of overall MC from other control practices increases the risk of serious model under specification (Chenhall, 2003) and may lead to unclear and conflicting outcomes (Sandelin, 2008). Thus, many recent studies have begun to include a wide range of controls, moving beyond formal controls to include informal and *softer* types of

controls (Chenhall & Moers, 2015; Davila et al., 2009). Organizations use a mix of several types of MC mechanisms to encourage desirable employee behaviour. MCs (outcome, personnel and cultural controls) are found to play a vital role in enhancing employee motivation and performance in the public sector (van der Kolk et al., 2019). This study uses a broader concept of MC and explores how a set of MC practices achieve effective outcomes in a fast-changing environment (Chenhall, 2003; Flamholtz et al., 1985; Malmi & Brown, 2008; Otley & Berry, 1980). MC mechanisms are used by organizations to ensure that employees' behaviours can contribute to the achievement of objectives (Abernethy & Chua, 1996; Flamholtz et al., 1985; Malmi & Brown, 2008; Otley & Berry, 1980).

TW received very little attention in MC literature before the COVID-19 pandemic. Managers and employees predominately worked in the same physical workplace traditionally and managers used centralized work arrangements to coordinate, motivate and control employees directly (Peters & den Dulk, 2003). Since there was only a small percentage of teleworkers and/or most of them spent only a small proportion of their time working remotely, organizations often saw little need to question and revise established MC.

2.2.2.1 Management Controls in Telework Environments

Due to the COVID-19 crisis, in particular lockdowns, organizations had to move much of their functions into remote spaces and change their work arrangements to keep their employees safe and to ensure the normal operation of business. The shift to TW amplifies control problems within the organizations and thus poses severe challenges for organizations' MC. Firstly, employees' actions are less observable in the remote working environment, which limit the possibilities for direct monitoring (Allen et al., 2015; Greer & Payne, 2014). Secondly, the information exchange is influenced by TW between employees and their supervisors as well as among employees. While the former reduces the supervisor's effectiveness in providing direction and support, the latter

causes less and more effortful communication (Gajendran & Harrison, 2007; Lill, 2020). Moreover, managers are typically interested in how to measure productivity, build trust and manage people who are physically out of sight (Olson, 1982). Organizations are required to consider employee empowerment under the dynamic environment and crisis (Malmi & Brown, 2008). Therefore, organizations needed to use more and modified MC mechanisms to overcome difficulties and reduce control problems. Action controls are used in remote working environments because they can reduce amplified control problems (Delfino & van der Kolk, 2021). For example, managers used an increasing number of online meetings to improve effectiveness, provide feedback and enable the exchange of non-structured information which was previously exchanged through informal communication at the office. It is believed that during the pandemic organizations increasingly needed action controls, such as standardization, pre-action reviews and planning participation (Barrero et al., 2021). This is because action controls be changed more easily in a short time period. Supervisors are found to use more strongly standardize tasks for employees working from home which provides evidence of strengthened action controls (Flassak et al., 2023). Stronger action controls reduce the necessity for time-consuming meetings under TW condition, which can improve employee productivity (Flassak et al., 2023).

Outcome controls identify the important objectives within employee activities and provides employees with more discretion and freedom to achieve desired goals (Groot & Merchant, 2000). For example, Kawaguchi and Motegi (2021) find that organizations place emphasis on using pay for performance, key performance indicators and management by objectives. Groen et al. (2018) analyse a single-firm and find that, when the share of TW time increases, the perceived level of outcome controls is higher amongst teleworkers. As TW is typically related to low levels of collaboration, it is important to develop teleworkers' skills and self-motivation (Peters & van der Lippe, 2007). Organizations can use personnel controls to keep track of the output and process and collect information to determine whether the skills of employees are adequate for their tasks

or the organization. Managers use several task-specific tactics to monitor teleworkers' behaviour, such as choosing appropriate teleworkers and conducting TW training. Supervisors choose employees who volunteer and possess certain personal characteristics, including dependability, ability to work independently, maturity, experience, and do not communicate with customers or colleagues face to face (Cooper & Kurland, 2002). Managers may also talk with incipient teleworkers about the implications of TW and prospective teleworkers about expectations and responsibilities (Cooper & Kurland, 2002). Finally, several studies have highlighted the importance of *culture* controls (Bedford, 2015; Chenhall, 2003; Malmi & Brown, 2008; Merchant & Van der Stede, 2007). Organizations use culture controls to direct employees' creative efforts towards their work and improve their intrinsic motivation (Bedford, 2015). Given that TW is related to low levels of collaboration and direct control, it is predicted that organizations with higher levels of TW use more comprehensive MC packages:

H2: Higher levels of telework lead to an increased use of MC.

2.2.2.2 MC and Operational Performance

Since the aim of MC research is used to provide relevant findings to assist managers in achieving organizational goals, it is essential to include performance as an independent variable to explain key characteristics of MC (Chenhall, 2003). Previous studies show that MC can provide significant information for coordination and learning, therefore improving firm performance (Bisbe & Otley, 2004; Henri, 2006; Widener, 2007). MC is important to offer information, which is useful for managerial decision making, planning, monitoring, and evaluation of organizational activities (Merchant & Van der Stede, 2007). Earlier studies examine the impact of both formal and informal controls on organizational performance (Chenhall & Morris, 1995). Simons (1995) uses the levers of control framework (LOC) and reported that control systems (beliefs, boundary, diagnostic and interactive) have an indirect a positive impact on firm performance through organizational

learning and the efficient use of management expertise. The use of control systems can improve the performance of a firm by using the LOC framework (Widener, 2007). Nevertheless, only limited studies have investigated other outcome variables of MC. MC can be used not only to monitor whether performance outcomes are in accordance with plans, but also to promote staff involvement, coordinate actions, organizational goals and communications (Henri & Wouters, 2020), thereby promoting firm performance. Accordingly, it is predicted that the overall operational performance of organizations will improve based on adjustments to MC. It follows that:

H3: Higher levels of MC lead to increased operational performance.

2.2.3 Dynamic Capabilities View (DCV)

The dynamic capabilities view (DCV) is an extension of the resource-based view (RBV), which is considered as one of the most powerful and most widely applied firm performance theories in the business literature, based on the resources companies own and control (Barney, 2001). The importance of improving management capabilities is emphasized by Teece et al. (1997), which combine organizational, functional and technology-related skills. They define dynamic capabilities as organizational abilities "to integrate, build, and reconfigure internal and external resources to address, shape and change business environment" (Teece et al., 1997) (p516). The term '*capabilities'* refers to a company's ability to use resources, typically in combination, and it includes both tacit and explicit processes, as well as leadership and knowledge ingrained in the processes. As a result, capabilities are frequently firm-specific and evolve over time as a result of intricate interactions among the resources of the company (Amit & Schoemaker, 1993). The DCV argues that enterprises must evolve their resource and capabilities to secure a sustainable

competitive advantage, in contrast to the RBV, which supports the idea that firms can achieve a competitive advantage based on their bundles of resources and capabilities (Peteraf et al., 2013).

Dynamic capabilities include the ability to find threats and opportunities, act on opportunities, and reallocate organizational resources in rapid changing environments, thus driving companies to achieve a sustainable competitive advantage (Eisenhardt & Martin, 2000; Teece et al., 1997). DCV was constructed around a few key components that illustrate its core theoretical foundations, including nature, role, context, creation and development, outcome, and heterogeneity (Barreto, 2010). DCV protagonists suggest first classifying the nature of the concept as an ability vs. capability, highlighting the crucial function of strategic management. Second, they outline the integration, development, and reconfiguration of internal and external competencies as the expected outcome of a specific capability. Third, they suggest considering a specific category of external context, namely, dynamic change of the environment. The concept of dynamic capacities is an extension of the RBV towards regimes of rapid change. Fourth, they assume that dynamic skills are often created rather than purchased and that both their development and evolution are part of organizational processes that are influenced by businesses' asset positions and their historical evolutionary routes. Fifth, they emphasize that dynamic capabilities are heterogeneous across organizations since they are based on firm-specific routes, distinctive asset situations, and unique processes, much like the resources and capabilities evaluated within RBV. Finally, they argue that dynamic skills directly lead to persistent competitive advantage.

Dynamic capabilities have a positive impact on firm performance in a variety of ways: matching the resource base with changing environments (Teece et al., 1997), creating market change (Eisenhardt & Martin, 2000), and improving inter-firm performance (Gudergan et al., 2012). Performance is eventually strengthened because dynamic capabilities increase the efficacy, speed, and efficiency of organizational responses to environmental turbulence (Chmielewski & Paladino, 2007; Hitt et al., 2001). They enable the company to take advantage of revenue generating

opportunities and alter its processes to save expenses (Drnevich & Kriauciunas, 2011). The organization can be provided a new set of choice possibilities through dynamic capabilities by sensing opportunities and reconfiguration, ultimately improving firm performance (Eisenhardt & Martin, 2000; Teece, 2007).

2.2.4.1 Information and Communication Technology (ICT) Capabilities

ICT is defined as "shared, unbounded, heterogeneous, open, and evolving socio-technical systems comprising an installed base of diverse information technology capabilities and their use, operations, and design communities" (Tilson et al., 2010) (p749). ICT provides useful solutions to share ideas, information and documents, manage complex projects and identifies opportunities, which can improve the coordination of activities and processes (Spagnoletti et al., 2015). ICT changes the way people receive information on business boundaries, hierarchical structures and the patterns of interactions between people, information exchange, communities and organizations. According to Rice and Martin (2020), ICT is a strategic resource whose impacts may vary amongst businesses. ICT can contribute to competitive advantage if organizations' employees are proficient in using it. It facilitates the creation, integration, growth, and improvement of important resources over time. Therefore, the effective use of ICT is an important factor in an organization's success. ICT enhances business development and competitive advantage because of allowing decision-making in almost real time (Jorgenson & Vu, 2016). They indicate that ICT promotes the exchange of information, operational management and production

control. Moreover, ICT is considered a strategy to help organizations make quick decisions in the dynamic environments (Cragg & McNamara, 2018).

2.2.4.2 ICT Capabilities and Operational Performance

Assessing whether ICT has been deployed successfully is not only based on the level of adoption of technology, but rather whether it actually improves performance (Yunis et al., 2018).

From the DCV point of view (Bharadwaj, 2000; Dale Stoel & Muhanna, 2009; Wade & Hulland, 2004), ICT capabilities involve the business ability to use ICT functions or applications strategically in their business operations using intranet, extranet, enterprise resource planning, supply chain management, e-commerce, and other related technological applications (Kannabiran & Dharmalingam, 2012). In order to gain competitive advantage in the constantly changing business environment, ICT capabilities are used to adapt, integrate, reconfigure, and recreate internal and external competencies. The IS literature identifies ICT capabilities as a multi-dimensional latent variable with various dimensions. The three distinct, but closely related, dimensions of ICT capabilities, include increase internal use (Fills, Johansson, and Wagner, 2003; Levy, Powell, and Yetton, 2001), initiate and maintain collaboration (Levy, Powell, and Yetton, 2001; Sarshar and Isikdag, 2004) and use for internal and external communication (Venkatraman, 1994). As such, DCV can be used to explain why ICT can improve firm performance. The internal use of ICT is defined as utilizing technology to develop efficient internal processes and activities which can decrease inefficiencies in production, reduce operational costs and lead to greater efficiency of distribution mechanisms of organizations (Fillis, Johansson, and Isikdag 2004). External ICT-collaboration refers to using technologies to increase and main relationships between organizations and their partners such as customer, suppliers and other external parties (Ciappini, Corso, and Perego, 2008). The third dimension of ICT, communication, is defined as using the intranet and extranet to create effective inflow and outflow of information and knowledge, which

may lead to better learning opportunities (Venkatraman 1994). ICT is stated as a strategic resource, and its effects are likely to vary among organizations (Rice & Martin, 2020). The aggregated measures of technological ICT use have a positive impact on organizational performance (Bresnahan et al., 2002). ICT is now used more frequently to achieve and maintain competitiveness, increase profitability, and prosper in today's dynamic market due to the quickly changing corporate environments (Stanimirovic, 2015).

There are numerous studies exploring how ICT affects firm performance from the dynamic capabilities point of view (Cepeda & Vera, 2007; Kindström et al., 2013; Rohrbeck, 2010; Tian et al., 2010; Yunis et al., 2018). ICT facilitates the creation, integration, growth and improvement of important resources over time. The three distinct but closely related dimensions of ICT capabilities (Fillis et al., 2003; Levy et al., 2001), initiate and maintain collaboration (Levy et al., 2001; Sarshar & Isikdag, 2004) and use for internal and external communication (Venkatraman, 1994), can all be used to explain how ICT can improve the firm performance. Firstly, ICT is considered as a facilitator in coordinating and managing business operations, which can enable more efficient decision-making and improve firm performance (Brynjolfsson & Hitt, 2000). Organizations can use ICT to scan the environment, identify competitors and search for new opportunities. This means that organizations can take advantage of ICT to understand customers' demands and develop customized products or services for new or existing markets. ICT also helps organizations to develop competence and skills of their employees and improve the knowledge base of employees by accessing new information (Sambamurthy et al., 2003). Organizations use ICT to help employees coordinate different tasks effectively and efficiently, which can enhance work processes and increase work efficiently (Cardona et al., 2013). Moreover, ICT can support

individuals and organizations by storing and retrieving large amounts of data quickly and inexpensively, and accessing data created outside the organization more selectively.

Secondly, ICT is used to maintain and improve the relationships between organizations and their partners, such as customers, suppliers and other external parties. Strong ICT capabilities enable businesses to offer their partners specialized services like updating transition records, just-in-time delivery, better communication, etc. All these services have the potential to foster the growth of satisfaction, commitment, and trust to maintain the positive relationships (Venkatraman, 1994). As such, ICT has the potential to provide reliable management information systems for MC and decision-making (Lyytinen et al., 2021). ICT supports management control decisions and improves the accuracy of employees' activities by collecting, storing, accessing, and analysing data. ICT enables both independent (by using digital platforms) and dependent work (by enabling closer supervision).

The third dimension of ICT is the potential to create effective inflows and outflows of information by using both intranets and extranets. The capacity of employees to learn can also be improved because high speed, and communication facilities related to ICT can generate knowledge (Ruiz-Mercader et al., 2006). Employees' knowledge is closely related to an organization's learning, and an increase in employees' knowledge is likely to impact positively on organizational performance. This can help organizations develop a common knowledge base amongst employees and enhance cross-department collaboration, which again leads to improved overall performance. Accordingly, the following hypothesis is proposed:

H4: Higher ICT capabilities lead to increased operational performance.

2.2.3 Environmental Dynamism

Organizations operate in different competitive environments, with regards to uncertainty and hostility (Chenhall & Euske, 2007; Otley, 2016). Environmental dynamism is an essential factor

in DCV, assuming that dynamic capabilities influence competitive advantages contingent on the degree of dynamism in the external environment of organizations (Schilke, 2014). Environmental dynamism refers to the unpredictability and instability of the environment (Salancik & Pfeffer, 1978) and an organization's difficulty to predict the future because of incomplete information or changing conditions (Germain et al., 2008). It stems from a lack of access to sufficient information during the decision-making process and the inability to reliably predict the future. In a turbulent environment, it is important for organizations to adapt to changes and modify their behaviour to meet both internal and external demands. Organizations adapt to the challenge and align internal resources with external demand to improve business evolution and survival when the external environment becomes increasingly turbulent and unpredictable. Previous literature argues that organizations must prepare and develop a set of capabilities (Hitt et al., 1998), to quickly respond to customer needs (Hung & Chou, 2013) and process information more rapidly than operating in a stable environment (Trinh et al., 2012).

Contingency theory has been used to analyse the relationship between organizational environment and MC for decades. The environment is one of the most important context factors of designing MC, which puts the pressure on organizations to meet financial targets and maintain efficient and effective operations and strong performance (Granlund & Lukka, 2017; Otley & Berry, 1980). Contingency theory states that mechanistic control systems work best in relatively stable environments in hierarchical bureaucracies (Chenhall, 2003; Chenhall & Euske, 2007; Otley, 2016). However, organizations adopt more organic control systems when the environment changes and dynamism increases. In more recent studies, mechanistic control systems are also found to be used in uncertain environments (Bedford & Malmi, 2015; Sandelin, 2008). For example, outcome controls and action controls are used in uncertain and hostile environments (Bedford & Malmi, 2015). The latter also call for hybrid controls, i.e. the combination of organic

and mechanistic forms of MC. Such hybrid MCs help manage organizations under complex conditions such as a crisis.

The importance of dynamism is addressed as the fundamental variable in MC (Chapman, 1997; Hartmann, 2000). The design of an MC needs to match its internal and external environment. Prior studies investigate contingency factors related to the choice and effectiveness of MC, such as strategy (Bedford et al., 2016; Bisbe & Otley, 2004; Widener, 2007), organizational structure (Abernethy et al., 2004; Gerdin, 2005), culture (Heinicke et al., 2016; Malmi et al., 2020), and environmental dynamism (Gerdin, 2005). Some research reports that the combinations of formal and informal controls are used in environmental dynamism. Both traditional budgetary controls and high participation, and interpersonal interactions between superiors and subordinates are used in high environmental dynamism (Ezzamel, 1990). When the environment is stable and has low noise and variation, outcome controls are important for organizations, because the desired results can be precisely measured, and desirable performance can be clearly identified (Snell, 1992). When the environment is unstable and uncertain, outcome controls are also valuable for organizations to provide relevant information. Organizations have pressure to meet financial targets and need some flexibility in forms of manipulation of information in environmental dynamism (Merchant, 1990). There is no single characteristic such as mechanistic or organic to describe the whole organizational MC when facing uncertain and hostile environments (Rikhardsson et al., 2021). This is supported by Bedford and Malmi's (2015) findings that a mixture of organic and mechanistic control systems is used to manage organizations under complex environments such as a crisis.

The COVID-19 crisis is one of the most prominent examples of high dynamism affecting the vast majority of organizations globally. The COVID-19 promoted using recent technologies to work, organize, communicate and offering control options. MC changes in responses to COVID-19 (Van der Stede, 2011) and its effects have been considered key areas to explore in future research. How

environmental changes can lead to various MC-related changes at lower levels of organizations and how employees respond to the MC changes in professional services firms in Italy are investigated by Delfino and van der Kolk (2021), and they find that organizations play emphasis on action controls to substitute for the employees' physical presence. More specifically, managers use software packages and increase the number of digital meetings to monitor employees' activities. They also find there is an increasing demand for using tighter and more constraining controls over employees in highly dynamic environments. All the above leads to the following prediction:

H5: Higher levels of environmental dynamism lead to increased levels of MC.

2.2.4 Moderation Effect of ICT Capabilities

Using advanced technological tools has changed communication, employee motivation and the opportunities for personal connectivity during the period of high environmental dynamism (Pérez et al., 2004). Teleworkers exchange information less frequently than employees working in the physical work location (Fornell & Larcker, 1981). The nature of interactions between employees changes in a TW environment, as informal information exchanges and communication are less readily available and decrease. ICT is considered a substitute for face-to-face communication, or overcomes the absence of direct communication (Potter, 2003). ICT applications such as videoconferencing were found to facilitate communication among virtual team members and influence the extent and patterns of information exchanges (Andres, 2006). Moreover, it is noted that ICT enables information management, monitoring performance, and promoting communication to reduce resistance. It promotes fast manager-employee communication, which helps managers to quickly assist employees or recognize situations of employee distress and build support and trust between managers and teleworkers (Shin et al., 2000). ICT enables social and informational linkages in organizations and reduces the potential of negative interpersonal and

social effects of TW, such as social isolation (Mumford, 2006). The interactive functionality of ICT can transform workplace structures while enhancing job performance. Similarly, the effectiveness of the workforce can be increased when improving ICT-based technologies during a pandemic (Davies, 2021). Recent advancements in ICT are an asset for organizations, because they enable employees to work outside their traditional environment without fully bearing the negative effects of working remotely.

Research on ICT innovations primarily focuses on the effects of ICT on employees' and organizational performance (Bayo-Moriones & Lera-López, 2007; Cardona et al., 2013; Day et al., 2010; Hall et al., 2013; O'Driscoll et al., 2010). ICT is transportable, which can support flexible work arrangements like TW, resulting in producing positive effects on employees and organizations by fostering flexibility, increasing the accessibility of employees, and reducing work-to-family conflict (Day et al., 2012). It supports coordination and helps managing business operations, which can enable more efficient decision-making and improve firm performance. It also provides a platform for sharing information, ideas and knowledge internally and externally, which helps organizations to develop their knowledge base and enhance the communication within and between organizations and partners (Nieto & Fernandez, 2005). According to this, ICT capabilities are expected to mitigate at least some of the negative effects of TW on operational performance. Based on the above arguments, the following hypothesis is proposed:

H6: ICT capabilities reduce the negative impact of telework on operational performance.

2.2.5 Moderation Effect of Environmental Dynamism

Studies exploring the relationship between environmental dynamism and firm performance produced mixed but insightful results. While some research acknowledges the challenges posed by dynamic conditions (Bendickson et al., 2018), a growing body of literature increasingly

highlights their constructive role in driving organizational performance (Mukherji & Mukherji, 2017; James & George, 2018). Environmental dynamism forces organizations to undertake strategic activities such as scanning and analysis of environmental signals, forming and maintaining important relationships and centralizing decisions for increased coherence, consistency and coordination of strategy (Mukherji & Mukherji, 2017). These adaptive behaviours not only help organizations identify new opportunities but also strengthen their capacity to compete in complex and dynamic environments. Furthermore, evidence from supply chain research underscores the positive operational outcomes associated with environmental dynamism, highlighting its role in facilitating performance under uncertainty (James & George, 2018).

Another stream of studies is concerned with the moderating effects of environmental dynamism on performance. Empirical studies indicate that it strengthens the link between staff localization and firm performance (Lam & Yeung, 2010), reinforces the contribution of strategic flexibility to performance outcomes (Anand & Ward, 2004), and moderates the relationship between strategic change and firm success (Goll et al., 2007). In highly dynamic contexts, organizations tend to prioritize structural flexibility and often adopt decentralized arrangements to maintain alignment with external conditions (Neirotti et al., 2013). TW represents one of decentralized mechanisms that strengthens an organization's connection to its external environment while sustaining operational continuity. In high dynamism, changes in the level of TW are therefore not expected to have a significant impact on operational performance.

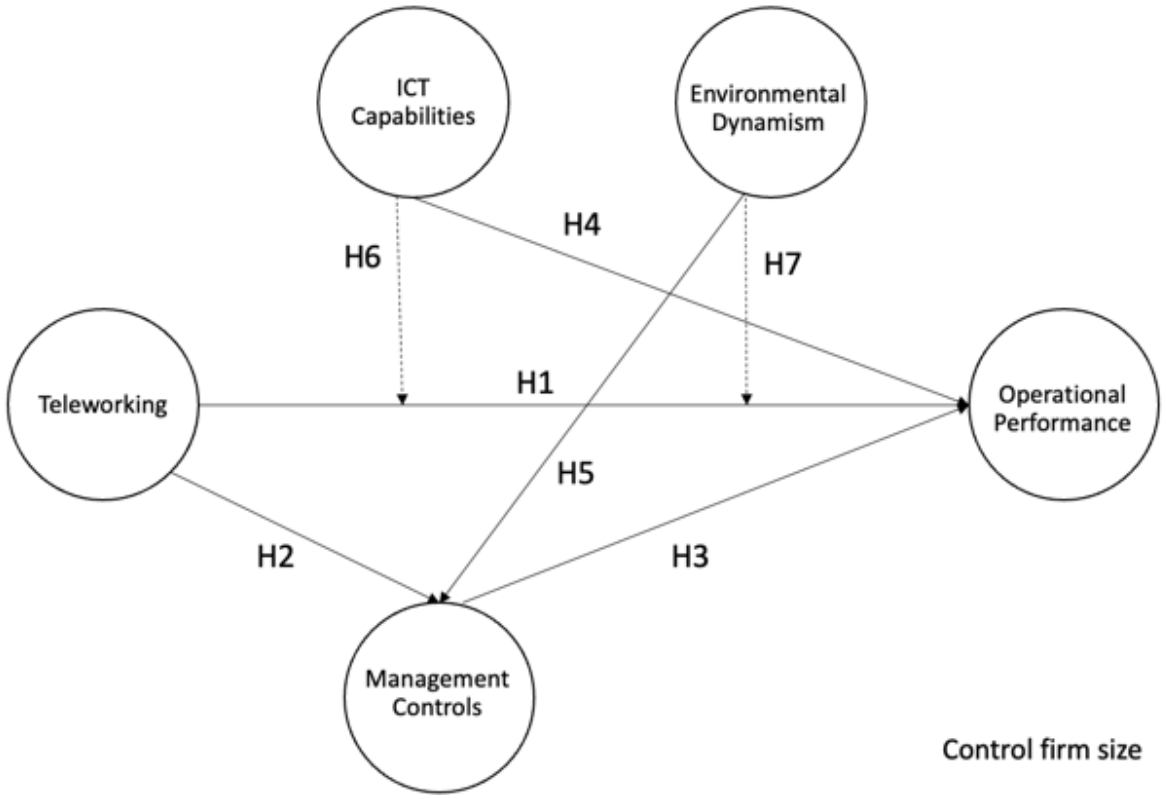
In low dynamism on the other hand, the negative impacts of TW on employee satisfaction and performance discussed in section 2.2.1. are expected to be more pronounced. In the absence of constant challenges imposed by rapidly changing environment conditions, employees will be more likely to disengage, get distracted by their home environment and the employers' loss of control over employees' work processes will have a stronger impact. In summary, the negative impact of TW on organizational performance is expected to be weaker for organizations operating in highly

dynamic environments than those in low dynamism. Therefore, the following moderation hypothesis is proposed:

H7: Environmental dynamism reduces the negative impact of telework on operational performance.

Figure 2 - 1 summarises the interrelationships among core variables in the structural PLS model.

Figure 2 - 1: ***Structural PLS Model (Conceptual)***



2.3 Research Design

2.3.1 Setting

This empirical research was conducted in Australia, which went through an initial lockdown due to COVID-19 in March 2020. Every person who could possibly work from home was required to do so. Many restrictions were relaxed later, but the mandate to continue TW as preferred option remained in place for many months. Before COVID-19, approximately one-third of the workforce

in Australia undertook some hours of remote work per week (Australian Bureau of Statistics, 2009). In comparison, 57% of employees in the Australian state of Victoria worked from home more than one full day per week during the pandemic (June 2021), suggesting that TW was a new experience for most employees (Australian Bureau of Statistics, 2021). In August 2021, almost two-thirds (64%) of managers and professionals routinely worked remotely, compared to about a quarter (25%) of people in all other roles (ABS, 2021). Nearly half (46%) of all Australian employees still worked from home to some degree in April 2022 (ABS, 2022). TW has become an important practice for both private and public organizations in mitigating the effects of COVID-19 and maintaining operations during pandemic, and anecdotal evidence suggests that it may be adopted on a wider scale after the pandemic. Hence, it is critical to implement policies and practices that encourage sustainable TW practices. During the survey period, CFOs and senior financial managers reported 2.5 years of TW experience in their organizations. Changing to TW was not a simple transition for all organizations, particular for those which have had no or limited experience with implementing TW.

2.3.2 Research Method

Data were collected through an online survey administered to CFOs and senior financial managers in medium and large Australian-based organizations. The survey method was chosen because it allows to examine complex phenomena in a natural setting while maintaining a degree of standardization necessary for quantitative analysis and theory testing (Spekle & Widener, 2018). The survey was developed based on established constructs and measurement instruments. It included six sections covering (1) respondent and organization, (2) TW, (3) MC, (4) ICT capabilities, (5) operational performance, and (6) environmental change. It was distributed online to senior managers through Qualtrics, which is a leading well-developed online survey platform.

2.3.2.1 Construct Measurements

Most constructs in this study are latent and therefore measured with multiple indicators (see table1) and data were analysed using the PLS-SEM method. MC and ICT capabilities are multi-dimensional, second order constructs, while all other latent variables are unidimensional. The measurement of *TW* is based on the differences of number of days of TW between the pre-COVID-19 state and the current situation at the time of the survey.

For *MC*, reflective constructs were developed in line with the Merchant and van der Stede (2007) framework, i.e., outcome controls (OC), action controls (AC), personnel controls (PC) and cultural controls (CC). These are measured as *the extent to which an organization uses specific MC*. Seven-point Likert scales were employed, with the anchors ranging between 1 (not used) to 7 (extensively used). To minimize the potential bias caused by sequencing effects, the order of items for the MC constructs was randomized. The scales for each type of MC are reflective constructions, since they all belong to the one category of MC elements. Action controls are measured based on the scales used by Jaworski and MacInnis (1989), Hutzschenreuther (2009) and Goebel and Weißenberger (2017), which are in line with theoretical underpinnings of the object-of-control framework (Merchant & Van der Stede, 2012). Outcome controls are measured using five items from Snell (1992) and (Jaworski & MacInnis, 1989). They measure the degree to which performance evaluation and rewards are based on the results achieved. Personnel controls are measured by four adapted items used by Hutzschenreuther (2009), who in turn relies on Snell's (1992) instrument to capture ‘input control’. According to Kiron and Shockley (2011), cultural controls are measured

by the organization's belief, attitude and behaviour towards using insight and information generated from data.

In accordance with previous research (Fink et al., 2017), a seven-item construct was used to measure *operational performance*, using a seven-point Likert scale with anchors ranging from 1 (completely disagree) to 7 (completely agree).

ICT capabilities were measured based on scales previously developed and validated (Johannessen et al., 1999; Parida et al., 2016). The three first-order dimensions of ICT capabilities are internal purposes (four items), collaboration (three items) and communication (three items). A seven-point Likert scale was used for all ICT items, anchored from 1 (completely disagree) to 7 (completely agree).

For the measurement of environmental dynamism, a seven-item construct was used to measure the extent of environmental change in organizations over the previous two years, using three items from Wieder & Ossimitz (2019). Respondent rated their organizations' environmental change on a seven-point Likert scale from 1 (completely disagree) to 7 (completely agree).

Firm *size* (number of full-time employees) was *controlled* for in the research model, because large organizations tend to have a larger resource base, typically perform better than smaller organizations and are subject to higher pressures from their external environment (Antonio & Foster, 2005; Subramani, 2004).

2.3.2.2 Sample Selection and Data Collection Process

The data for hypotheses testing was collected from June to September 2022 using an online survey administered to 4,399 senior managers of Australia-based organizations. Assuming that the influence of MC and ICT capabilities are more obvious for medium to larger organizations, the sample was limited to organizations with a minimum of 200 full-time equivalent employees. To ensure all respondents in the sample had adequate time to be familiar with MC and ICT capabilities

in their organization, managers with less than one year working experience at their current organizations were excluded. The survey was conducted in four rounds, each including an email invitation with a hyperlink to the online survey and follow-up emails of the survey sent out one week after the previous email invitation. A total of 148 responses were received from individual organizations. Due to missing data and selection of 'no basis for answering' for the main study variables, 55 responses were unusable. This resulted in a 2.11 percent response rate.

Table 3 shows that most respondents belonged to the CFO/finance director/finance manager group, while the smallest proportion were business executives/managers. Most respondents were in the public sector, followed by other services, education, manufacturing, mining, construction and wholesale, finance, insurance, transportation, agriculture, retail trade and communication. More than 60 % of the organizations have operated for more than 20 years, 23.7 % of organizations have operated between 5 and 20 years, and 6.5% of organizations have operated between 2-5 years. Respondents have worked for their respective organizations for an average of 6.44 years.

To assess potential non-response bias, an *independent t-test* was conducted, comparing early and late respondents based on the mean values of measurement items used in this study (Table 13). The results reveal no significant differences, suggesting that non-response bias is unlikely to have influenced the findings.

2.3.2.3 Measurement Model Quality and Results

To determine the most appropriate analysis and testing techniques, the univariate normality of all the main constructs was examined. All normality tests were significant, indicating that the data is not normally distributed.

This study uses PLS-SEM path modelling to validate the constructs' measures and test the research model and hypotheses based on the survey data. PLS-SEM is deemed to be suitable for analysing non-normal datasets, relatively small sample size and complex models with mediating and

moderating constructs and second-order constructs (Hair et al., 2013) and formative measurement constructs. A two-stage analysis was performed in the PLS method to assess the measurement and structural models, estimate the path coefficients at the second order level, and show the strength of the associations between the dependent and independent variables and R-square and f-square values.

2.3.2.4 Measurement Model Quality

As the research model includes both reflective and formative constructs, it is required to conduct a separate set of analyses (F. Hair Jr et al., 2014). The measurement model was tested for internal consistency (composite reliability), indicator reliability, convergent validity, and discriminant validity. The formative measurement quality was determined having tests for multicollinearity, indicator weights, significance of the weights, and indicator loadings (F. Hair Jr et al., 2014). To ensure the appropriateness of the measurement model, established instruments from previous studies were employed.

Reliability is measured based on the composite reliability and indicator reliability, relating to the internal consistency and accuracy of the measurement items, and the results are summarized in table 6 (Hulland, 1999; Straub, 1989). Cronbach's alpha for the reflective constructs OP (0.83), ICT Capabilities (0.80) and ENV (0.86) are clearly above 0.60, indicating that the reliability of these reflective constructs is acceptable. The composite reliability of all constructs in the measurement model are larger than 0.70, which indicates that all constructs met the recommended threshold. The indicator reliability was examined by factor loadings, which refers to the extent to which each of the items in the correlation matrix correlates with the given principal components. As shown in table 4, all measurement items in the model exceeded the recommended minimum value of 0.5, except for one item of the ICT construct, which was therefore removed (Hair et al.,

2016). In the final model, the loadings on the remaining items are all significant at the $p<0.01$ level.

Convergent validity uses item loadings and average variance extracted (AVE) to assess whether measures for constructs that are modelled reflectively. Table 6 shows that all measurement items for reflective measures have high and significant loadings. AVE for all constructs is above 0.50 ranging between 0.554 to 0.747, which supports the convergent validity claim for the measurement items. The results indicate the significant contribution of the measurement items to the construct.

Discriminant validity uses two criteria: the Fornell and Larcker (1981) criterion and the indicators' cross-loadings (Chin, 1998). As shown in table 10, all values of the square roots of the AVE are greater than the inter-construct correlations, indicating adequate discriminant validity of the measures. In addition, heterotrait-monotrait ratios (HTMT) were calculated, and all fell below the conservative threshold 0.9 (Teo et al., 2008), which reconfirming the established discriminant validity. The third test is to assess whether each first-order measurement item has a higher loading on its assigned factor than on any other factor (Chin, 1998; Gefen et al., 2000). Table 9 shows that each measurement item loaded higher on the appropriate construct than on any other construct (Chin, 1998; Gefen et al., 2000), which indicates that all measures have appropriate discriminant validity.

The variance inflation factors (VIF) values of all formative constructs were used to examine the level of multicollinearity. The threshold value suggested for VIF is five (F. Hair Jr et al., 2014), and the test in table 11 confirmed that all VIF values related to MC indicators were below 5, which means that there were no major multicollinearity problems. Therefore, based on the above evaluations, the formative part of the measurement model was valid.

2.3.2.5 Common Method Bias (CMB)

Since the data was collected through a single survey, common-method bias may influence the findings. Both procedural and statistical remedies were implemented to control for common-method bias and minimize its potential effects (Podsakoff et al., 2003). Procedural remedies are used in the early stage of survey design to prevent the emergence of CMB, while statistical remedies are applied to assess the effectiveness of preventative measures (Lindell & Whitney, 2001). As for procedural remedies, the survey was pilot tested with several academics to ensure that all the measurements were appropriate, and respondents could understand the questions. The question order was counterbalanced by splitting the survey into sections on demographics, environmental dynamism, TW, management controls, ICT capabilities and operational performance, to neutralize some biases related to items' embeddedness or question context (Podsakoff et al., 2003). Constructs were clearly defined at the beginning of the survey, questions were kept simple and specific, and all scale points were labelled to reduce ambiguity (Podsakoff et al., 2003). To reduce the response format similarity, both 7-point and 5-point Likert-type scales are used in the survey (Podsakoff et al., 2003). Moreover, participants were given assurance that all identities and responses are anonymous, and all information is kept confidential, to ensure that they are more likely to answer honestly and have less evaluation apprehension (Philip M Podsakoff et al., 2003; Steenkamp et al., 2010).

2.3.3 Structural Model Results

Table 2-1 provides summaries of the results for the effects in the structural model. Overall, the model performance indicators suggest that the model has good prediction quality. All the hypotheses in the model were tested for magnitude and significance of path coefficients estimated using PLS-SEM. The hypotheses about each of the relations in the structural equation model are summarized in the table.

H1 suggests that changes of TW have a negative impact on operational performance. The results in table 2-1 support this hypothesis given the significant negative coefficient of TW → OP (-0.202*). This finding successfully challenges the assertion of some previous papers, arguing that implementing TW has a positive impact on operational performance (Allen et al., 2015; Crandall & Gao, 2005; Gajendran et al., 2015). H2 examines the relationship between changes of TW and levels of MC. The results in table 2-1 support the hypothesis given the significant positive coefficient of TW → MC (0.187*). The results for H3 confirm a significant positive effect of MC on OP (0.484**), with a medium effect size (f^2 = 0.246). Table 2-1 also provides the results of additional mediation tests which show that the indirect path from TW to OP via MC is statistically significant, thereby confirming that MC partially mediates the relationship between changes of TW and operational performance.

In H4, it is hypothesized that ICT has a positive impact on OP. The results support the hypothesis with the strong and significant direct relationship (0.222*), consistent with previous studies (Bharadwaj, 2000; Grant, 1991; Santhanam & Hartono, 2003). H5 predicts that there is a positive relationship between environmental dynamism (ENV) and level of MC. The results support this hypothesis given the significant positive coefficient for ENV → MC (0.379*), and a medium effect size (f^2 = 0.175). Combining the positive effects predicted in H3 and H5 reveals a significant indirect effect of ENV on OP (0.184*).

H6, which posits that ICT reduces the negative relationship between increases in TW and OP, receives strong support based on the significant and positive moderation coefficient (0.129*). The visual presentation of this moderation effect in figure 2-2, which portraits the TW-OP relationship for high ICT (+1 standard deviation), mean and low ICT (-1 SD), demonstrates very clearly that high ICT capability almost completely ‘absorbs’ the negative effect of TW on OP, whereas in low ICT organizations, the effect of TW on OP is extremely negative. While this is not per se a surprising finding, the visualization of the effect demonstrates clearly how important ICT

capabilities are in TW environments. Finally, H7 examines the moderating role of environmental dynamism on the relationship between changes of TW and OP. In line with the prediction, ENV – just like ICT – also reduces the negative relationship between increases in TW and OP. Figure 2-3 highlights that in high dynamism the effect of TW on OP is almost completely neutralized, whereas in low dynamism it is strongly negative.

In addition to *p*-values, explanatory power was assessed using R-squares and effect sizes (f^2) for endogenous constructs. It is obvious from the f^2 values in table 2-1 that TW explains only a very small portion of the variation in MC and OP, which can be considered a limitation of the study. However, demonstrating high magnitude effects was neither an objective of this study nor was it expected. Changing MC systems is typically a slow process (Chenhall & Euske, 2007) and changes in the competitive position do not typically occur because of smaller[2] changes in work practices – even less so if all competitors are equally affected by the external shock imposed by a pandemic. Insofar, finding any statistically *significant* effects can be considered a noteworthy finding.

[2] The changes in the percentage of employees working remotely pre- and post-COVID19 ranged from -2 to 5% only (table 2-2).

Table 2 - 1: ***Test Results for Hypotheses***

Hypothesis/ Result	***Path:***	***Effect***[1)]	***Without Moderation***		***With Moderation***	
			Coeff.	***f Square***	***Coeff.***	***f Square***
H1 conf.	TW → OP	D	-0.202*[2)]	0.056	-0.198*	0.055
H2 conf.	TW → MC	D	0.187*	0.043	0.187*	0.043
H3 conf.	MC → OP	D	0.484**	0.246	0.476**	0.239
H4 conf.	ICT CAP → OP	D	0.222*	0.062	0.239*	0.074
H5 conf.	ENV → MC	D	0.379*	0.175	0.380*	0.175
H6 conf.	ICT*TW → OP	M			0.129*[3)]	0.022
H7 conf.	ENV*TW → OP	M			0.148*[3)]	0.024
	TW → MC → OP	I	0.090[3)]		0.089[3)]	
	ENV → MC → OP	I	0.184*		0.181*	
Controls	SIZE → ICT CAP	C	-0.061		-0.061	
	SIZE → MC	C	-0.044		-0.044	
	SIZE → OP	C	-0.010		-0.029	
R square:						
H1, H3, H4, H6, H7	OP			0.318		0.347
H2, H5	MC			0.192		0.192

[1)] D = direct effects, I = indirect effects, M = moderation effects; [2)] Significance 1-tailed: p < 0.05; p < 0.01**; p < 0.001****

[3)] significant only when applying bias corrected confidence interval method.

Figure 2 - 2: ***Visual Presentation of Moderating Effect ICT_CAP*TW (Standardised)***

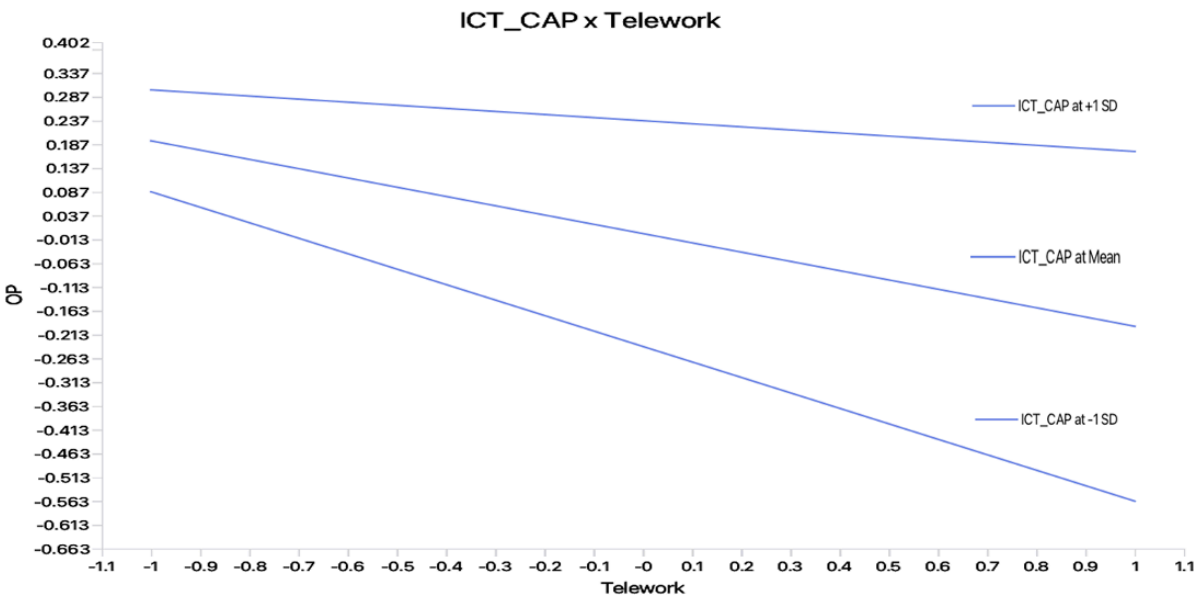
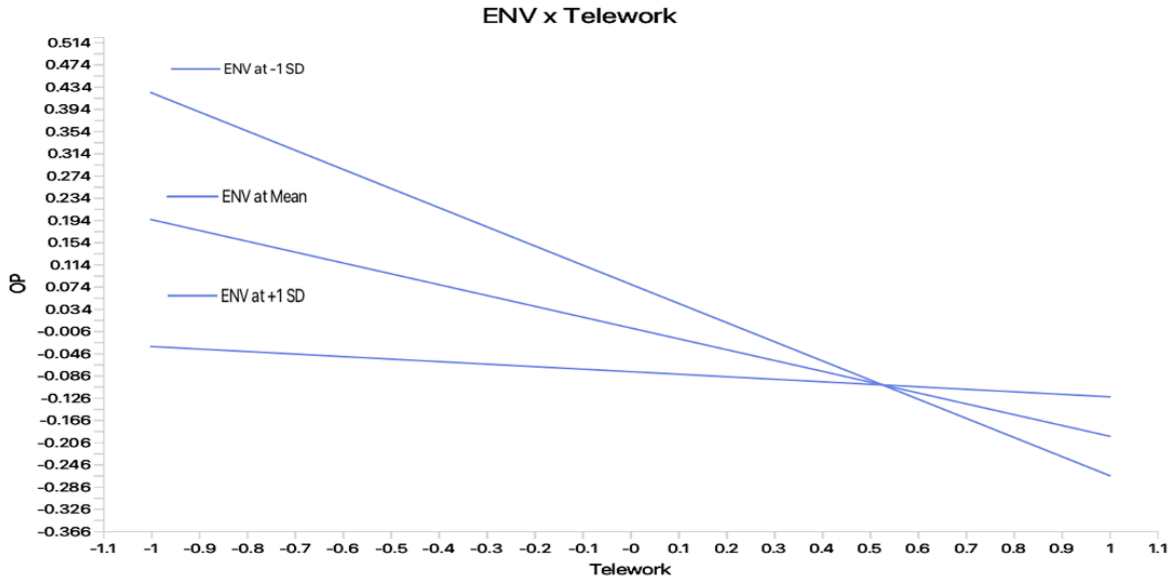


Figure 2 - 3: ***Visual Presentation of Moderating Effect ENV*TW (Standardised)***



2.4 Discussion

Enabling effective and efficient TW has become a critical business problem for many organizations. This study incorporates insights from the literatures on DCV, MC and environmental dynamism, and provides theoretical and practical implications for TW success.

2.4.1 Theoretical Contributions

This study advances theory in three interrelated literature streams—telework (TW), accounting information systems (AIS), and management control (MC)—by examining how TW, ICT capabilities, and MC jointly shape operational performance under varying degrees of environmental dynamism.

First, the study contributes to the growing TW literature by adopting a longitudinal perspective that compares pre-COVID conditions to late-pandemic (2022) working arrangements. Prior research typically examined TW at a single point in time (Bloom et al., 2015; Felstead et al., 2002; Gajendran & Harrison, 2007), often during the early stages of the pandemic when organizations and employees were still adjusting to heightened uncertainty. By analysing conditions after extended exposure to TW, when managers and employees had largely adapted to remote work routines, this study provides a more stable and realistic assessment of TW's performance implications. Contrary to findings of universal performance benefits, the results show that increases in TW can impede operational performance, thereby sharpening the theoretical understanding of the conditions under which TW enhances—or constrains—organizational outcomes.

Second, this study advances AIS research by unpacking the role of ICT capabilities as organizational resources that facilitate adaptation in remote work environments. Rather than treating ICT capability as a monolithic construct, this study examines distinct capability dimensions—internal system use, communication-related use, and collaboration-supporting use—and theorises their effects through the lens of the dynamic capabilities view (DCV). Consistent with DCV predictions, ICT capabilities are shown to enhance operational performance directly and to buffer the negative performance implications of increased TW. These findings extend AIS theory by illuminating how ICT-enabled sensing, coordination, and knowledge-sharing

mechanisms mitigate the informational frictions created by remote work, support employee competence, and maintain collaborative functioning. In doing so, the study offers new empirical insights into how ICT capabilities strengthen work efficiency and reduce constraints associated with reduced physical interaction.

Third, this study contributes to the MC literature by examining how organizations mobilise control mechanisms when operating under high TW intensity and environmental dynamism. Drawing on the Merchant and Van der Stede (2007) framework, it analyses the combined use of action, results, personnel, and cultural controls rather than isolating individual forms. The results demonstrate that MC packages play an important role in sustaining operational performance, supporting recent arguments stressing the interdependence of MC mechanisms (Cardinal et al., 2017). Moreover, by revealing that MC mediates the relationship between environmental dynamism and performance, the study provides evidence that organizations intensify and reconfigure control systems to manage heightened uncertainty. This extends MC scholarship by showing how dynamic capabilities and control packages jointly function to maintain performance in remote working conditions—an area previously underexplored due to TW's limited prevalence before COVID-19.

Finally, by examining the moderating influence of environmental dynamism, the study provides new insights into the boundary conditions shaping the TW–performance relationship. The findings show that higher environmental dynamism attenuates the negative impact of increased TW on performance, suggesting that TW may be less detrimental when firms already operate in contexts that require flexibility, decentralised decision-making, and rapid information flows. To the best of our knowledge, this is the first empirical investigation to demonstrate how environmental dynamism conditions the performance effects of TW. This contributes to contingency-based theorising by illustrating how environmental turbulence interacts with organizational resources and work arrangements to shape performance outcomes.

Overall, this study enriches theoretical understanding by demonstrating that the performance consequences of TW depend critically on the organization's ICT capabilities, control configurations, and environmental context. By integrating insights from TW, AIS, and MC research streams, the findings offer a more holistic explanation of how organizations can maintain operational performance in increasingly flexible and dynamic working environments.

2.4.2 Practical Implications

This study provides important practical insights for practitioners. As TW is likely to continue in the future, organizations must align TW with their MC and ICT capabilities. The results show that higher levels of TW may reduce operational performance, which emerges as a paramount concern. The study sheds light on the significance of this concern for organizations and offers guidelines to reduce this concern. To mitigate the negative effects, organizations need to develop and use ICT capabilities to facilitate employees' work from home effectively. In this context, managers should enable their employees to use ICT to access relevant and useful information, interact with managers and team members, and maintain collaboration within the organization. The results of the study will help managers nurture ICT in their company to develop their strategies, especially in response to increasing levels of environmental dynamism.

Furthermore, the shift to TW amplifies MC problems and thus poses significant challenges to organizations. MC of an organization can influence its chance of survival and success in a fast-changing environment (Chenhall, 2003), and as such, improving the understanding of how MC affects operational performance is critical for management effectiveness. Supporting the idea that action, outcome, personnel and cultural control co-exist in organizations, this study provides evidence that TW requires higher levels of MC mechanisms to realize operational efficiency and effectiveness. This requires more inputs from managers, such as clearly defined tasks and deliverables, establishing specific milestones, setting up frequent meetings and casual online

conversations, providing suitable training, promoting core values of the organization and encouraging mutual monitoring. These findings also provide insights into how MC is influenced by environmental dynamism. Managers must pay attention to the external environment and analyse and interpret its features so that they can prepare appropriate plans for important future events.

2.5 Conclusion and Limitations

The rapid development of ICT has promoted organizations to adopt TW to improve flexibility and maintain normal operations in the uncertain environment caused by COVID-19 pandemic. In this situation, this study has explored the relevant opportunities and challenges in the TW environment. The purpose of this study was to improve our understanding of the role of MC and ICT capabilities in TW environments and how they may improve operational performance. MC was examined based on Merchant and van der Stede (2007) framework, which includes action, results, personnel and cultural control. ICT capabilities were examined through three dimensions (1) internal use; (2) collaboration; and (3) communication.

To test the theoretical model, survey responses were collected from CFO/senior financial managers from medium to large Australian organizations. The analysis of the research model indicates that the model is robust, and all theorized relationships are significant. The model examines both direct effects amongst TW, MC and ICT capabilities, and the moderating effects of ICT capabilities and environmental dynamism.

My study contributes to four underlying main literature streams. First, it advances the growing literature on TW by demonstrating that implementing TW is perceived to have a negative impact on the operational performance in organizations. However, the results show that higher levels of TW lead to higher levels of MC used in combinations to indirectly improve the operational performance. Building on the Merchant et al. (2007), these findings strengthen the foundation for

future research, particularly in the TW context, which may need deeper exploration at MC practices. Second, the study contributes to DCV literature by generating deeper knowledge about how organizations' capabilities can lead to operational performance, directly or indirectly. The results indicate that ICT capabilities are an influential factor to enhance operational performance and highlight the positive moderating effect of ICT capabilities in the relationship between TW and operational performance. Third, this study extends research on the role of MC in dynamic environments and extends this stream of research by investigating multiple types of MC and their relations with operational performance in TW environment. Lastly, this study provides a systematic perspective on the role of environmental dynamism in the value and capabilities of resources and strengthening studies in this field. Results indicate that MC intensity increases with higher environmental dynamism. In addition, the study confirms a moderating effect of environmental dynamism on the performance impacts of TW on performance: when environmental dynamism is high, increasing TW has almost no effect on the performance of organizations.

This study has several limitations which suggest additional exploration for future research. First, the cross-sectional survey design does not permit a full examination of changes in MC over time. Future research on MC might consider the changes of MC and use longitudinal field research methods. Second, the results are based on the perception of managers. Investigating the employee perspectives would be beneficial to provide more comprehensive understanding of their experiences with TW, MC and ICT. Also, the model primarily focuses on a set of MC practices within the organization. Investigating the relationship between various types of MC and their interactions is also an important aspect for future research. Another potential limitation is that the effect sizes of changes in TW levels on MC and OP are very small, although still statistically significant. Finally, data was collected Australia only, so the results obtained in this research may

not be generalizable for all countries. It would be interesting to further explore how MC, ICT capabilities and TW vary across a larger sample of various cultural contexts.

2.6 Tables

Table 2 - 2: ***Descriptive Statistics (Questionnaire Items/Indicators)*** [3]

Indicator	Question (short version)	Scale	Mean/ Median	Std. Dev.	Kurt/ SE	Skew/ SE
Firm Size	Annual revenue	1-6	2.900	1.336	1.271	0.171
TW	% change of TW staff pre- to post-COVID19	-2-5	1.650	1.434	0.198	-0.241
MC_AC	Action control					
MC_AC1	Emphasis is placed on complying with rules and procedures.	1-5	4.270	0.934	-1.466	2.192
MC_AC2	The most important tasks for routine processes are defined by managers.	1-5	3.690	1.021	-0.839	0.439
MC_AC3	Employees are provided with information on the most important steps regarding the achievement of performance goals.	1-5	3.670	0.982	-0.762	0.650
MC_AC4	Policies and procedures manuals define the fundamental course of processes.	1-5	3.710	1.038	-0.818	0.341
MC_PC	Personnel control					
MC_PC1	Employees are carefully selected based on whether they fit our organization's values and norms.	1-5	4.250	0.985	-1.703	3.141
MC_PC2	Emphasis is placed on hiring the best-suited applicants for a particular job position.	1-5	4.130	0.981	-1.466	2.490
MC_PC3	Training and development activities for employees are regarded as being very important.	1-5	3.980	0.989	-1.059	1.096
MC_PC4	Numerous opportunities are being offered to employees to broaden their range of skills.	1-5	3.460	1.119	-0.475	-0.360
MC_CC	Cultural control					
MC_CC1	Traditions, values, and norms play a major role in our organization.	1-5	3.970	0.972	-0.878	0.867
MC_CC2	In our organization, high emphasis is placed on sharing informal codes of conduct with employees.	1-5	3.630	1.196	-0.618	-0.345
MC_CC3	Our mission statement conveys the organization's core values to our employees.	1-5	4.300	1.008	-1.549	2.088
MC_CC4	Top managers communicate the organization's core values to employees.	1-5	4.100	1.124	-1.275	0.872
MC_OC	Outcome control					
MC_OC1	Specific performance targets are created for employees.	1-5	3.850	1.063	-1.025	0.840
MC_OC2	The achievement of performance targets per employee is being measured and controlled by their respective superiors.	1-5	3.730	1.162	-0.644	-0.336

[3] The number of responses for all questions are 93.

M^4C_OC3	Potential deviations from organizational performance goals have to be explained by the responsible managers.	1-5	3.800	1.109	-1.001	0.584
MC_OC4	Employees receive feedback from their superiors concerning the extent to which they achieved their performance goals.	1-5	3.700	1.101	-1.021	0.645
ICT_INT	Increase internal use					
ICT_INT1	Enable strategic planning	1-5	3.900	0.956	-0.641	-0.093
ICT_INT2	Detailed MA info. is reported directly to line managers	1-5	3.840	0.924	-0.346	-0.734
ICT_INT3	Enable competence/skills development for employees	1-5	3.960	0.943	-0.787	0.227
ICT_COL	Initiate and maintain collaboration					
ICT_COL1	Maintain collaboration with existing business partners	1-5	4.090	0.905	-0.982	0.833
ICT_COL2	Establish business collaborations with new partners	1-5	3.840	1.035	-0.750	0.186
ICT_COL3	Enable work flexibility (e.g., work outside the office)	1-5	4.590	0.811	-1.991	3.041
ICT_COM	Use for internal and external communication					
ICT_COM1	Handle communication within the firm (e.g., intranet)	1-5	4.610	0.723	-1.906	3.037
ICT_COM2	Handle external communication with the firm's stakeholders	1-5	4.200	0.879	-0.905	0.051
ICT_COM3	Promote marketing activities	1-5	4.260	0.920	-1.055	0.155
OP	Operational performance					
OP1	Significant steps of improving production/service processes have been performed in the organization.	1-7	5.090	1.380	-0.639	0.096
OP2	The efficiency of internal processes in the organization has been increasing in terms of time and cost.	1-7	4.830	1.457	-0.728	0.237
OP3	Employee productivity has been increasing.	1-7	4.620	1.398	-0.248	-0.165
OP4	The geographic distribution of sales/service activities has been expanding.	1-7	4.550	1.658	-0.372	-0.587
OP5	Operating costs have been reducing	1-7	3.430	1.814	0.372	-0.855
OP6	Customer services have been improving.	1-7	4.560	1.289	-0.180	-0.078
ENV	Environmental dynamism					
ENV1	Changes happen more quickly and expansively than before.	1-7	5.200	1.479	-0.980	0.637
ENV2	Changes are more complicated and solutions to one problem often impact on other areas and issues	1-7	5.230	1.497	-0.833	0.092

ENV3	Predicting change has become more difficult and more imprecise.	1-7	5.130	1.377	-0.748	0.182
ENV4	Changes are more complicated and solutions to one problem often impact on other areas and issues	1-7	4.820	1.359	-0.563	-0.168

Table 2 - 3: ***Descriptive Statistics***

Variables	*Frequency*	*Percent*
Industry (n=93)		
Agriculture, forestry and fishing	3	3.2
Mining	6	6.5
Construction	6	6.5
Manufacturing	9	9.7
Public services	15	16.1
Wholesale trade	6	6.5
Retail trade	2	2.2
Finance	4	4.3
Insurance and real estate	4	4.3
Transportation	4	4.3
Communication	2	2.2
Education	10	10.8
Other services	13	14.0
Other	9	9.7
Years of operation(n=93)		
2-5 years	6	6.5
5-20 years	22	23.7
More than 20 years	65	69.9
Number of employees(n=93)		
20-199	18	19.4
200-499	28	30.1
500-1000	23	24.7
more than 1000	24	25.8
Annual revenue(n=93)		
10-250 million	55	59.1
250-500 million	17	18.3
500-1000 million	3	3.2
more than 1000 million	11	11.8
N/A	7	7.5
Job title (n=93)		
CFO	43	46.2
Director finance	10	10.8
Head of finance	14	15.1
Senior financial manager	5	5.4
Other	21	22.6

Table 2 - 4: ***Factor Loadings***

Indicator	Loadings	Construct
ICT_INT1	0.714	ICT_INT
ICT_INT2	0.876	
ICT_INT3	0.860	
ICT_COL1	0.926	ICT_COL
ICT_COL2	0.899	
ICT_COL3	0.765	
ICT_COM1	0.793	ICT_COM
ICT_COM2	0.687	
ICT_COM3	0.872	
MC_AC1	0.694	MC_AC
MC_AC2	0.564	
MC_AC3	0.869	
MC_AC4	0.798	
MC_OC1	0.826	MC_OC
MC_OC2	0.770	
MC_OC3	0.824	
MC_OC4	0.855	
MC_PC1	0.710	MC_PC
MC_PC2	0.743	
MC_PC3	0.801	
MC_PC4	0.816	
MC_CC1	0.640	MC_CC
MC_CC2	0.665	
MC_CC3	0.835	
MC_CC4	0.875	
ENV1	0.857	ENV
ENV2	0.897	
ENV3	0.921	
ENV4	0.659	
OP1	0.784	OP
OP2	0.884	
OP3	0.893	
OP5	0.518	
OP6	0.747	
Firm Size	1.000	Firm Size
TW	1.000	TW

All factor loadings are above 0.5.

Table 2 - 5: ***Latent Variables – 1st Order Constructs***

Latent Variable	Cronbach's Alpha	Rho_A	Composite reliability	AVE
TW	1.000	1.000	1.000	1.000
MC_AC	0.732	0.783	0.830	0.554
MC_OC	0.839	0.843	0.892	0.674
MC_PC	0.776	0.776	0.856	0.597
MC_CC	0.763	0.814	0.847	0.584
ICT_INT	0.758	0.903	0.848	0.656
ICT_COL	0.831	0.835	0.899	0.747
ICT_COM	0.739	0.767	0.845	0.646
ENV	0.862	0.908	0.905	0.706
OP	0.831	0.882	0.881	0.604

Table 2 - 6: ***Latent Variables – 2nd Order Constructs***

Latent Variable	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
TW	1.000	1.000	1.000	1.000
OP	0.831	0.877	0.881	0.605
MC	0.000	1.000	0.000	0.000
ICT CAP	0.801	0.811	0.883	0.716
ENV	0.862	0.923	0.903	0.704
Firm Size	1.000	1.000	1.000	1.000

Table 2 - 7: ***Discriminant Validity (Indicator Cross-Loadings) – 1st Order Constructs***

	TW	Firm Size	MC_AC	MC_CC	MC_OC	MC_PC	ICT_INT	ICT_COL	ICT_COM	OP	ENV
TW	**1.000**	0.022	0.167	0.170	0.202	0.165	0.146	0.192	0.103	-0.065	0.053
Firm Size	0.022	**1.000**	0.029	-0.075	-0.152	-0.091	-0.003	-0.021	-0.129	-0.059	-0.123
MC_AC1	0.072	-0.049	**0.692**	0.396	0.336	0.433	0.164	0.202	0.135	0.337	0.079
MC_AC2	-0.010	-0.094	**0.600**	0.455	0.362	0.396	0.055	0.062	-0.011	0.284	0.115
MC_AC3	0.162	-0.033	**0.839**	0.625	0.643	0.641	0.450	0.410	0.173	0.446	0.278
MC_AC4	0.207	0.207	**0.820**	0.552	0.355	0.437	0.157	0.232	0.031	0.357	0.198
MC_CC1	0.085	-0.187	0.434	**0.684**	0.446	0.452	0.031	-0.009	-0.032	0.174	0.259
MC_CC2	0.082	-0.070	0.383	**0.669**	0.256	0.281	0.171	0.233	0.102	0.259	0.260
MC_CC3	0.157	0.038	0.674	**0.819**	0.567	0.668	0.282	0.204	0.239	0.380	0.272
MC_CC4	0.170	-0.059	0.585	**0.866**	0.631	0.621	0.294	0.215	0.309	0.369	0.456
MC_OC1	0.250	-0.087	0.474	0.517	**0.842**	0.629	0.256	0.205	0.077	0.334	0.291
MC_OC2	0.073	-0.136	0.369	0.374	**0.800**	0.599	0.179	0.125	-0.046	0.375	0.179
MC_OC3	0.097	-0.109	0.458	0.564	**0.807**	0.695	0.389	0.169	0.114	0.304	0.312
MC_OC4	0.221	-0.168	0.613	0.641	**0.833**	0.696	0.357	0.293	0.203	0.325	0.280
MC_PC1	0.178	-0.073	0.418	0.460	0.597	**0.768**	0.107	0.089	0.019	0.344	0.193
MC_PC2	0.211	-0.098	0.458	0.504	0.700	**0.781**	0.151	0.086	0.116	0.266	0.196
MC_PC3	0.033	-0.109	0.563	0.608	0.616	**0.753**	0.364	0.306	0.229	0.419	0.210
MC_PC4	0.103	0.001	0.567	0.527	0.560	**0.789**	0.362	0.251	0.081	0.356	0.205

	TW	Firm Size	MC_AC	MC_CC	MC_OC	MC_PC	ICT_INT	ICT_COL	ICT_COM	OP	ENV
ICT2	-0.033	0.052	0.182	0.260	0.219	0.164	**0.627**	0.354	0.482	0.136	0.038
ICT3	0.055	0.022	0.258	0.215	0.306	0.281	**0.866**	0.501	0.395	0.238	0.080
ICT4	0.222	-0.038	0.297	0.245	0.336	0.306	**0.908**	0.683	0.414	0.259	-0.012
ICT5	0.216	-0.002	0.349	0.156	0.197	0.213	0.628	**0.912**	0.435	0.237	-0.057
ICT6	0.159	0.075	0.385	0.253	0.251	0.205	0.589	**0.860**	0.439	0.242	-0.019
ICT7	0.126	-0.107	0.160	0.180	0.193	0.210	0.520	**0.820**	0.558	0.332	0.044
ICT8	0.076	-0.174	0.074	0.152	0.049	0.108	0.471	0.600	**0.853**	0.247	0.007
ICT9	0.041	0.017	0.055	0.042	-0.007	-0.002	0.491	0.575	**0.756**	0.141	-0.109
ICT10	0.111	-0.095	0.144	0.305	0.177	0.188	0.285	0.252	**0.799**	0.263	-0.046
OP1	-0.072	0.011	0.378	0.341	0.335	0.414	0.207	0.164	0.175	**0.784**	0.128
OP2	0.049	-0.092	0.462	0.394	0.308	0.398	0.161	0.299	0.299	**0.884**	0.142
OP3	-0.089	-0.014	0.520	0.369	0.382	0.394	0.253	0.347	0.212	**0.893**	-0.014
OP5	-0.074	-0.010	0.108	0.004	0.140	0.100	0.307	0.328	0.117	**0.518**	0.039
OP6	-0.091	-0.120	0.275	0.311	0.353	0.359	0.222	0.141	0.287	**0.747**	0.076
ENV1	0.014	-0.056	0.266	0.394	0.352	0.256	0.185	0.034	-0.027	0.235	**0.852**
ENV2	-0.003	-0.119	0.205	0.369	0.254	0.255	-0.035	-0.027	-0.048	0.060	**0.897**
ENV3	0.095	-0.182	0.215	0.390	0.284	0.207	0.009	0.018	-0.021	-0.007	**0.922**
ENV4	0.111	-0.046	0.077	0.227	0.153	0.119	-0.171	-0.114	-0.082	-0.070	**0.667**

Table 2 - 8: ***Discriminant Validity – HTMT - 1st Order Constructs***

	ENV	Firm Size	ICT_COL	ICT_COM	ICT_INT	MC_AC	MC_CC	MC_OC	MC_PC	OP	TW
ENV	**0.840**										
Firm Size	-0.123[a)]	**1.000**									
	0.129[b)]										
ICT_COL	-0.009	-0.021	**0.865**								
	0.083	0.078									
ICT_COM	-0.045	-0.129	0.559	**0.804**							
	0.116	0.137	0.741								
ICT_INT	0.033	-0.003	0.668	0.492	**0.810**						
	0.172	0.052	0.787	0.731							
MC_AC	0.244	0.029	0.335	0.121	0.313	**0.744**					
	0.270	0.150	0.413	0.202	0.369						
MC_CC	0.423	-0.075	0.225	0.237	0.279	0.692	**0.764**				
	0.489	0.132	0.281	0.295	0.359	0.900					
MC_OC	0.326	-0.152	0.246	0.111	0.361	0.588	0.643	**0.821**			
	0.362	0.166	0.291	0.152	0.435	0.721	0.770				
MC_PC	0.261	-0.091	0.243	0.147	0.324	0.652	0.682	0.798	**0.773**		
	0.304	0.103	0.294	0.166	0.391	0.844	0.854	0.991			
OP	0.093	-0.059	0.317	0.287	0.274	0.485	0.402	0.406	0.453	**0.777**	
	0.170	0.070	0.393	0.339	0.353	0.573	0.472	0.473	0.535		
TW	0.053	0.022	0.192	0.103	0.146	0.166	0.170	0.202	0.165	-0.065	**1.000**
	0.071	0.022	0.212	0.109	0.144	0.177	0.185	0.213	0.193	0.107	

a) Fornell-Larcker Criterion: AVE-squared in diagonal (bold) compared with latent variable correlations (first value underneath diagonal).
b) Heterotrait-Monotrait Ratio (HTMT) (second value underneath diagonal); all HTMT values significant at $p < 0.01$.

Table 2 - 9: ***Discriminant Validity (Indicator Cross-Loadings) – 2nd Order Constructs***

	TW	Firm Size	MC	ICT CAP	OP	ENV
TW	***1.000***	0.022	0.205	0.176	-0.068	0.051
Firm Size	0.022	***1.000***	-0.086	-0.059	-0.059	-0.122
MC_AC	0.166	0.029	***0.837***	0.306	0.482	0.247
MC_CC	0.170	-0.075	***0.914***	0.290	0.399	0.425
MC_OC	0.201	-0.152	***0.859***	0.281	0.407	0.329
MC_PC	0.165	-0.091	***0.828***	0.280	0.452	0.262
ICT_COL	0.192	-0.021	0.296	***0.892***	0.318	-0.007
ICT_COM	0.103	-0.129	0.189	***0.801***	0.286	-0.044
ICT_INT	0.146	-0.003	0.361	***0.843***	0.278	0.041
OP1	-0.072	0.010	0.401	0.213	***0.780***	0.135
OP2	0.048	-0.092	0.438	0.302	***0.876***	0.145
OP3	-0.089	-0.014	0.470	0.324	***0.893***	-0.007
OP4	-0.091	-0.120	0.363	0.251	***0.755***	0.080
ENV1	0.014	-0.056	0.394	0.072	0.235	***0.863***
ENV2	-0.003	-0.119	0.330	-0.043	0.058	***0.893***
ENV3	0.095	-0.182	0.350	0.003	-0.009	***0.919***
ENV4	0.111	-0.046	0.186	-0.143	-0.073	***0.654***

Table 2 - 10: ***Discriminant Validity (Latent Variables) – 2nd Order Constructs***

	ENV	Firm Size	ICT CAP	MC	OP	TW
ENV	**0.839**					
Firm Size	-0.122[a)] 0.129[b)]	**1.000**				
ICT CAP	-0.005 0.109	-0.059 0.068	**0.846**			
MC	0.394 0.000	-0.086 0.000	0.332 0.000	**0.000**		
OP	0.098 0.170	-0.059 0.070	0.348 0.440	0.484 0.000	**0.778**	
TW	0.051 0.072	0.022 0.022	0.176 0.194	0.205 0.000	-0.068 0.107	**1.000**

a) Fornell-Larcker Criterion: AVE-squared in diagonal (bold) compared with latent variable correlations (first value underneath diagonal).

b) Heterotrait-Monotrait Ratio (HTMT) (second value underneath diagonal); all HTMT values significant at $p < 0.01$.

Table 2 - 11: ***Indicator Multicollinearity Test (Variance Inflation Factor)***

	VIF		VIF		VIF
TW	1.000	MC_AC3	1.565	MC_PC4	1.721
Firm Size	1.000	MC_AC4	1.613	OP1	1.973
ICT_INT1	1.393	MC_CC1	1.385	OP2	2.859
ICT_INT2	1.896	MC_CC2	1.295	OP3	2.631
ICT_INT3	1.628	MC_CC3	1.726	OP5	1.305
ICT_COL1	3.305	MC_CC4	1.810	OP6	1.766
ICT_COL2	2.831	MC_OC1	2.161	ENV1	1.968
ICT_COL3	1.513	MC_OC2	1.996	ENV2	3.073
ICT_COM1	1.776	MC_OC3	1.940	ENV3	3.752
ICT_COM2	1.761	MC_OC4	2.044	ENV4	1.613
ICT_COM3	1.257	MC_PC1	1.946		
MC_AC1	1.346	MC_PC2	1.980		
MC_AC2	1.220	MC_PC3	1.599		

all outer VIF scores < 5.0.

Table 2 - 12: ***Test of Normality***

	Kolmogorov-Smirnov[a)]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Ch_Tel_Num	0.136	93	0.000	0.948	93	0.001
MC_AC	0.143	93	0.000	0.897	93	0.000
MC_OC	0.137	93	0.000	0.910	93	0.000
MC_PC	0.161	93	0.000	0.867	93	0.000
MC_CC	0.136	93	0.000	0.898	93	0.000
OP	0.094	93	0.040	0.981	93	0.186
ICT	0.134	93	0.000	0.908	93	0.000
ENV	0.143	93	0.000	0.937	93	0.000

a. Lilliefors Significance Correction

Table 2 - 13: ***Independent Samples Test (Equal Variances Assumed)***

	Mean Difference	Sig.	95% CI LL	95% CI UL
TW	-0.247	0.343	-0.761	0.268
MC_AC1	0.231	0.236	-0.153	0.615
MC_AC2	0.501	0.017	0.091	0.911
MC_AC3	0.201	0.328	-0.205	0.606
MC_AC4	0.501	0.019	0.084	0.918
MC_PC1	0.145	0.480	-0.262	0.552
MC_PC2	0.341	0.093	-0.059	0.741
MC_PC3	0.474	0.020	0.076	0.871
MC_PC4	0.442	0.056	-0.012	0.896
MC_CC1	0.495	0.013	0.106	0.885
MC_CC2	0.137	0.584	-0.358	0.631
MC_CC3	0.424	0.042	0.015	0.832
MC_CC4	0.321	0.170	-0.140	0.781
MC_OC1	0.175	0.429	-0.263	0.614
MC_OC2	0.414	0.086	-0.059	0.888
MC_OC3	0.241	0.297	-0.216	0.698
MC_OC4	0.179	0.437	-0.276	0.633
ICT_INT1	-0.278	0.163	-0.669	0.114
ICT_INT2	-0.061	0.752	-0.444	0.322
ICT_INT3	-0.085	0.666	-0.475	0.305
ICT_COL1	-0.260	0.167	-0.631	0.111
ICT_COL2	0.025	0.908	-0.404	0.454
ICT_COL3	-0.163	0.334	-0.497	0.171
ICT_COM1	-0.207	0.169	-0.503	0.090
ICT_COM2	-0.155	0.398	-0.518	0.208
ICT_COM3	-0.006	0.977	-0.386	0.375
OP1	0.127	0.659	-0.444	0.698
OP2	0.090	0.768	-0.513	0.693
OP3	0.245	0.402	-0.332	0.822
OP4	-0.679	0.048	-1.351	-0.006
OP5	-0.009	0.981	-0.761	0.742
OP6	0.117	0.664	-0.416	0.651
ENV1	0.103	0.739	-0.509	0.715
ENV2	0.576	0.063	-0.033	1.184
ENV3	0.212	0.460	-0.356	0.781
ENV4	0.327	0.249	-0.232	0.885

Chapter 3 Enhancing Performance through Dynamic Capabilities: The Role of Data-Driven Decision-Making and Environmental Dynamism

Abstract

In today's rapidly evolving business environment, organizations increasingly develop dynamic capabilities to effectively respond to unprecedented challenges and enhance firm performance. Data-driven decision-making (DDDM) has emerged as a critical strategy, enabling organizations to leverage comprehensive data analysis to guide decision-making and promote evidence-based management. Drawing on the dynamic capabilities view (DCV), this study extends existing research by examining how advancements in information and communication technology (ICT) and business analytics (BA) capabilities support DDDM, thereby facilitating the transformation of big data into improved operational performance. Additionally, this study investigates the pivotal role of environmental dynamism in promoting DDDM supported by dynamic capabilities.

To validate the proposed model, a survey was conducted among senior managers from medium and large Australian organizations operating at varying levels of dynamic capabilities. The findings demonstrate that dynamic capabilities enhance operational performance through the mediating role of DDDM. Moreover, the study provides novel insights into the moderating effect of environmental dynamism on the relationship between BA capabilities and DDDM, offering a deeper understanding of how external conditions shape DDDM processes.

Keywords: Business Analytics Capabilities, ICT Capabilities, Data-driven Decision-making, Dynamic Capabilities View, Performance Management

3.1 Introduction

Organizations operate in increasingly complex and turbulent environments shaped by uncontrollable factors such as competition, globalization, and technological innovation. These dynamic conditions present both opportunities and challenges for organizations striving to achieve their strategic objectives (Dubey et al., 2020; Li et al., 2024; Saeed et al., 2023). In such rapidly evolving contexts, firms must exhibit agility by continuously adapting their strategies and operations while developing dynamic capabilities to align with changing market conditions (Syed et al., 2020; Yayla & Hu, 2012). Dynamic capabilities, defined as a firm's ability to integrate, build, and reconfigure internal and external resources to address environmental shifts, evolve through intricate interactions among organizational resources (Teece, 2018). These capabilities enable organizations to respond effectively to uncertainty. However, more recently the linkage between dynamic capabilities and competitive advantage had been described as indirect, which means that dynamic capabilities influence business performance through unique resources and capability they develop (Teece, 2018). As businesses accumulate vast amounts of data from sources such as operations, distribution, and customer interactions, leveraging big data becomes essential for maintaining competitiveness (Provost & Fawcett, 2013; Richins et al., 2017). In this context, data-driven decision-making (DDDM) translates insights generated from dynamic capabilities into competitiveness.

DDDM has emerged as a transformative approach, relying on comprehensive data analysis to inform strategic decisions and promote evidence-based management (Huerta & Jensen, 2017; McAfee et al., 2012). Unlike traditional decision-making processes, which often depend on managerial intuition or past experience, DDDM prioritizes empirical evidence derived from data, enhancing decision accuracy, mitigating risks, and optimizing outcomes across business functions (McAfee et al., 2012). The effective implementation of DDDM hinges on several

key factors, including extensive data utilization, managerial support for analytics, a learning-oriented culture, knowledge dissemination, and adaptability to change – elements that necessitate a robust set of organizational capabilities (Duan et al., 2020; Janssen et al., 2017; Upadhyay & Kumar, 2020). Consequently, investigating the role of DDDM in value creation is imperative for business success.

Studies have recently begun focusing on dynamic capabilities and the value organizations can create by successfully rooting these capabilities in management accounting tasks (Vidgen et al., 2017). However, research on the use of dynamic capabilities to facilitate DDDM and ultimately generate organizational competitiveness is still sporadic. Prior research highlights the critical role of business analytics (BA) capabilities and information and communication technology (ICT) capabilities in fostering and enhancing DDDM and firm performance (Shamim et al., 2019; Wamba et al., 2017). BA capabilities serve as a foundation that enables organizations to systematically analyse vast amounts of structured and unstructured data, thereby improving the relevance, accuracy, and timeliness of insights available to decision-makers (Işık et al., 2013; Santiago et al., 2015). Recognized as a competitive differentiator, BA has been consistently linked to improved organizational performance, both directly and indirectly (Ashrafi et al., 2019; Gupta & George, 2016; Torres et al., 2018; Trkman et al., 2010; Vidgen et al., 2017). In parallel, ICT capabilities are fundamental to supporting DDDM by enabling large-scale data collection, storage, and processing. ICT capabilities encompass a range of technologies, including intranet, extranet, enterprise resource planning (ERP) systems, and supply chain management tools, all of which contribute to the optimization of organizational processes (Kannabiran & Dharmalingam, 2012). These capabilities facilitate the adaptation, integration, and reconfiguration of both internal and external competencies, which are essential for navigating volatile business environments (Fillis et al., 2003; Levy et al., 2001).

Contextual factors are expected to play a crucial role in shaping firm actions, either enhancing or diminishing their effectiveness (Wamba et al., 2020). Firms operating in highly dynamic environments are more likely to adopt proactive strategies, develop dynamic capabilities, and implement rapid adaptive processes to maintain competitiveness compared to those in relatively stable or less dynamic environments (Oreja-Rodriguez & Yanes-Estevez, 2010; Sharma et al., 2022; Surty & Scheepers, 2020). While it is acknowledged that the external environment can affect dynamic capabilities to support firm performance (Saeed et al., 2023; Singh et al., 2022), there is limited research incorporating environmental dynamism into the examination of how dynamic capabilities affect DDDM. Therefore, there is a literature gap concerning the question of how dynamic capabilities (BA and ICT capabilities) benefit DDDM under conditions of varying degrees of environmental dynamism. Environmental dynamism, which encompasses the volatility and unpredictability of a firm's external environment (Gordon & Narayanan, 1984; Schilke, 2014), is a critical factor that demands greater attention. Investigating the moderating influence of environmental dynamism offers valuable insights into the strategies organizations can employee to effectively navigate uncertain conditions and foster DDDM through their investment in technological and analytical foundations.

Despite the recognized importance of BA and ICT capabilities, existing research has yet to fully elucidate how these dynamic capabilities interact to influence operational performance and DDDM, particularly in environments characterized by varying degrees of environmental dynamism. Therefore, to address the literature gap, the following key research questions are posed:

1. How does data-driven decision making (DDDM) improve the effects of dynamic capabilities (BA and ICT capabilities) on operational performance?

2. What role does environmental dynamism play in shaping the relationship between dynamic capabilities (BA and ICT capabilities) and DDDM?

Grounded in the Dynamic Capabilities View (DCV) theory, a theoretical model is proposed to address these research questions. the DCV provides a robust framework for understanding how organizations strategically develop and deploy resources to achieve long-term competitive advantage (Chae et al., 2014; Dubey et al., 2020). It underscores the need for organizations to align their capabilities to systematically exploit big data for performance improvements (Chen et al., 2015; Ghasemaghaei et al., 2017). Through dynamic capabilities, firms can continuously adapt to environmental shifts, effectively converting big data into actionable strategies that drive superior performance outcomes. The model is empirically tested using survey data collected from senior managers in medium and large organizations across Australia.

This study offers two unique contributions. First, it reveals that the link between dynamic capabilities and operational performance is not necessarily direct and may occur through DDDM. This study draws on the DCV to analyse how DDDM can help translate the insights generated by dynamic capabilities into improved operational performance. Therefore, the study provides interesting insights concerning DDDM as a mediating mechanism between dynamic capabilities (BA and ICT capabilities) and operational performance. While this perspective has proven its importance in the accounting information system literature, it has received less attention in the context of BA and ICT capabilities, and DDDM. Second, by examining the moderating role of environmental uncertainty, this study addresses recent calls for research on the conditions under which dynamic capabilities enhance DDDM. The findings demonstrate that the effectiveness of BA capabilities is contingent on the stability of the external environment.

In summary, this study seeks to unravel the complex interdependencies among dynamic capabilities, DDDM and operational performance, offering both theoretical and practical implications for organizations striving to maintain competitiveness in today's fast-paced business landscape.

The remainder of this paper is structured as follows: Section 2 presents the theoretical framework and constructs. Section 3 develops the hypotheses to address the research questions. Section 4 details the research methodology, followed by an analysis of the results in Section 5. Section 6 discusses the findings and their implications for both theory and practice. Finally, the study's limitations and future research avenues are outlined.

3.2 Theoretical Background

3.2.1 Dynamic Capability View (DCV)

The Dynamic Capability View (DCV) provides a robust framework for examining the interplay between dynamic capabilities, such as business analytics (BA) and information and communication technology (ICT) capabilities, and their role in enhancing the effective implementation of data-driven decision-making (DDDM) (Teece et al., 1997; Teece, 2018). Unlike the resource-based view (RBV), which prioritizes the possession of valuable resources and assets, the DCV emphasizes the organizational ability to develop, integrate, and reconfigure these resources to achieve sustained competitive advantage (Teece, 2018). The DCV posits that resources and assets, in isolation, are insufficient for superior organizational performance. Instead, it is the firm's ability to coordinate and leverage these resources to capitalize on opportunities for strategic renewal and long-term success that drives competitive advantage (Teece, 2018).

DCV complements RBV by focusing on dynamic processes such as recognizing, adapting, and reconfiguring resources in response to volatile and unpredictable environments (Dubey et al., 2019). This perspective underscores the importance of enhancing management capabilities by integrating organizational, functional, and technological skills to maintain competitive relevance in rapidly changing markets (Teece et al., 1997). Dynamic capabilities, defined as the ability to integrate, build, and reconfigure internal and external resources to address and shape changing business environments (Teece, 2018), are inherently firm-specific and evolve through complex interactions among organizational resources (Amit & Schoemaker, 1993).

As uncertainty and business complexity grow, organizations increasingly rely on dynamic capabilities, given the potential obsolescence of static resources (Teece et al., 1997). These capabilities encompass three core attributes: *sensing, seizing, and transforming*. Sensing refers to identifying opportunities and threats, seizing involves mobilizing resources to capitalize on these opportunities, and transforming entails the continual renewal of internal processes and external relationships to sustain value creation (Teece, 2018). These attributes collectively enable organizations to remain agile, innovative, and competitive (Roberts & Grover, 2012).

Organizations with well-developed dynamic capabilities excel in optimizing and reconfiguring resources, fostering unique routines, and adapting to shifting market conditions (Teece, 2018). The DCV provides a robust theoretical lens for understanding how organizations can manage structured and unstructured data effectively. Achieving sustainable competitive advantage requires continuous reassessment and evolution of digital resources and managerial approaches to align with environmental dynamism. By enabling firms to develop new products, processes, and strategies, the DCV offers a valuable framework for examining resource development and capability enhancement in turbulent markets. This study leverages the DCV to explore how

BA capabilities, ICT capabilities, and DDDM collectively enhance operational performance in dynamic environments.

3.2.2 Data-driven Decision-making (DDDM)

In contemporary management practices, data-driven decision-making (DDDM) has emerged as a cornerstone for informed and evidence-based strategic initiatives, replacing intuition-based approaches (Gupta & George, 2016). DDDM entails leveraging data and its analytical insights to guide strategic and operational decisions (McAfee et al., 2012). Key elements of DDDM include extensive data utilization, managerial support for analytics, a culture of learning, knowledge dissemination, and adaptability to change (Duan et al., 2020; Upadhyay & Kumar, 2020). By embedding analytics into decision-making processes, DDDM fosters evidence-based management and enhances organizational performance.

One of DDDM's key advantages is its ability to minimize biases and errors in decision-making. Unlike traditional approaches that primarily rely on intuition, DDDM's reliance on empirical evidence reduces subjective biases, resulting in more consistent and effective decisions (Kiron & Shockley, 2011). Organizations that embrace a data-driven culture empower managers to base decisions on robust insights, potentially significantly improving operational efficiency. Furthermore, advanced analytics facilitate the identification of trends and patterns that may not be discernible through conventional methods, enabling better forecasting and strategic planning (Garcia & Adams, 2023).

In addition to improving decision accuracy, DDDM fosters organizational transparency and accountability by clearly linking decisions to data-driven insights (Duan et al., 2020). This transparency enhances stakeholder trust and alignment with organizational goals, promoting a culture of shared responsibility and continuous improvement. Furthermore, by leveraging

historical and real-time data, DDDM strengthens risk management capabilities, enabling organizations to identify potential threats and implement mitigation strategies effectively (Garcia & Adams, 2023). This proactive approach to risk management is particularly valuable in dynamic environments, where the ability to anticipate and respond to change is critical for maintaining competitive advantage (Bousdekis et al., 2021).

Overall, DDDM represents a transformative shift in how organizations approach decision-making, offering significant benefits in terms of accuracy, transparency, and adaptability. This study builds on the DDDM literature to examine its role as a critical mechanism linking BA and ICT capabilities to operational performance in dynamic contexts.

3.2.3 Business Analytics (BA)

Business analytics (BA) has become a cornerstone of strategic planning and operational decision-making in contemporary organizations. In an era marked by increasing complexity and uncertainty, BA offers a systematic approach to analysing data, generating actionable insights, and informing strategic and operational initiatives (Appelbaum et al., 2017; Chen et al., 2012; Fink et al., 2017). As data is widely recognized as a critical organizational resource, BA has emerged as an essential practice for organizations seeking to remain competitive and adaptive (Peppard et al., 2016). Although widely adopted, BA lacks a universally accepted definition due to its multifaceted and evolving nature (Holsapple et al., 2014). For the purposes of this study, BA is defined as the extensive use of data, statistical and quantitative analysis, predictive and prescriptive modelling, and computer-based algorithms to support insight generation and guide decision-making (Appelbaum et al., 2017).

At its core, BA enables organizations to process and analyse large datasets, uncover hidden patterns, and make informed decisions that support evidence-based problem-solving

(Appelbaum et al., 2017; Sharda et al., 2018). BA generally encompasses descriptive analytics (identifying trends and relationships in historical data), predictive analytics (for forecasting future outcomes), and prescriptive analytics (recommending optimal actions through scenario analysis) (Sharda et al., 2018). Together, these analytical approaches provide the foundation for BA's contribution to improved decision-making and organizational performance.

To support these processes, BA relies on a broad range of information technologies, including data warehouses, online analytical processing (OLAP), data mining applications, visualization tools, and statistical analysis systems (Gandomi & Haider, 2015; Seddon et al., 2017). These tools facilitate the collection, preparation, integration, and analysis of data from diverse sources, often producing dashboards and visualizations that make insights accessible to decision-makers (Rikhardsson & Yigitbasioglu, 2018). Through these technologies, BA enables organizations to develop a comprehensive understanding of internal operations and external environments.

The integration of BA into organizational practices can significantly influence competitive advantage and business value creation. Organizations that effectively deploy BA systems are better equipped to proactively reconfigure their resource base, adapt to dynamic market conditions, and achieve sustainable competitive advantages (Boerner et al., 2025; Vidgen et al., 2017). In digital environments, BA supports the extraction of insights from large volumes of structured and unstructured data through advanced analytical applications (Bayrak, 2015). By transforming data into actionable knowledge, BA strengthens strategic decision-making, enhances operational processes, and fosters innovation and growth (Elbashir et al., 2013; Ramanathan et al., 2017).

Over time, BA research has evolved from viewing BA primarily as a set of analytical tools to a more holistic perspective that emphasizes organizational capabilities. Early studies highlighted BA's technological components (Chae et al., 2014; Klatt et al., 2011), whereas

contemporary research underscores the importance of managing the tangible, human, and intangible resources required for effective BA implementation (Vidgen et al., 2017). This shift has led to the conceptualization of BA capabilities—an organization's ability to capture and analyse data, generate insights, and manage data, technology, and talent effectively (Mikalef et al., 2018).

BA capability is defined as the ability to utilize resources to perform BA tasks through the interaction between IT assets and complementary organizational resources (Cosic et al., 2012). These capabilities include both data- and technology-related resources as well as the analytical and managerial skills required for insight generation and informed decision-making. In this study, BA capabilities are categorized into two primary dimensions: *technology capabilities* and *governance capabilities*.

Technology capabilities constitute the technical foundation for BA and include data management systems, integration tools, reporting and visualization technologies, and discovery-oriented BA tools (Cosic et al., 2012). These capabilities enable organizations to maintain high-quality data repositories (Davenport & Harris, 2017), integrate BA systems with other information systems (Kohavi et al., 2002), and transform raw data into meaningful insights (Watson, 2002). Advanced statistical tools further support pattern identification, trend forecasting, and process enhancement (Negash, 2004). Collectively, these capabilities equip organizations with the infrastructure needed to generate valuable insights and respond effectively to external pressures (Gold et al., 2001).

Governance capabilities provide the organizational framework for BA by defining decision rights, aligning BA initiatives with strategic objectives, fostering dynamic capabilities, and managing organizational change (Cosic et al., 2012). Effective governance includes the allocation of decision-making authority, oversight of BA resources, and processes that ensure

strategic alignment and responsiveness to environmental changes (Weill & Ross, 2004). These capabilities also mitigate the risks associated with uncertainty by ensuring that BA efforts remain coherent and goal-oriented (Collis, 1994). Strong governance promotes information sharing, knowledge dissemination, and the strategic application of BA throughout the organization, thereby enhancing its value creation potential.

The interplay between BA technology and governance capabilities creates higher-order capabilities that enhance an organization's ability to derive business value and maintain competitiveness (Wamba et al., 2017). Senior executives increasingly depend on BA to generate actionable insights, enabling evidence-based decision-making that is difficult to achieve through traditional approaches (LaValle et al., 2010). While scholars and practitioners widely acknowledge BA's potential to improve performance (Wamba et al., 2017; Peters et al., 2016), the relationship between BA capabilities and organizational outcomes remains complex and contingent on contextual factors. As organizations operate in increasingly dynamic environments, further research is needed to understand how decision-making processes mediate the relationship between BA capabilities and performance (Sharma et al., 2014).

Against this backdrop, this study examines how technology and governance dimensions of BA capabilities jointly contribute to operational performance and competitive advantage in dynamic environments.

Business analytics (BA) has emerged as a cornerstone for strategic planning and operational decision-making in contemporary organizations. In an era marked by increasing complexity and uncertainty, BA offers a systematic approach to analysing data, generating actionable insights, and informing strategic and operational initiatives (Appelbaum et al., 2017; Chen et al., 2012; Fink et al., 2017). Data is recognized as a critical organizational resource, essential for capturing, harnessing, and interpreting business operations. Consequently, BA has become a vital practice that organizations must adopt to remain competitive and adaptive (Peppard et al., 2016). Despite its widespread adoption, no universally accepted definition of BA exists, reflecting its multifaceted and evolving nature (Holsapple et al., 2014). For the purposes of this study, BA is broadly defined as the extensive use of data, statistical and quantitative analysis, predictive and prescriptive modelling, and computer-based algorithms to gain insights and guide decision-making in business contexts (Appelbaum et al., 2017).

At its core, BA enables organizations to systematically process and analyse large datasets, uncover hidden patterns, and make informed decisions that support evidence-based problem-solving (Appelbaum et al., 2017; Sharda et al., 2018). The analytical processes encompassed by BA include descriptive analytics (which identifies trends and relationships in historical data), predictive analytics (which forecasts future outcomes based on existing data patterns), and prescriptive analytics (which recommends optimal actions by simulating scenarios and evaluating potential outcomes) (Sharda et al., 2018). These systematic processes form the foundation of BA's ability to drive meaningful insights and improve organizational decision-making.

To achieve these objectives, BA employs a wide array of advanced information technology tools, including data warehouses, online analytical processing (OLAP), data mining software, visualization tools, and statistical and quantitative analysis systems (Gandomi & Haider, 2015;

Seddon et al., 2017). These tools enable organizations to collect, store, prepare, analyse, and report data, often producing dashboards and visualizations that present insights in an accessible format for decision-makers (Rikhardsson & Yigitbasioglu, 2018). By leveraging these tools, BA enhances the organization's ability to integrate, process, and analyse data from diverse sources, facilitating a more comprehensive understanding of internal and external dynamics.

The integration of BA into organizational practices can have a profound impact on competitive advantage and business value. Organizations that successfully implement BA systems are better equipped to proactively create, extend, and modify their resource base, thereby adapting to dynamic market conditions and achieving sustainable competitive advantages (Boerner et al., 2025; Vidgen et al., 2017). In digital environments, BA serves as a robust solution for deriving business insights by collecting, storing, retrieving, and analysing large volumes of structured and unstructured data through advanced applications and technologies (Bayrak, 2015). These capabilities enable organizations to transform data into actionable knowledge, supporting strategic decision-making, improving operational processes, and fostering innovation and growth (Elbashir et al., 2013; Ramanathan et al., 2017).

The conceptualization of BA has evolved over time. Early research primarily focused on the technological aspects of BA, treating it as a collection of analytical tools and methodologies designed to enable data-driven decision-making (Chae et al., 2014; Klatt et al., 2011). However, effective BA implementation requires a broader organizational focus that extends beyond technical tools to include the management of tangible, human, and intangible resources (Vidgen et al., 2017). This broader perspective has led to the emergence of BA capabilities, which emphasize an organization's ability to capture and analyse data, generate insights, and manage data, technology, and talent effectively (Mikalef et al., 2018).

BA capability is defined as the ability to utilize resources to perform BA tasks through the interaction between IT assets and other organizational resources (Cosic et al., 2012). These capabilities encompass both data- and technology-related resources and the analytical and managerial skills required to derive insights and make informed decisions. In this study, BA capabilities are classified into two primary categories: *technology capabilities and governance capabilities.*

Technology capabilities form the technical foundation for BA initiatives, encompassing the deployment of data management systems, integration tools, reporting and visualization technologies, and discovery-oriented BA technologies (Cosic et al., 2012). These capabilities involve managing high-quality, integrated data repositories (Davenport & Harris, 2017), ensuring seamless integration of BA systems with other organizational information systems (Kohavi et al., 2002), and transforming raw data into meaningful insights using reporting and visualization tools (Watson, 2002). Furthermore, sophisticated statistical tools support the identification of patterns, forecasting of trends, and enhancement of operational processes (Negash, 2004). Technology capabilities equip organizations with the tools and infrastructure necessary to generate valuable insights, enabling them to respond to external pressures and maintain competitiveness (Gold et al., 2001).

Governance capabilities provide the organizational framework for BA by defining decision rights, aligning BA systems with strategic goals, fostering dynamic BA capabilities, and managing organizational change (Cosic et al., 2012). Effective governance involves the management of BA resources, the assignment of decision-making authority, and the establishment of processes that ensure BA initiatives remain strategically aligned and responsive to changes in the business environment (Weill & Ross, 2004). Governance capabilities also mitigate the risks associated with environmental uncertainty by maintaining

alignment between BA initiatives and organizational objectives (Collis, 1994). Moreover, robust governance facilitates the sharing of information, the dissemination of knowledge, and the strategic application of BA across the enterprise, maximizing its value creation potential.

The interplay between BA technology and governance capabilities creates higher-order capabilities that significantly enhance an organization's ability to derive business value and maintain a competitive edge (Wamba et al., 2017). Senior executives increasingly rely on BA to extract actionable insights from data, enabling evidence-based decision-making that would be difficult to achieve otherwise (LaValle et al., 2010). While both scholars and practitioners widely acknowledge the performance-enhancing potential of BA (Wamba et al., 2017; Peters et al., 2016), the relationship between BA capabilities and organizational performance remains complex and multifaceted. As organizations operate in increasingly dynamic and competitive environments, further research is needed to explore how decision-making processes mediate the link between BA capabilities and improved performance outcomes (Sharma et al., 2014).

Given the limited understanding of these dynamics, this study seeks to contribute to the literature by examining how BA capabilities – encompassing both technological and governance dimensions – support operational performance and competitive advantage in dynamic environments.

3.2.4 ICT Capabilities

Information and communication technology (ICT) has become an essential driver of organizational efficiency, strategic agility, and competitive advantage. It is defined as "shared, unbounded, heterogeneous, open, and evolving socio-technical systems comprising an installed base of diverse information technology capabilities and their use, operations, and design communities" (Tilson et al., 2010, p. 749). ICT facilitates the seamless exchange of ideas,

information, and documents, enables the management of complex projects, and enhances the coordination of organizational activities and business processes (Spagnoletti et al., 2015). Furthermore, ICT plays a transformative role in reshaping hierarchical structures, redefining interaction patterns, and fostering dynamic information flows across business boundaries, thereby influencing communication, knowledge exchange, and collaboration within and between organizations.

The strategic impact of ICT, however, varies across organizations depending on their ability to utilize these technologies effectively (Rice & Martin, 2020). ICT serves as a crucial enabler of business development, allowing firms to create, integrate, and enhance key organizational resources over time. When leveraged strategically, ICT contributes to competitive advantage by enhancing decision-making processes, facilitating real-time information exchange, and optimizing operational performance (Jorgenson & Vu, 2016). In addition, ICT promotes efficiency in production control and resource allocation, enabling organizations to make rapid and well-informed decisions, particularly in dynamic and uncertain business environments (Cragg & McNamara, 2018).

From the perspective of the Dynamic Capability View (DCV), ICT capabilities extend beyond mere technological infrastructure and instead emphasize the ability of organizations to dynamically utilize and adapt ICT to evolving business needs (Bharadwaj, 2000; Dale Stoel & Muhanna, 2009; Wade & Hulland, 2004). Thus, rather than focusing on ICT infrastructure investments, this study adopts a capability-based perspective, defining ICT capabilities as an organization's strategic ability to leverage a diverse array of digital technologies to support and enhance business functions (Kannabiran & Dharmalingam, 2012). Given the increasingly volatile nature of business environments, organizations must continuously adapt, integrate, and reconfigure their internal and external ICT competencies to sustain competitive advantage.

The information systems (IS) literature conceptualizes ICT capabilities as a multidimensional construct encompassing various strategic and operational dimensions. This study focuses on three key interrelated dimensions of ICT capabilities: *internal use***,** *external collaboration, and internal and external communication* (Fillis et al., 2003; Levy et al., 2001; Sarshar & Isikdag, 2004; Venkatraman, 1994).

3.2.4.1 Internal Use of ICT

The *internal use* of ICT pertains to the deployment of digital technologies to improve the efficiency and effectiveness of internal business processes. This includes the automation of core business operations, the reduction of production inefficiencies, cost minimization, and the enhancement of distribution mechanisms (Fillis et al., 2003). Organizations frequently leverage ICT to streamline workflows and reduce operational overhead, thereby improving productivity and cost-effectiveness (Dale Stoel & Muhanna, 2009). Additionally, ICT serves as a powerful tool for environmental scanning, enabling organizations to collect, process, and analyse critical business data for strategic decision-making (Johannessen et al., 1999).

Beyond operational efficiencies, ICT also plays a pivotal role in human capital development by facilitating access to digital knowledge repositories, training platforms, and e-learning tools. These digital resources enhance employees' skills and competencies, ensuring that organizations remain adaptive and resilient in dynamic markets. The ability to integrate and effectively utilize ICT within internal processes thus becomes a key determinant of an organization's agility and long-term sustainability.

3.2.4.2 External ICT Collaboration

External ICT collaboration involves the strategic use of digital technologies to facilitate relationships and interactions with key stakeholders, including customers, suppliers, and

business partners (Ciappini et al., 2008). ICT enables organizations to enhance supply chain integration, establish seamless coordination with external partners, and create more agile and responsive business networks.

By fostering transparency, trust, and mutual collaboration, these digital systems enhance customer satisfaction, supplier reliability, and overall value chain efficiency. Organizations with robust ICT capabilities can offer high-value services, such as just-in-time (JIT) delivery, improved responsiveness to customer inquiries, and streamlined procurement processes. These capabilities strengthen long-term partnerships and improve competitive positioning in increasingly digitalized markets.

Moreover, firms with advanced ICT capabilities are perceived as attractive partners for strategic alliances and collaborative ventures (Nieto & Fernández, 2005). The ability to integrate digital tools into inter-organizational relationships thus enhances firms' strategic flexibility and facilitates business model innovation.

3.2.4.3 Internal and External Communication

The third dimension of ICT capabilities pertains to *internal and external communication***,** which encompasses the use of digital platforms such as intranet and extranet systems to facilitate information sharing, knowledge dissemination, and organizational learning (Shiau et al., 2009).

An intranet serves as a critical internal communication platform, enabling employees to exchange information, access shared knowledge resources, and foster organizational cohesion. By providing a structured digital environment for knowledge management, intranet systems promote collaboration and ensure that employees across different functions remain aligned with the organization's strategic objectives. Additionally, intranets facilitate the development

of tacit knowledge by fostering an internal culture of continuous learning and knowledge exchange.

Conversely, an extranet extends an organization's communication capabilities beyond internal boundaries, facilitating interactions with external stakeholders such as customers, suppliers, and strategic partners (Nieto & Fernández, 2005). Extranet systems enable seamless and secure data sharing across organizational boundaries, supporting joint decision-making, co-innovation, and strategic collaborations. These digital communication platforms play a crucial role in eliminating geographical barriers, fostering cross-border business interactions, and supporting virtual teamwork in globalized business contexts.

By fostering these dimensions – internal use, external collaboration, and communication – organizations can maximize the value derived from ICT investments, creating a digital ecosystem that supports both operational and strategic goals. The ability to effectively harness ICT capabilities thus becomes a key determinant of business performance, enabling firms to sustain competitiveness in an increasingly fast-paced and technology-driven environment.

3.2.4.4 Conclusion

ICT capabilities represent a fundamental enabler of digital transformation and strategic agility in modern organizations. By leveraging ICT to optimize internal processes, enhance external collaborations, and facilitate seamless communication, organizations can significantly improve their decision-making efficiency, responsiveness to market changes, and long-term resilience.

From a *Dynamic Capability View* (*DCV*), ICT capabilities are not merely static resources but rather dynamic competencies that firms must continuously develop and refine to maintain strategic relevance (Bharadwaj, 2000; Dale Stoel & Muhanna, 2009). Organizations that effectively integrate ICT into their operational and strategic frameworks can gain a competitive

advantage by fostering innovation, improving supply chain agility, and strengthening stakeholder relationships.

This study extends existing research by examining how ICT capabilities, in conjunction with business analytics (BA) and data-driven decision-making (DDDM), contribute to superior operational performance in dynamic and uncertain business environments. By adopting a multidimensional approach to ICT capabilities, this study provides a comprehensive framework for understanding how digital technologies drive business success in today's rapidly evolving competitive landscape.

3.3 Hypotheses Development

This section develops hypotheses to examine the influence of dynamic capabilities – specifically business analytics (BA) and information and communication technology (ICT) capabilities – on data-driven decision-making (DDDM), and consequently, on operational performance. It also explores how external environmental conditions shape DDDM processes. First, the mediating role of DDDM in the relationship between dynamic capabilities and operational performance is assessed. Second, the potential moderating role of environmental dynamism is examined, positing that it strengthens the effect of ICT capabilities on DDDM, while weakening the impact of BA capabilities. A conceptual representation of the theoretical framework is provided in Figure 1.

3.3.1 The Mediating Effect of Data-Driven Decision-Making

The increasing prevalence of big data and BA has made DDDM a focal point in academic and managerial discourse. DDDM is widely recognized as a key enabler of organizational alignment and strategic success (Mikalef & Krogstie, 2020). The integration of new technologies into organizational decision-making processes enhances internal communication

and knowledge sharing, streamlines technology implementation, and simplifies the management of technological change (Bhatti & Ahsan, 2016). DDDM signifies a paradigm shift in organizational behaviour – from more intuition-based judgments to empirically grounded decision-making (McAfee et al., 2012). In today's competitive landscape, the capacity to derive actionable insights from data has become essential for firms seeking to sustain and enhance performance.

To effectively support DDDM, organizations must possess dynamic capabilities that enable them to acquire, analyse, and apply data insights (Birkinshaw et al., 2016; Gupta & George, 2016). BA and ICT capabilities exemplify such dynamic capabilities, as they are embedded in routines and analytical frameworks that support organizational agility and learning. BA capabilities enhance DDDM by improving the accuracy, and relevance of information available to decision-makers (LaValle et al., 2010; Wade & Hulland, 2004). These capabilities provide a structured approach to analysing large volumes of organizational and market data, facilitating informed decision-making (Delen & Demirkan, 2013). Furthermore, BA enables strategic use of data assets for not only operational efficiency but also for long-term competitive positioning (Janssen et al., 2017; Shamim et al., 2019).

Conversely, ICT capabilities play a foundational role for DDDM by supporting data collection, storage, and large-scale processing. Advanced ICT enhances decision-making by enabling rapid information dissemination, improving accuracy, and accelerating response times (Soto-Acosta et al., 2018). These capabilities also reduce knowledge barriers and improve coordination by ensuring timely access to relevant insights (Bagheri et al., 2016). Moreover, ICT systems bolster firms' capacity to synthesize internal and external data, offering a comprehensive view of the operational and market environment (Muazu & Abdulmalik, 2021).

Although dynamic capabilities can serve as a source of competitive advantage, their effectiveness in enhancing performance is contingent upon the adoption of DDDM practices (Mikalef et al., 2020; Wamba et al., 2017). DDDM enables organizations to transform data into actionable strategies and performance outcomes (Brynjolfsson & McElheran, 2016; Garcia & Adams, 2023). Firms that are able to reconfigure their resources and routines to respond to emerging challenges are better equipped to detect environmental changes and capitalize on new opportunities. Through integration of internal and external data, organizations can achieve superior financial and operational outcomes. Empirical evidence suggests that firms practicing DDDM report significantly higher productivity (by approximately 5%) and profitability (by around 6%) relative to those relying on traditional decision-making approaches (Brynjolfsson & McElheran, 2016). The enhanced performance of data-driven firms is attributed to reduced uncertainty, improved forecasting accuracy, and better alignment with strategic goals. DDDM also streamlines operations, optimizes workflows, and identifies opportunities for cost savings, further solidifying its strategic value (Garcia & Adams, 2023). Consequently, organizations with underdeveloped DDDM practices should prioritize cultivating a data-driven culture and analytical mindset before investing heavily in ICT or BA tools.

Based on this rationale, the following hypotheses are proposed:

- **H1A:** Data-driven decision-making positively mediates the relationship between ICT capabilities and operational performance.
- **H1B:** Data-driven decision-making positively mediates the relationship between BA capabilities and operational performance.

3.3.2 The Moderating Role of Environmental Dynamism

The modern business environment is increasingly shaped by unpredictable and rapidly changing external forces. Factors such as intensified global competition, technological disruption, evolving customer preferences, and crisis events (e.g., pandemics) have amplified the need for organizational agility (Sanderson & Luffman, 1988). Environmental dynamism reflects the scarcity of information and the difficulty of forecasting future developments (Darvishmotevali et al., 2020; Pavlou & El Sawy, 2010). Such dynamism manifests in rapid shifts in consumer demand, unstable supplier relationships, competitive pressures and disruptive innovations.

3.3.2.1 Environmental Dynamism and Organizational Adaptation

Dynamic environments fundamentally reshape firms' information-processing and adaptation requirements. To maintain competitiveness, firms must sense emerging threats and opportunities, seize them quickly, and continuously transform resources and processes in line with shifting conditions (Teece, 2018). These environments demand rapid adjustments in both strategic orientation and operational execution to avoid obsolescence (Dubey et al., 2020).

Because existing knowledge becomes less reliable under volatility, organizations must generate timely insights based on fresh data rather than relying on routines or accumulated experience (Hitt et al., 1998; Alexander et al., 2018). High environmental dynamism therefore heightens the need for superior information-processing capacity to support real-time, data-driven decisions (Chen et al., 2015). In this way, dynamism directly increases the value of resources and capabilities that enhance the speed, accuracy, and agility of decision-making (Oreja-Rodriguez & Yanes-Estevez, 2010).

3.3.2.2 ICT Capabilities as Enablers in Dynamic Environments

ICT capabilities play a pivotal role in meeting these heightened information-processing and coordination demands. Real-time data integration, cloud-based platforms, and AI-supported analytics expand organizations' capacity to monitor their environment continuously, interpret signals quickly, and generate insights that guide timely decisions (Schilke, 2014). These technologies support agile communication and cross-unit knowledge flows, enabling firms to respond more effectively to uncertainty and market volatility.

In contrast, when environments are stable, organizations can rely more heavily on established routines and accumulated expertise, reducing the marginal value of sophisticated ICT infrastructures (Sabherwal et al., 2019; Zhou et al., 2023). Under such conditions, decision-making is less contingent on real-time data and rapid information processing.

In dynamic settings, however, advanced digital infrastructures become essential. Real-time data-sharing systems and AI-powered analytics help synchronize operations, enhance strategic agility, and enable continuous monitoring and rapid recalibration of organizational activities (Muazu & Abdulmalik, 2021). By reducing information asymmetry and fostering swift coordination, ICT capabilities strengthen firms' responsiveness to fast-changing conditions (Bagheri et al., 2016; Soto-Acosta et al., 2018).

Thus, as environmental dynamism increases, organizations face greater pressure to rely on timely, high-quality data to guide decisions. ICT capabilities directly address these pressures by expanding firms' capacity to generate, process, and disseminate actionable insights. Consequently, the effect of ICT capabilities on data-driven decision-making (DDDM) should become stronger when environmental dynamism is high.

- **H2A:** Environmental dynamism positively moderates the relationship between ICT capabilities and data-driven decision-making.

3.3.2.3 Business Analytics Capabilities in Dynamic Environments

While BA capabilities offer powerful insights through predictive analytics and modelling, their utility diminishes in rapidly changing environments. This is largely due to their reliance on historical data, which becomes less relevant as market conditions shift unpredictably – particularly during crises such as COVID-19. Although BA enables integration of external knowledge, its benefits are constrained when past patterns fail to reflect future realities (Chae et al., 2014; Lane et al., 2006; Sharma et al., 2014).

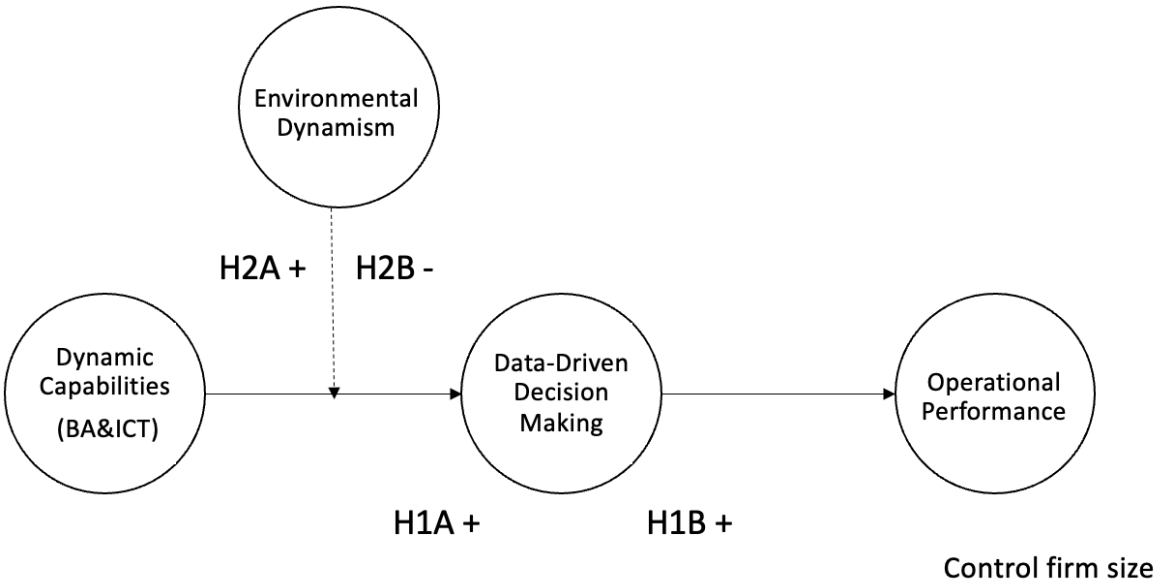
Empirical studies show that environmental dynamism can attenuate the efficacy of dynamic capabilities, as unpredictable shifts require speed and adaptability that exceed the temporal scope of traditional BA methods (Taghizadeh et al., 2020; Park & Xiao, 2020). BA processes are often time-intensive, and in highly dynamic contexts, the insights generated may become obsolete before they can be applied. Consequently, organizations may find it difficult to leverage BA effectively under such conditions.

Based on these insights, the following hypothesis is proposed:

- **H2B:** Environmental dynamism negatively moderates the relationship between BA capabilities and data-driven decision-making.

Figure 1 presents the proposed structural model underlying these hypotheses.

Figure 3 - 1: ***Structural PLS Model (conceptual)***



3.4 Research Design

3.4.1 Data Collection

This study employed an online survey to collect data from a target sample of 4,399 *senior managers* in *medium and large Australian-based organizations*. The survey method was selected due to its effectiveness in examining complex organizational phenomena in a natural setting while ensuring standardization necessary for quantitative analysis and theory testing (Spekle & Widener, 2018). The survey was administered using Qualtrics, a widely recognized online survey platform that ensures data security and efficient response tracking.

Given that BA and ICT capabilities are typically more developed in larger organizations and acknowledging that firm size can influence performance (Peters et al., 2016), this study focused exclusively on firms with a minimum annual revenue of A$10 million. Furthermore, to ensure sufficient organizational experience and familiarity with decision-making processes, only respondents with at least one year of tenure within their respective organizations were included

in the sample. The list of eligible organizations and respondents was obtained from a verified external source and was initially screened to confirm eligibility and suitability for the study.

The survey was conducted in two rounds. In the first round, a survey invitation – including a cover letter and a URL to the online survey – was emailed to targeted respondents, primarily CFOs or senior financial managers in each organization. To maximize response rates, weekly reminder emails were sent to those who had not yet participated. Four weeks after the initial distribution, a second round of invitations was sent to non-respondents, accompanied by continued weekly reminders to encourage their participation in the same survey.

A single respondent per organization was targeted to ensure equal representation of each respondent organization. A total of 148 responses were received, yielding a response rate of 3.36%. However, 55 responses were excluded due to missing data or incomplete responses, resulting in a final usable sample of 93 organizations (2.11% response rate).

3.4.2 Respondent Characteristics

Table 3 presents the demographic characteristics of the respondents. The majority held senior financial roles, such as Chief Financial Officers (CFOs), Finance Directors, or Finance Managers, predominantly from public sector companies/organizations operating in a competitive environment. Public sector organizations often operate in rapidly changing environments, which are increasingly confronting requests to become more efficient and effective (Panagiotopoulos, et al., 2023). Implementing change is particularly challenging in public sector organizations, where managers must satisfy multiple, often conflicting goals imposed by numerous stakeholders (Piening, 2013; Rashman et al., 2019). The need to align diverse stakeholder interests and comply with regulatory requirements can slow decision-making processes, making it challenging to respond swiftly to environmental changes. For

example, the Australian tertiary education sector has undergone significant transformations due to shifts in public policy and funding, increasing international competition, frequent university restructures, and the global COVID-19 pandemic. In order to remain competitive in this highly dynamic environment, universities and other public sector organizations need to adopt a dynamic capabilities approach (Hube et al., 2022). These factors may collectively contribute to the high response rates observed among CFOs and senior financial managers in public services sector. Additional industries represented in the sample include manufacturing, mining, construction, wholesale, finance, insurance, transportation, agriculture, retail trade, and communication.

Regarding organizational tenure, over 60% of firms had been in operation for more than 20 years, while 23.7% had operated for 5–20 years, and 6.5% had been established within 2–5 years. The average tenure of respondents within their organizations was 6.44 years, indicating a high level of institutional knowledge among participants.

3.4.3 Non-Response Bias Assessment

To assess potential non-response bias, an *independent t-test* was conducted, comparing early and late respondents based on the mean values of measurement items used in this study (Table 12). The results reveal no significant differences, suggesting that non-response bias is unlikely to have influenced the findings.

3.4.4 Common Method Bias (CMB)

As the study relied entirely on self-reported survey data, common method bias (CMB) was a potential concern. To mitigate and assess the potential impact of CMB, both *procedural and statistical* remedies were applied in line with best practices (Podsakoff et al., 2003).

To minimize CMB during survey design, several procedural remedies were applied:

- *Counterbalancing question order*: The survey sections were *rearranged* to reduce biases related to question sequencing. Demographic information, environmental dynamism, BA capabilities, ICT capabilities, DDDM, and operational performance were *presented in counterbalanced, interleaved blocks and section breaks* to prevent response patterning (Podsakoff et al., 2003).
- *Clear construct definitions*: Each construct was explicitly defined at the relevant sections of the survey to enhance respondent understanding and ensure conceptual clarity.
- *Reduction of response format similarity*: To reduce response bias, the survey incorporated both 7-point and 5-point Likert-type scales, following best practices for scale variation (Podsakoff et al., 2003).
- *Anonymity and confidentiality assurance*: Respondents were assured that their identities and responses would remain confidential, reducing potential evaluation apprehension (Podsakoff et al., 2003; Steenkamp et al., 2010).

To statistically assess CMB, *Harman's single-factor test* was performed. The results indicated that a single construct accounted for only 34.10% of total variance, well below the 50% threshold, confirming that CMB was not a significant concern (Podsakoff et al., 2003). Additionally, a variance inflation factor (VIF) analysis was conducted, as a VIF exceeding 3.3 is considered an indicator of potential CMB contamination (Kock, 2015). The full collinearity test results (Table 11) showed that all VIFs in the inner model were below 3.3, further confirming that CMB was not a significant issue in this study.

3.4.5 Variable Measurement

Prior to full-scale data collection, the survey instrument was pilot tested with academic experts to ensure that all measurement items were conceptually valid and comprehensible to respondents. Following feedback, minor refinements were made to item wording and survey design to enhance validity and clarity.

In designing the questionnaire, the conceptual nature of each construct was carefully considered, addressing issues of dimensionality and the appropriate use of formative or reflective indicators (Bedford & Spekle, 2018a; Bisbe et al., 2007). The specific questionnaire items are listed in Table 2, alongside descriptive statistics. This study primarily uses latent constructs measured with multiple indicators analysed via the PLS-SEM method.

ICT capabilities (ICT CAP) were assessed as an aggregate *multidimensional construct* comprising three dimensions: *internal ICT use (ICT_INT), ICT collaboration (ICT_COL), and ICT communication (ICT_COM).* Each dimension was measured using three reflective items adapted from Johannessen et al. (1999) and Parida et al. (2016), rated on a five-point Likert scale (1 = none, 5 = extensive). Factor analysis (Table 5) confirmed the expected three-factor structure, with Cronbach's alphas of 0.758, 0.831, and 0.739, respectively.

BA capabilities (BA CAP) were conceptualized as an aggregate *multidimensional construct* (Ramakrishnan et al., 2020) with two components: *BA Technology (BAT) and BA Governance (BAG)*. BAT was assessed with four reflective items, and BAG with three reflective items, using a seven-point Likert scale (1 = none, 7 = extensive) (Ramakrishnan et al., 2020). Factor analysis confirmed the two-factor structure, with Cronbach's alphas of 0.941 and 0.939, exceeding the minimum reliability thresholds (Nunnally, 1978).

Data-Driven Decision-Making (DDDM) measured organizational *beliefs, attitudes, and behaviours toward data-driven insights* using four reflective items adapted from Duan et al. (2020), with a Cronbach's alpha of 0.87.

Operational Performance (OP) was assessed using four reflective items from Fink et al. (2017) on a seven-point Likert scale, with a Cronbach's alpha of 0.852.

Environmental Dynamism (ENV) was measured based on organizational changes over the past two years, using three items from Wieder & Ossimitz (2019), returning a Cronbach's alpha of 0.88.

Firm size, represented by *annual revenue*, was included as a control variable due to its influence on resource availability and external pressures (Antonio & Foster, 2005; Subramani, 2004).

3.4.6 Model Quality and Results

To determine the most appropriate analytical and testing techniques, univariate normality was assessed for all primary constructs. The results indicated that none of the constructs followed a normal distribution, as all normality tests returned statistically significant results. Given the non-normal nature of the data, *structural equation modelling using partial least squares (PLS-SEM)* was employed, which is particularly well-suited for non-parametric data, small sample sizes, and complex models incorporating mediating, moderating, and second-order constructs (Chin, 1998; Hair et al., 2013).

PLS-SEM allows for the validation of construct measures and testing the structural model and hypotheses. A two-stage analytical approach was applied to (1) evaluate the measurement model by examining reliability, validity, and dimensionality of the constructs and (2) assess

the structural model by estimating path coefficients, the strength of relationships among constructs, and overall model fit using R^2 and f^2 values.

3.4.7 Measurement Model Assessment

Robustness of the measurement model was examined by assessing internal consistency, indicator reliability, convergent validity, and discriminant validity for all constructs with reflective indicators. The reliability and validity metrics are presented in Tables 4 to 10.

Reliability was assessed using *Cronbach's alpha, composite reliability (CR), and indicator reliability* to determine the internal consistency and accuracy of the measurement items. Table 6 presents the results. Cronbach's alphas for the reflective constructs were all above 0.70, confirming adequate reliability (Hulland, 1999; Straub, 1989). The composite reliability (CR) values also exceeded 0.70 for all constructs, indicating strong internal consistency. Indicator reliability was examined by factor loadings, referring to the extent to which each item in the correlation matrix correlates with the given principal components. As shown in Table 4, all measurement items in the first order model were above the recommended minimum value of 0.5 (Hair et al., 2016). In the final model, the loadings on the remaining items are all significant at the $p < 0.01$ level.

Convergent validity was assessed using *average variance extracted (AVE)*, which measures the extent to which items associated with a construct share common variance. Table 6 shows that all AVE values exceeded the recommended 0.50 threshold (Hair et al., 2016), with values ranging from 0.70 to 0.90, confirming convergent validity.

Discriminant validity was tested using: (1) the *Fornell-Larcker criterion,* ensuring that the square root of AVE for each construct is greater than its correlations with other constructs (Fornell & Larcker, 1981); (2) the *Heterotrait-Monotrait Ratio (HTMT),* requiring that all

values are below the conservative threshold of 0.85 (Teo et al., 2008). Table 8 confirms that this criterion is met. At the item level, discriminant validity was determined by assessing whether each first-order measurement item has a higher loading on its assigned factor than any other factor (Chin, 1998; Gefen et al., 2000). The results in Table 7 indicate appropriate discriminant validity for all measures.

3.4.8 Structural Model Assessment

The structural model was assessed based on path coefficients, R^2 values and f^2 effect sizes to evaluate the strength of relationships among independent, mediating, moderating, and dependent variables. A bootstrapping resampling technique (5,000 bootstrap samples, N = 93) was employed to generate robust significance estimates for each path coefficient. A significance level of 5% ($p < 0.05$) was applied as the criterion for statistical conclusions. The results for the hypothesized relationships are summarized in Table 1, whereas Table 13 and 14 in the appendix provide additional insights into other direct, indirect and total effects.

3.4.8.1 Mediation Hypotheses

H1A posited that DDDM mediates the relationship between ICT capabilities and operational performance. This hypothesis was *supported* ($\beta = 0.098$, $p < 0.05$ without moderation; $\beta = 0.099$, $p < 0.05$ with moderation). The results confirm that DDDM *fully* mediates this relationship, as the direct effect of ICT capabilities on operational performance – tested in a separate model – became *insignificant* when DDDM was included.

H1B predicted that DDDM mediates the relationship between BA capabilities and operational performance. This hypothesis was also *supported* when using the bias-corrected confidence interval method, confirming that leveraging BA capabilities through DDDM enhances operational performance. In this case, however, the direct effect of *BA capabilities* on

operational performance remains significant when adding DDDM to the model (partial mediation), suggesting that BA capabilities provide benefits beyond their role in managerial decision support.

3.4.8.2 Moderation Hypotheses

H2A predicted that environmental dynamism *positively* moderates the relationship between ICT capabilities and DDDM. This hypothesis is technically *not supported*, as the interaction term is *statistically insignificant.* However, the visualization of the effects of ICT capabilities on DDDM in various levels of environmental dynamism supports the theorised effect. This suggests that firms operating in highly unpredictable conditions do require ICT capabilities to facilitate DDDM.

H2B proposed that environmental dynamism *negatively* moderates the relationship between BA capabilities and DDDM. The results in Table 1 *support this hypothesis*, as the interaction term is *significantly negative*. Figure 2 provides deeper insights into this interaction by splitting the effect of BA capabilities on DDDM in three scenarios: High environmental dynamism (ENV at +1 standard deviation), average dynamism and low dynamism (ENV at -1 standard deviation). The regression lines clearly reveal that organizations operating in highly dynamic environments generally base their decisions more on data than organizations in low dynamic environments, but in contrast to the latter, the level of BA capabilities has barely any impact on the level of DDDM – in fact it is even slightly negative. In low dynamism, however, increased BA capabilities have a very strong positive effect on DDDM. The findings support the theory that BA capabilities are more useful in more stable environments, where historical data-driven insights generated from more advanced BA leads to increased use of information generated by BA. In highly dynamic environments, advanced BA capabilities do not seem to

be appreciated by decision-makers, arguably because BA generated information relies heavily on historical and potentially outdated data.

Table 3 - 1: ***Test Results for Hypotheses***

Hypothesis	**Path:**	**Effect[1)]**	**Without Moderation** Coeff.[2)]	**With Moderation** Coeff.[2)]
H1A ✓	ICT CAP → DDDM → OP	I	0.098*	0.099*
H1B ✓	BA CAP → DDDM → OP	I	0.061[3)]	0.068[3)]
H2A✗	ENV*ICT CAP → DDDM	M		0.203
H2B✓	ENV*BA CAP → DDDM	M		-0.327**
Controls	SIZE → BA CAP	C	0.090	0.090
	SIZE → DDDM	C	0.133*	0.145*
	SIZE → OP	C	-0.113	-0.113
R squares (adjusted):				
	OP		*0.27 (0.24)*	*0.27 (0.24)*
	BA CAP		*0.29 (0.27)*	*0.29 (0.27)*
	DDDM		*0.42 (0.40)*	*0.51 (0.48)*

1) *D = direct, I = indirect/mediation, M = moderation; C = control (direct)*
2) *Significance 1-tailed: p < 0.05*; p < 0.01**; p < 0.001****
3) *Significant in confidence intervals bias corrected*

Figure 3 - 2: ***Visual Presentation of Moderating Effect ENV*ICT CAP (Standardised)***

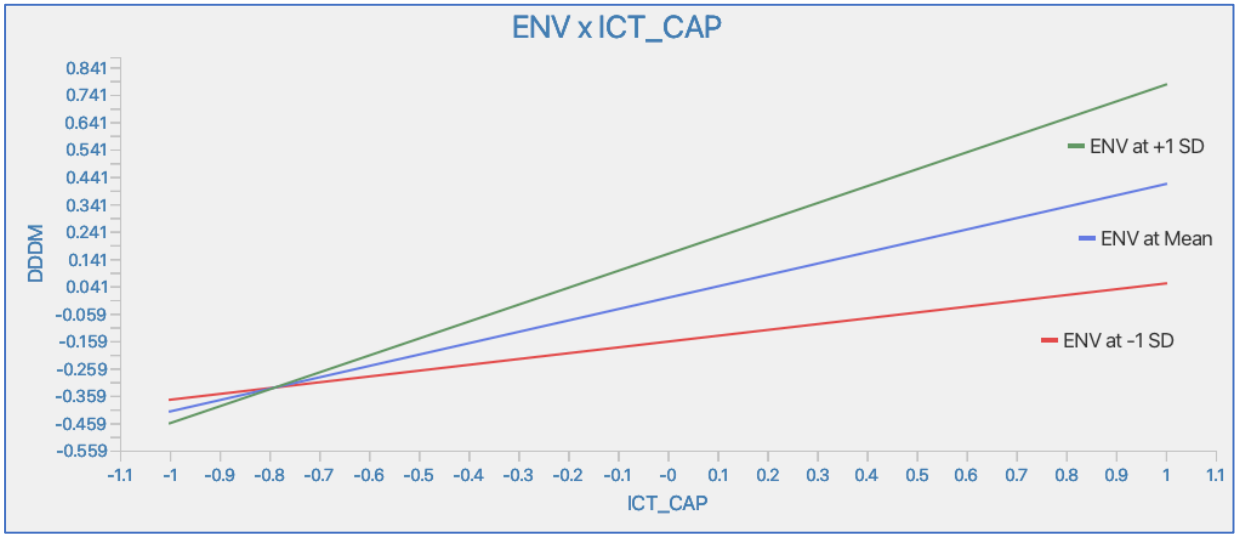
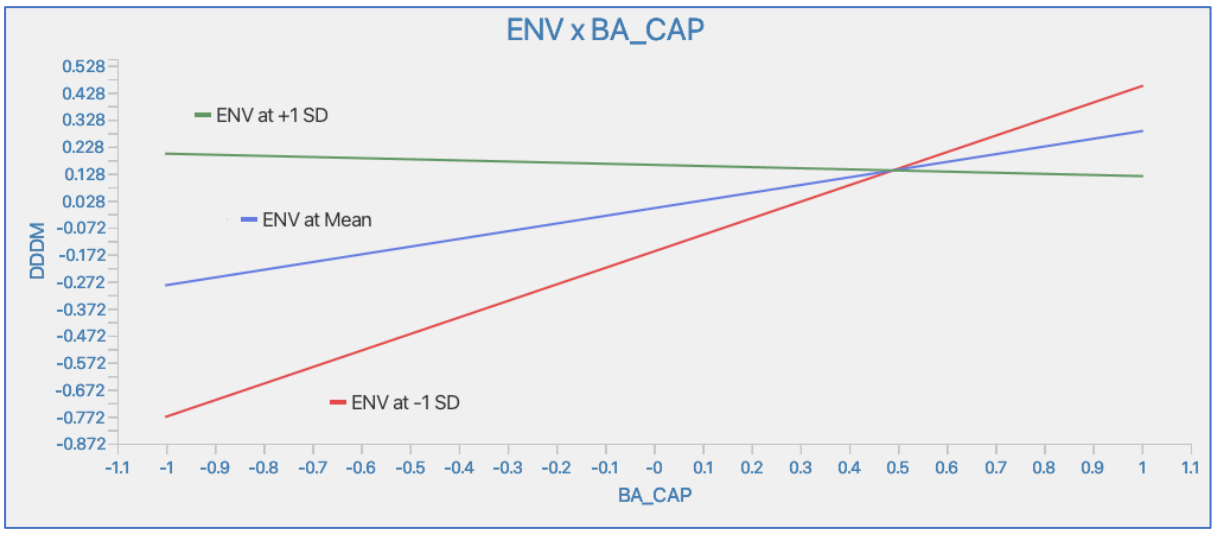


Figure 3 - 3: ***Visual Presentation of Moderating Effect ENV*BA CAP (Standardised)***



3.4.8.3 Control Variable Analysis

Interestingly, firm size had a significant effect on DDDM, but no significant effect on BA capabilities or operational performance. This finding suggests that larger organizations, which typically manage more complex operations and handle larger volumes of data, have a greater incentive to leverage data analytics for decision-making. Another possible explanation for this effect is that in larger organizations, (senior) management is more detached from operations

and that the resulting intransparency requires them to rely more on data than their counterparts in smaller organizations.

It is also interesting to note that firm size has almost no impact on BA capabilities, a finding which contrasts the widely used argument that smaller firms cannot afford investments into BA capabilities/systems (Ashrafi et al., 2019; Tippins & Sohi, 2003).

3.4.8.4 Summary of Findings

Overall, the results confirm that dynamic capabilities (BA and ICT) enhance operational performance primarily through DDDM. BA capabilities serve as a critical mechanism in this process, but they also have a direct effect on performance. ICT capabilities play a fundamental role in supporting DDDM. Additionally, environmental dynamism weakens the impact of BA on DDDM, highlighting the challenges of applying historical data-driven insights in rapidly evolving environments.

3.5 Discussion and Implications

3.5.1 Theoretical Contributions

This study contributes to the literature on dynamic capabilities, data-driven decision-making (DDDM), and organizational performance by integrating the Dynamic Capabilities View (DCV) with emerging digital technologies and analytical practices. By examining the interplay between business analytics (BA) capabilities, information and communication technology (ICT) capabilities, this research extends existing frameworks on how organizations can leverage the benefits dynamic capabilities in rapidly evolving business landscape.

One of the key contributions of this research advances the understanding of DDDM as *a mediating mechanism* between dynamic capabilities and operational performance. While

organizations are increasingly investing in big data, existing studies have not fully examined how DDDM interacts with other technological and analytical capabilities to enhance performance. ICT capabilities should not be viewed as standalone assets but as integral components that amplify the effects of other dynamic capabilities. The findings refine and expand the DCV by illustrating the mechanisms through which technological and analytical capabilities translate into business value, emphasizing the role of *DDDM as an intermediary capability* in this process. Notably, the results reveal that BA capabilities positively influence operational performance beyond their impact on DDDM, indicating that analytics not only support decision-making but also enhance knowledge creation, collaboration, and strategic information processing. ICT capabilities, while foundational for digital transformation, primarily enhance performance by supporting DDDM, rather than exerting direct effects.

Environmental dynamism emerges as an external factor that can force organizations to leverage their dynamic capabilities to improve decision-making process (Saeed et al., 2023; Singh et al., 2022). Despite its acknowledged importance, few research has investigated the moderating role of environmental dynamism in this relationship. This study fills this gap by identifying the role of environmental dynamism as a *boundary condition* influencing the relationship between dynamic capabilities and DDDM. The results demonstrate that higher levels of environmental volatility weaken the impact of BA capabilities on DDDM, revealing that the effectiveness of BA capabilities is contingent on the stability of the external environment. In stable environments, organizations can rely on historical data and predictive modelling to drive DDDM effectively. However, in highly dynamic environments, where market conditions shift unpredictably and historical data loses relevance, organizations may struggle to rely solely on analytics for decision-making. This finding challenges the assumption that BA capabilities always enhance decision-making and suggests that their effectiveness depends on the degree of environmental uncertainty organizations face. This study provides a better understanding of

how BA capabilities and operational performance relationship functions in a particular context, thereby enriching the scope of BA-enabled organizational capabilities perspectives.

3.5.2 Practical Implications

The findings of this study offer valuable managerial insights for organizations seeking to enhance their decision-making processes and operational performance in an increasingly data-driven business environment. The results confirm that DDDM is a critical driver of business success, and to foster truly data-driven decision-making, managers should ensure that employees beyond specialized analytics teams are encouraged and equipped to use data in their daily decision-making. Encouraging employees to challenge established practices through the use of data, supporting decisions with empirical evidence, and recognizing the strategic value of data-driven insights are essential. This study also highlights the importance of fostering DDDM to fully leverage the benefits of both ICT and BA capabilities.

Environmental dynamism also presents both challenges and opportunities for organizations. Given that highly volatile environments reduce the effectiveness of BA capabilities in supporting DDDM, firms operating in such conditions must develop alternative decision-making approaches that complement BA-driven insights. This includes incorporating real-time data streams, adaptive forecasting techniques, and scenario-based decision frameworks to navigate market uncertainty more effectively. Managers should remain proactive in monitoring external environmental shifts, ensuring that they adjust their analytics strategies accordingly rather than relying on potentially outdated predictive models.

3.6 Conclusion and Limitations

This study investigates the effects of dynamic capabilities (BA and ICT capabilities) in dynamic environment, considering the importance and data-driven decision-making (DDDM)

and whether a DDDM truly mediates the relationship between dynamic capabilities and operational performance. Using survey data from senior managers in medium and large Australian organizations, the study validated a theoretical model that incorporates both indirect and moderating effects.

The findings contribute to multiple streams of literature, including AIS and DCV research, by demonstrating that DDDM serves as a mediator on the relationship between dynamic capabilities (BA and ICT capabilities) and operational performance. Additionally, the findings provide a nuanced perspective on how environmental dynamism shapes the value of dynamic capabilities, revealing that BA capabilities are less effective in volatile environments where historical data becomes less reliable.

Despite its contributions, this study has several limitations. The cross-sectional research design limits the ability to capture longitudinal changes in BA capabilities, ICT capabilities, DDDM and operational performance. Future studies could employ longitudinal methodologies to observe how these relationships evolve over time. Additionally, this study relies on managerial perceptions, which, while valuable, may not fully capture the experiences of employees at different organizational levels. Future research could incorporate employee perspectives to provide a more comprehensive view of how BA and ICT capabilities are integrated into organizational decision-making. Given that data collection was conducted in Australia, the generalizability of the findings to other geographical contexts may be limited. Future research could replicate this study in different regions to examine whether the relationships identified here hold across various institutional and technological environments. Moreover, detailed case studies could further enhance understanding by exploring the specific mechanisms through which organizations implement BA and ICT capabilities in real-world settings.

3.7 Tables

Table 3 - 2: ***Descriptive Statistics (Questionnaire Items/Indicators)***

Indicator	Question (short version)	Scale	Mean/ Median	Std. Dev.	Kurt/ SE	Skew/ SE
Firm Size	**Annual revenue**	1-6	2.900	1.336	1.271	0.171
DDDM	**Data-driven decision making**					
DDDM1	Have, understand, and use data and information plays a critical role	1-7	6.270	1.012	-2.236	7.729
DDDM2	Open to new ideas and approaches that challenge current practices on the basis of new information	1-7	5.970	1.165	-1.579	3.617
DDDM3	Depend on data-based insights to support decision making	1-7	5.570	1.440	-1.281	1.530
DDDM4	Use data-based insights for the creation of new services or products	1-7	5.260	1.474	-0.813	0.608
BAT	**Business Analytics Technology**					
BAT1	Use business analytics tools/systems to retrieve and use intelligence about products and processes	1-7	4.770	1.629	-0.689	-0.112
BAT2	Use business analytics tools/systems to collaborate with individuals inside and/or outside the organization	1-7	4.420	1.715	-0.335	-0.668
BAT3	Use business analytics tools/systems to search for new knowledge and map a specific type of knowledge	1-7	4.110	1.665	0.057	-0.725
BAT4	Use business analytics tools/systems to allow employees in multiple locations to learn as a group from shared sources	1-7	4.490	1.761	-0.436	-0.542
BAG	**Business Analytics Governance**					
BAG1	Promote collective intelligence rather than individualistic acumen	1-7	4.510	1.585	-0.244	-0.633
BAG2	Have processes to facilitate exchange and sharing of intelligence	1-7	4.480	1.633	-0.361	-0.593
BAG3	Facilitate the transfer of intelligence across structural boundaries	1-7	4.390	1.554	-0.104	-0.581
ICT_INT	**Increase Internal Use**					
ICT_INT1	Enable strategic planning	1-5	3.900	0.956	-0.641	-0.093
ICT_INT2	Detailed MA info. is reported directly to line managers	1-5	3.840	0.924	-0.346	-0.734
ICT_INT3	Enable competence/skills development for employees	1-5	3.960	0.943	-0.787	0.227
ICT_COL	**Initiate and Maintain Collaboration**					
ICT_COL1	Maintain collaboration with existing business partners	1-5	4.090	0.905	-0.982	0.833
ICT_COL2	Establish business collaborations with new partners	1-5	3.840	1.035	-0.750	0.186
ICT_COL3	Enable work flexibility (e.g., work outside the office)	1-5	4.590	0.811	-1.991	3.041
ICT_COM	**Use for Internal and External Communication**					
ICT_COM1	Handle communication within the firm (e.g., intranet)	1-5	4.610	0.723	-1.906	3.037

Indicator	Question (short version)	Scale	Mean/ Median	Std. Dev.	Kurt/ SE	Skew/ SE
ICT_COM2	Handle external communication with the firm's stakeholders	1-5	4.200	0.879	-0.905	0.051
ICT_COM3	Promote marketing activities	1-5	4.260	0.920	-1.055	0.155
OP	**Operational Performance**					
OP1	Significant steps of improving production/service processes have been performed in the organization	1-7	5.090	1.380	-0.639	0.096
OP2	The efficiency of internal processes in the organization has been increasing in terms of time and cost	1-7	4.830	1.457	-0.728	0.237
OP3	Employee productivity has been increasing	1-7	4.620	1.398	-0.248	-0.165
OP4	Customer service has been improving.	1-7	4.560	1.289	-0.180	-0.078
ENV	Environmental dynamism					
ENV1	Changes happen more quickly and expansively than before	1-7	5.200	1.479	-0.980	0.637
ENV2	Changes are more complicated and solutions to one problem often impact on other areas and issues	1-7	5.230	1.497	-0.833	0.092
ENV3	Predicting change has become more difficult and more imprecise	1-7	5.130	1.377	-0.748	0.182

Table 3 - 3: ***Demographic Characteristics of Respondents***

Variables	*Frequency*	*Percent*
Industry (n=93)		
Agriculture, forestry and fishing	3	3.2
Mining	6	6.5
Construction	6	6.5
Manufacturing	9	9.7
Public services	15	16.1
Wholesale trade	6	6.5
Retail trade	2	2.2
Finance	4	4.3
Insurance and real estate	4	4.3
Transportation	4	4.3
Communication	2	2.2
Education	10	10.8
Other services	13	14.0
Other	9	9.7
Years of operation (n=93)		
2-5 years	6	6.5
5-20 years	22	23.7
More than 20 years	65	69.9
Number of employees (n=93)		
20-199	18	19.4
200-499	28	30.1
500-1000	23	24.7
more than 1000	24	25.8
Annual revenue (n=93)		
10-250 million	55	59.1
250-500 million	17	18.3
500-1000 million	3	3.2
more than 1000 million	11	11.8
N/A	7	7.5
Job title (n=93)		
CFO	43	46.2
Director finance	10	10.8
Head of finance	14	15.1
Senior financial manager	5	5.4
Other	21	22.6

Table 3 - 4: *Factor Loadings*

Indicator	Loadings	Construct
ICT_INT1	0.742	ICT_INT
ICT_INT2	0.857	
ICT_INT3	0.856	
ICT_COL1	0.928	ICT_COL
ICT_COL2	0.910	
ICT_COL3	0.749	
ICT_COM1	0.829	
ICT_COM2	0.834	
ICT_COM3	0.767	
DDDM1	0.798	DDDM
DDDM2	0.874	
DDDM3	0.898	
DDDM4	0.823	
BAT1	0.906	BAT
BAT2	0.947	
BAT3	0.930	
BAT4	0.903	
BAG1	0.916	BAG
BAG2	0.967	
BAG3	0.949	
ENV1	0.862	ENV
ENV2	0.906	
ENV3	0.927	
OP1	0.825	OP
OP2	0.906	
OP3	0.880	
OP4	0.710	
Firm Size	1.000	Firm Size

All factor loadings are above 0.5.

Table 3 - 5: *Latent Variables – 1st Order Constructs*

Latent Variable	Cronbach's Alpha	Rho_A	Composite reliability	AVE
BAT	0.941	0.942	0.958	0.849
BAG	0.939	0.939	0.961	0.892
DDDM	0.870	0.872	0.912	0.721
ICT_INT	0.758	0.781	0.860	0.673
ICT_COL	0.831	0.867	0.899	0.750
ICT_COM	0.739	0.738	0.852	0.657
ENV	0.880	0.882	0.926	0.807
OP	0.852	0.877	0.900	0.695

Table 3 - 6: *Latent Variables – 1st Order Constructs*

Latent Variable	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
BA_CAP	0.885	0.889	0.946	0.897
DDDM	0.870	0.872	0.912	0.721
ICT_CAP	0.806	0.835	0.885	0.719
ENV	0.880	0.882	0.926	0.807
OP	0.852	0.869	0.901	0.696

Table 3 - 7: ***Discriminant Validity (Indicator Cross-Loadings) – 1st Order Constructs***

	BAT	BAG	DDDM	ICT_INT	ICT_COL	ICT_COM	ENV	OP	Firm Size
BAT1	**0.906**	0.691	0.443	0.417	0.452	0.325	0.087	0.296	0.095
BAT2	**0.947**	0.751	0.460	0.415	0.527	0.308	0.088	0.327	0.061
BAT3	**0.930**	0.767	0.450	0.456	0.485	0.288	0.146	0.355	0.073
BAT4	**0.903**	0.717	0.361	0.326	0.499	0.320	0.094	0.389	0.076
BAG1	0.693	**0.916**	0.523	0.304	0.517	0.333	0.158	0.437	0.018
BAG2	0.772	**0.967**	0.457	0.280	0.490	0.315	0.048	0.479	0.101
BAG3	0.787	**0.949**	0.434	0.318	0.485	0.296	0.107	0.520	0.050
DDDM1	0.292	0.316	**0.798**	0.358	0.337	0.355	0.250	0.390	0.108
DDDM2	0.320	0.450	**0.874**	0.304	0.404	0.310	0.278	0.390	0.054
DDDM3	0.471	0.453	**0.898**	0.515	0.489	0.352	0.166	0.286	0.119
DDDM4	0.495	0.473	**0.823**	0.457	0.493	0.286	0.109	0.316	0.096
ICT_INT1	0.256	0.135	0.453	**0.742**	0.349	0.499	0.070	0.121	0.052
ICT_INT2	0.297	0.185	0.411	**0.857**	0.500	0.416	0.107	0.219	0.022
ICT_INT3	0.487	0.413	0.344	**0.856**	0.685	0.422	0.005	0.231	-0.038
ICT_COL1	0.508	0.435	0.397	0.609	**0.928**	0.464	-0.037	0.204	-0.002
ICT_COL2	0.535	0.522	0.531	0.562	**0.910**	0.466	-0.007	0.218	0.075
ICT_COL3	0.308	0.400	0.372	0.504	**0.749**	0.553	0.061	0.325	-0.107
ICT_COM1	0.209	0.242	0.333	0.488	0.552	**0.829**	0.025	0.247	-0.174
ICT_COM2	0.319	0.242	0.285	0.519	0.568	**0.834**	-0.096	0.127	0.017
ICT_COM3	0.282	0.319	0.313	0.311	0.261	**0.767**	-0.050	0.269	-0.094
ENV1	0.185	0.144	0.212	0.183	0.026	-0.044	**0.862**	0.234	-0.056
ENV2	0.036	0.022	0.203	-0.022	-0.031	-0.061	**0.906**	0.065	-0.119
ENV3	0.082	0.128	0.221	0.018	0.006	-0.036	**0.927**	0.007	-0.182

	BAT	BAG	DDDM	ICT_INT	ICT_COL	ICT_COM	ENV	OP	Firm Size
OP1	0.285	0.437	0.350	0.191	0.147	0.159	0.134	**0.825**	0.010
OP2	0.304	0.483	0.363	0.156	0.276	0.271	0.147	**0.906**	-0.092
OP3	0.373	0.440	0.383	0.238	0.348	0.206	0.008	**0.880**	-0.014
OP4	0.277	0.302	0.239	0.227	0.128	0.269	0.080	**0.710**	-0.120
Firm Size	0.082	0.059	0.111	0.008	0.000	-0.102	-0.134	-0.059	**1.000**

Table 3 - 8: ***Discriminant Validity – HTMT - 1st Order Constructs***

	BAG	BAT	DDDM	ENV	Firm Size	ICT_COL	ICT_COM	ICT_INT	OP
BAG	**0.944**								
BAT	0.795 [a)]	**0.922**							
	0.845 [b)]								
DDDM	0.500	0.466	**0.849**						
	0.551	0.513							
ENV	0.111	0.113	0.236	**0.899**					
	0.125	0.124	0.270						
Firm Size	0.059	0.082	0.111	-0.134	**1.000**				
	0.062	0.085	0.119	0.141					
ICT_COL	0.527	0.531	0.508	0.001	0.000	**0.866**			
	0.592	0.589	0.589	0.052	0.078				
ICT_COM	0.334	0.336	0.383	-0.052	-0.102	0.560	**0.811**		
	0.396	0.400	0.478	0.098	0.137	0.741			
ICT_INT	0.318	0.439	0.482	0.067	0.008	0.644	0.538	**0.820**	
	0.353	0.499	0.604	0.129	0.052	0.787	0.731		
OP	0.507	0.370	0.405	0.113	-0.059	0.278	0.266	0.237	**0.834**
	0.559	0.416	0.467	0.165	0.077	0.333	0.340	0.297	

a) Fornell-Larcker Criterion: AVE-square root in diagonal (bold) compared with latent variable correlations (first value underneath diagonal).
b) Heterotrait-Monotrait Ratio (HTMT) (second value underneath diagonal); all HTMT values significant at $p < 0.01$.

Table 3 - 9: ***Discriminant Validity (Indicator Cross-Loadings) – 2nd Order Constructs***

	BA_CAP	DDDM	ICT_CAP	ENV	OP	Size
BAT	**0.943**	0.467	0.525	0.113	0.372	0.082
BAG	**0.951**	0.500	0.475	0.111	0.504	0.059
DDDM1	0.321	**0.797**	0.409	0.250	0.390	0.108
DDDM2	0.409	**0.871**	0.405	0.278	0.389	0.054
DDDM3	0.488	**0.899**	0.539	0.166	0.285	0.119
DDDM4	0.511	**0.825**	0.497	0.109	0.315	0.096
ICT_COL	0.559	0.509	**0.894**	0.001	0.279	0.000
ICT_COM	0.353	0.384	**0.790**	-0.052	0.268	-0.102
ICT_INT	0.397	0.483	**0.858**	0.067	0.240	0.008
ENV1	0.173	0.211	0.068	**0.862**	0.232	-0.056
ENV2	0.030	0.202	-0.042	**0.906**	0.062	-0.119
ENV3	0.112	0.220	-0.001	**0.927**	0.003	-0.182
OP1	0.384	0.349	0.193	0.134	**0.815**	0.010
OP2	0.419	0.363	0.276	0.147	**0.899**	-0.092
OP3	0.430	0.382	0.320	0.008	**0.886**	-0.014
OP4	0.306	0.238	0.233	0.080	**0.725**	-0.120
Firm Size	0.074	0.111	-0.029	-0.134	-0.061	**1.000**

Table 3 - 10: ***Discriminant Validity (Latent Variables) – 2nd Order Constructs***

	BA_CAP	DDDM	ENV	Firm Size	ICT_CAP	OP
BA_CAP	**0.947**					
DDDM	0.511[a)] 0.580[b)]	**0.849**				
ENV	0.118 0.133	0.235 0.270	**0.899**			
Firm Size	0.074 0.079	0.111 0.119	-0.134 0.141	**1.000**		
ICT_CAP	0.527 0.610	0.546 0.644	0.010 0.074	-0.029 0.048	**0.848**	
OP	0.465 0.530	0.405 0.467	0.109 0.165	-0.061 0.077	0.308 0.372	**0.834**

a) Fornell-Larcker Criterion: AVE-square root in diagonal (bold) compared with latent variable correlations (first value underneath diagonal).

b) Heterotrait-Monotrait Ratio (HTMT) (second value underneath diagonal); all HTMT values significant at $p < 0.01$.

Table 3 - 11: ***Collinearity statistics (VIF) Inner Model – List***

	VIF
BAG -> DDDM	2.981
BAG -> OP	2.883
BAT -> DDDM	3.056
BAT -> OP	2.765
DDDM -> OP	1.367
ICT_INT -> BAG	1.858
ICT_INT -> BAT	1.858
ICT_INT -> DDDM	2.008
ICT_COL -> BAG	1.922
ICT_COL -> BAT	1.922
ICT_COL -> DDDM	2.324
ICT_COM -> BAG	1.609
ICT_COM -> BAT	1.609
ICT_COM -> DDDM	1.646
ENV -> DDDM	1.066
Firm Size -> BAG	1.018
Firm Size -> BAT	1.018
Firm Size -> DDDM	1.057
Firm Size -> OP	1.015

Table 3 - 12: ***Independent Samples Test (Equal Variances Assumed)***

	Mean Difference	Sig.	95% CI LL	95% CI UL
ICT_INT1	-0.278	0.163	-0.669	0.114
ICT_INT2	-0.061	0.752	-0.444	0.322
ICT_INT3	-0.085	0.666	-0.475	0.305
ICT_COL1	-0.260	0.167	-0.631	0.111
ICT_COL2	0.025	0.908	-0.404	0.454
ICT_COL3	-0.163	0.334	-0.497	0.171
ICT_COM1	-0.207	0.169	-0.503	0.090
ICT_COM2	-0.155	0.398	-0.518	0.208
ICT_COM3	-0.006	0.977	-0.386	0.375
DDDM1	0.059	0.781	-0.360	0.478
DDDM2	0.237	0.329	-0.243	0.717
DDDM3	0.267	0.374	-0.327	0.861
DDDM4	-0.006	0.986	-0.616	0.605
BAT1	-0.232	0.496	-0.905	0.442
BAT2	-0.074	0.838	-0.784	0.637
BAT3	0.084	0.810	-0.606	0.773
BAT4	-0.355	0.334	-1.080	0.371
BAG1	-0.032	0.922	-0.689	0.624
BAG2	-0.075	0.826	-0.751	0.601
BAG3	0.035	0.915	-0.609	0.678
OP1	0.127	0.659	-0.444	0.698
OP2	0.090	0.768	-0.513	0.693
OP3	0.245	0.402	-0.332	0.822
OP4	0.117	0.664	-0.416	0.651
ENV1	0.103	0.739	-0.509	0.715
ENV2	0.576	0.063	-0.033	1.184
ENV3	0.212	0.460	-0.356	0.781
ENV4	0.327	0.249	-0.232	0.885

Table 3 - 13: ***Other Direct and Indirect Effects***

Path:	Effect[1)]	Without Moderation				With Moderation			
		Coeff.	f squares	95% CI LL	95% CI UL	Coeff.	f squares	95% CI LL	95% CI UL
ICT CAP → BA CAP	D	0.530***[2)]	0.392	*0.404*	*0.654*	0.530***	0.392	*0.402*	*0.652*
ICT CAP → DDDM	D	0.412**	0.210	*0.171*	*0.669*	0.416***	0.251	*0.209*	*0.652*
BA CAP → OP	D	0.352***	0.125	*0.195*	*0.529*	0.352***	0.125	*0.189*	*0.527*
BA CAP → DDDM	D	0.258**	0.081	*0.085*	*0.410*	0.285**	0.115	*0.101*	*0.432*
DDDM→OP	D	0.237*	0.056	*0.028*	*0.424*	0.237*	0.056	*0.037*	*0.424*
ENV→DDDM	D	0.219*	0.080	*0.047*	*0.396*	0.160*	0.047	*0.021*	*0.287*
ICT CAP→BA CAP →DDDM→OP	I	0.032		*0.001*	*0.081*	0.036		*0.002*	*0.082*
ENV→DDDM→OP	I	0.052		*0.000*	*0.147*	0.038		*0.000*	*0.095*
ICT CAP → BA CAP → OP	I	0.187**		*0.095*	*0.307*	0.187**		*0.093*	*0.308*
ICT CAP → BA CAP → DDDM	I	0.137*		*0.043*	*0.239*	0.151**		*0.051*	*0.248*
Firm_Size→ BA CAP→DDDM	I	0.023		-0.010	0.062	0.026		-0.011	0.071
Firm_Size→ BA CAP→DDDM→OP	I	0.006		-0.002	0.021	0.006		-0.002	0.024
Firm_Size→ BA CAP→OP	I	0.032		-0.016	0.086	0.032		-0.016	0.085
Firm_Size→ DDDM→OP	I	0.032		*0.000*	*0.079*	0.034		*0.000*	*0.083*
ENV x BA_CAP →DDDM→OP	MI					-0.078		*-0.185*	*-0.002*
ENV x ICT_CAP →DDDM→OP	MI					0.048		-0.023	0.144

1) D = direct, I = indirect/mediation, MI = moderation indirect (moderated mediation)

2) Significance 1-tailed: $p < 0.05$; $p < 0.01$**; $p < 0.001$****

Table 3 - 14: *Total Effects*

Path:	Effect[1)]	Without Moderation			
		Coeff.	P-value	95% CI LL	95% CI UL
BA CAP→OP	T	0.414	0.000	0.255	0.547
ICT CAP→DDDM	T	0.548	0.000	0.315	0.723
ICT CAP→OP	T	0.317	0.000	0.215	0.412
ENV→OP	T	0.052	0.132	0.002	0.155

1) T = total effect

Note: all

Chapter 4: Conclusion

4.1 Conclusion

Motivated by the rapid rise of telework (TW) and the increasing reliance on digital technologies, the thesis aims to advance understanding of how organizations can maintain or improve operational performance by leveraging technological and analytical capabilities, data-driven decision-making (DDDM) and management control (MC) systems within increasingly dynamic environments.

Drawing on the Dynamic Capabilities View (DCV)**,** the research developed and tested two theoretical models using empirical data collected from senior managers in medium and large Australian organizations. Chapter 2 developed the theoretical model by integrating the dimensions of MC (action, outcome, personnel, and cultural controls), information and communications technologies (ICT) capabilities (internal use, communication, and collaboration), and examined their relationships with TW intensity, environmental dynamism, and operational performance. The empirical findings provide new insights into the performance implications of TW. While TW adoption expanded rapidly during the COVID-19 pandemic, this study shows that increasing levels of TW may decrease operational. However, using the management control framework developed by Merchant and van der Stede (2007), the study finds that combined MC mechanisms are increased under TW, which are critical in maintaining operational efficiency within organizations. Furthermore, the results indicate that ICT capabilities are an influential factor to enhance operational performance and highlight the positive moderating effect of ICT capabilities in the relationship between TW and operational performance. Finally, this study provides a systematic perspective on the role of environmental dynamism in the value and capabilities of resources. Results indicate that MC intensity increases with higher environmental dynamism. In addition, the study confirms a moderating

effect of environmental dynamism on the performance impacts of TW on performance: when environmental dynamism is high, increasing TW has almost no effect on the performance of organizations.

Chapter 3 developed the theoretical model which integrates dynamic capabilities (ICT and BA capabilities) and DDDM and examined their relationships with environmental dynamism and operational performance. The findings contribute to multiple streams of literature, including AIS and DCV research, by demonstrating that DDDM serves as a critical mediating mechanism between dynamic capabilities and operational outcomes. BA capabilities were shown to directly enhance performance not only by enabling better decision-making but also by fostering knowledge creation and strategic alignment. ICT capabilities, while foundational for digital transformation, primarily enhance performance by supporting DDDM rather than exerting direct effects. However, the study also finds that the benefits of BA capabilities in driving DDDM are diminished under high environmental dynamism. This insight refines our understanding of when and how BA capabilities contribute to performance and underscores the importance of contextual factors in deploying technological capabilities.

4.2 Theoretical Contributions

This thesis makes several important theoretical contributions to the literature on TW, MC, DDDM, and accounting information systems (AIS), by extending the DCV to incorporate the role of emerging digital technologies and analytical practices in rapidly evolving business environments.

First, this study contributes to the growing body of TW literature by examining changes in TW intensity over time, specifically comparing pre-COVID conditions with the later stages of the pandemic. Unlike prior studies that typically assess TW at a fixed point in time, this research provides a more robust understanding of its performance implications. By analysing conditions

after extended exposure to TW, when managers and employees had largely adapted to remote work routines, this study provides a more stable and realistic assessment of TW's performance implications. Contrary to findings of universal performance benefits, the results show that increases in TW can impede operational performance, thereby sharpening the theoretical understanding of the conditions under which TW enhances—or constrains—organizational outcomes.

Second, this research enriches MC literature by emphasizing the need for bundled MC mechanisms (action, outcome, personnel, and cultural controls) when operating under high TW intensity and environmental dynamism. Unlike earlier research that often focused on individual control types, this study provides evidence of the interdependent and complementary nature of MC systems in dynamic environments. Drawing on Merchant and van der Stede's (2007) framework, the study reveals that MC intensity increases in TW settings and that MC mechanisms are critical mediators between environmental dynamism and performance. This extends MC scholarship by showing how dynamic capabilities and control packages jointly function to maintain performance in remote working conditions—an area previously underexplored due to TW's limited prevalence before COVID-19.

Third, the thesis contributes to the AIS literature by clarifying the differentiated roles of BA and ICT capabilities. It demonstrates that BA capabilities exert both direct and indirect effects on performance, not only supporting DDDM but also enhancing strategic information processing, knowledge generation, and organizational learning. In contrast, ICT capabilities are shown to support performance primarily through their enabling role in DDDM, rather than as direct performance drivers. This distinction provides a deeper understanding of how different types of capabilities interact with performance. Moreover, the thesis offers a detailed conceptualization of ICT capabilities across three dimensions: internal use, communication,

and collaboration. It demonstrates that ICT capabilities not only enable the effective implementation of TW but also moderate its performance impacts. Drawing upon the DCV framework, the study validates ICT capabilities as dynamic enablers that strengthen organizational adaptability in remote work settings, while also highlighting their role in enhancing communication, reducing social isolation, and facilitating access to critical knowledge.

Fourth, the study advances our theoretical understanding by conceptualizing DDDM as a mediating mechanism that links dynamic capabilities (specifically BA and ICT capabilities) to operational performance. While prior research has acknowledged the strategic importance of big data and digital capabilities, few studies have empirically investigated how these capabilities are activated and transformed into business value. This thesis addresses that gap by illustrating that DDDM is a key intermediary process through which analytical and technological resources are converted into organizational outcomes.

The thesis introduces environmental dynamism as a moderator that shapes the effectiveness of both TW practices and dynamic capabilities. The findings show that higher environmental dynamism attenuates the negative impact of increased TW on performance, suggesting that TW may be less detrimental when firms already operate in contexts that require flexibility, decentralised decision-making, and rapid information flows. In addition, it demonstrates that high levels of environmental dynamism weaken the link between BA capabilities and DDDM, challenging the common assumption that analytics always enhances decision quality. This insight advances our theoretical understanding by emphasizing the context-dependent nature of the capabilities.

4.3 Practical Implications

The findings of this thesis offer several important implications for organizations seeking to enhance operational performance in remote and digitally dynamic environments.

First, as TW continues to be an important mode of work, organizations must align TW strategies with both ICT capabilities and MC. The results reveal that high levels of TW may reduce operational performance. To mitigate this risk, managers should ensure employees have access to ICT tools that facilitate communication, collaboration, and information access in remote settings. Investment in ICT not only improves operational efficiency but also strengthens employee connectivity in remote work environments.

Second, the shift to TW introduces challenges related to MC, making it more difficult for organizations to monitor, coordinate, and guide employee behaviour in remote settings. This study provides evidence that higher levels of integrated MC mechanisms—including action, outcome, personnel, and cultural controls—are required to sustain efficiency and effectiveness in a TW environment. For practitioners, this means investing additional effort in defining clear deliverables, setting up regular performance reviews, facilitating virtual team interactions, offering targeted training, and reinforcing organizational values.

Third, the findings of this study provide valuable guidance for managers aiming to strengthen decision-making processes and improve operational performance in an increasingly data-driven environment. The results underscore the importance of DDDM as a key enabler of business success. However, the effectiveness of DDDM is contingent on its integration across all levels of the organization**.** Managers should go beyond relying solely on specialized analytics teams and actively empower employees across all functions to use data in their daily decision-making. Encouraging staff to challenge assumptions, support decisions with empirical evidence, and recognize the strategic value of data insights are essential to realizing the full

benefits of DDDM. In addition, the research highlights the need for organizations to align DDDM efforts with ICT and BA capabilities to unlock their full potential**.**

Finally, environmental dynamism amplifies the importance of both capability alignment and adaptive control systems. In highly volatile environments, managers must be attentive to external shifts, regularly analysing the environment to inform strategic planning and MC adjustments. Proactively adapting control systems and adjust ICT and BA investments to align with environmental conditions can enhance organizational agility and performance stability during periods of rapid change. The effectiveness of traditional BA capabilities in supporting DDDM can diminish, particularly when historical data becomes less relevant. To address this, managers should adopt flexible decision-making strategies to respond effectively to uncertainty, such as real-time data integration, agile forecasting methods, and scenario-based planning.

4.4 Limitations and Opportunities for Future Research

While this thesis makes several theoretical and practical contributions, it is subject to a number of limitations that offer valuable directions for future research.

First, both studies rely on cross-sectional survey data, which limits the ability to capture dynamic changes in MC systems, dynamic capabilities (ICT and BA), and DDDM over time. Future research would benefit from adopting longitudinal research designs or field studies to better understand how these relationships evolve and interact in different stages of organizational transformation or dynamic environment.

Second, the findings are primarily based on the perceptions of senior managers. While this perspective provides strategic insights, it may not fully reflect the experiences of employees, who are directly involved in day-to-day implementation of TW, technological and analytical capabilities, control mechanisms and decision-making process. Future studies should consider

incorporating multi-level data collection, such as interviews or surveys with diverse organizational stakeholders, to develop a more comprehensive view of how digital and managerial practices are experienced across levels.

Third, the thesis focuses on a predefined set of MC mechanisms (action, outcome, personnel and cultural controls) and explores their collective effects on operational performance. However, future research could delve deeper into the interactions, complementarities, or trade-offs among different types of controls.

Fourth, the data used in this thesis were collected exclusively from organizations in Australia. It would be interesting to further explore the tested relationships across a larger sample of various cultural contexts increase the robustness of the findings. However, as the organizations studied operated under very similar COVID-19 rules and institutional conditions, cross-country pandemia policy heterogeneity was avoided, which in turn increases internal validity.

Finally, while the survey methodology enabled broad empirical testing, it does not capture the detailed organizational practices through which organizations build and integrate their digital capabilities. Qualitative case studies or mixed-method approaches could provide deeper insights into how BA and ICT capabilities are embedded in organizational routines, how control systems are practically implemented in TW environments, and how DDDM is institutionalized in different organizational settings.

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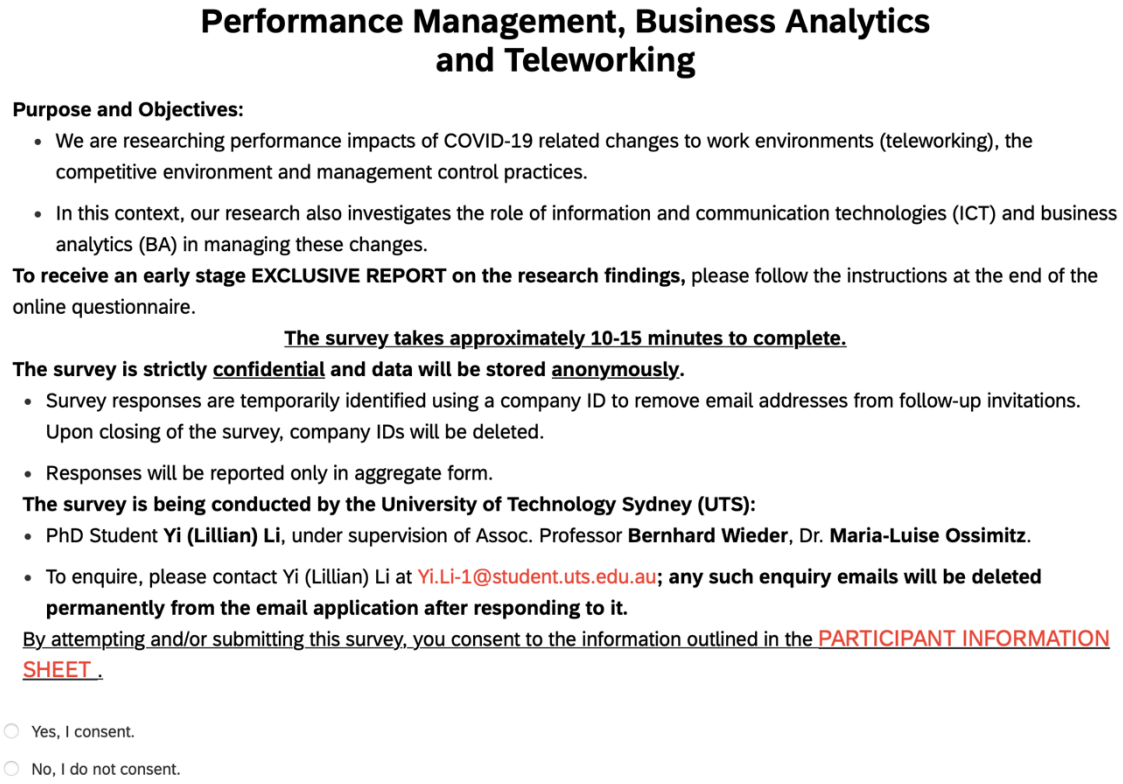
Appendix A

Figure 1: *Cover Page of The Survey*



Performance Management, Business Analytics and Teleworking

Purpose and Objectives:

- We are researching performance impacts of COVID-19 related changes to work environments (teleworking), the competitive environment and management control practices.
- In this context, our research also investigates the role of information and communication technologies (ICT) and business analytics (BA) in managing these changes.

To receive an early stage EXCLUSIVE REPORT on the research findings, please follow the instructions at the end of the online questionnaire.

The survey takes approximately 10-15 minutes to complete.

The survey is strictly confidential and data will be stored anonymously.

- Survey responses are temporarily identified using a company ID to remove email addresses from follow-up invitations. Upon closing of the survey, company IDs will be deleted.
- Responses will be reported only in aggregate form.

The survey is being conducted by the University of Technology Sydney (UTS):

- PhD Student **Yi (Lillian) Li**, under supervision of Assoc. Professor **Bernhard Wieder**, Dr. **Maria-Luise Ossimitz**.
- To enquire, please contact Yi (Lillian) Li at Yi.Li-1@student.uts.edu.au**; any such enquiry emails will be deleted permanently from the email application after responding to it.**

By attempting and/or submitting this survey, you consent to the information outlined in the PARTICIPANT INFORMATION SHEET .

- Yes, I consent.
- No, I do not consent.

Figure 2: *Definitions and Terminology*

Definitions and Terminology:

- Organisation: The survey uses this generic term to denote your area of responsibility: please answer the questions based on your knowledge and experience with your area of responsibility (e.g. business unit, company, group).
- Teleworking: refers to working at home, remote working or doing normal work activities while away from one's normal workplace.
- Management controls: refers to activities and mechanisms used by managers to assure resources are obtained and used effectively and efficiently in the accomplishment of the organisation's objectives.
- Business analytics: refers to the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions.
- BA tools/systems: refers to a collective term for all ICT-based applications and systems used by an organisation in direct or indirect support of Business Analytics.
- Information and communication technologies: refers to any electronic device or technology which has the ability to collect, store and send information.
- Operating performance: refers to the measurable aspects of the outcomes of an organisation's process.
- Pre-COVID: refers to the period before the Australian federal government announced a ban on non-essential indoor gatherings of 100 or more people (including staff) on 18th of March 2020.

Figure 3: *Survey Questions on Industry Sector*

A. Demographics

Please select your organisation's industry sector:

Agriculture
Forestry and Fishing
Mining
Construction
Manufacturing
Public services
Wholesale Trade
Retail Trade
Finance
Insurance and Real Estate
Transportation

Figure 4: ***Survey Questions on the Years of Operation in Organization***

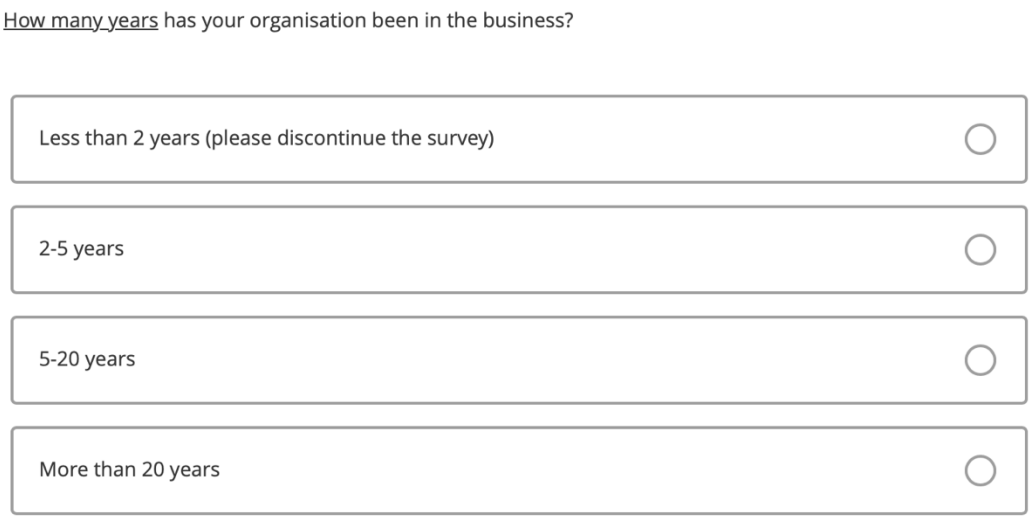


Figure 5: ***Survey Questions on the Number of Employees in Organization***

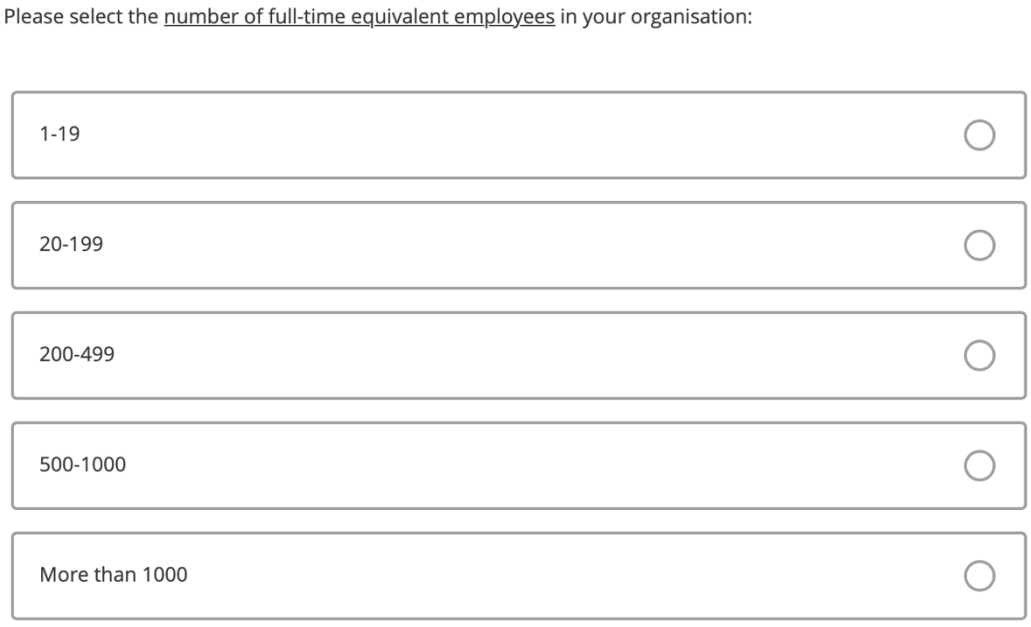


Figure 6: *Survey Questions on Annual Revenue*

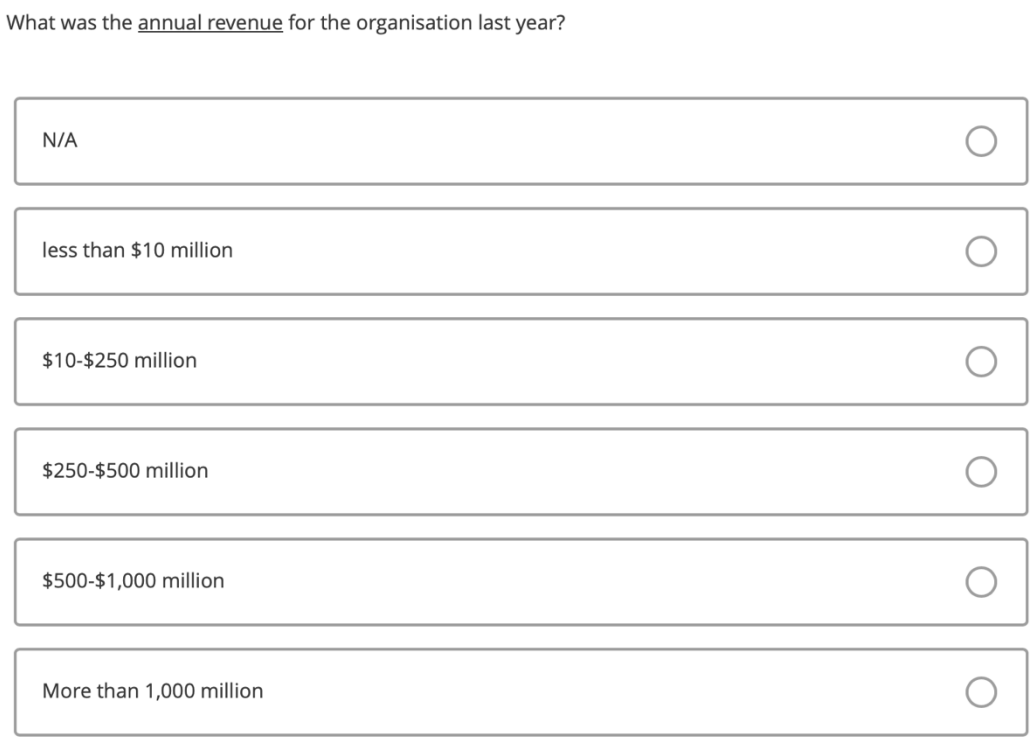


Figure 7: *Survey Questions on Job Title of the Participants*

Figure 8: ***Survey Questions on How Long the Participants Have Held Their Current Role and Organization***

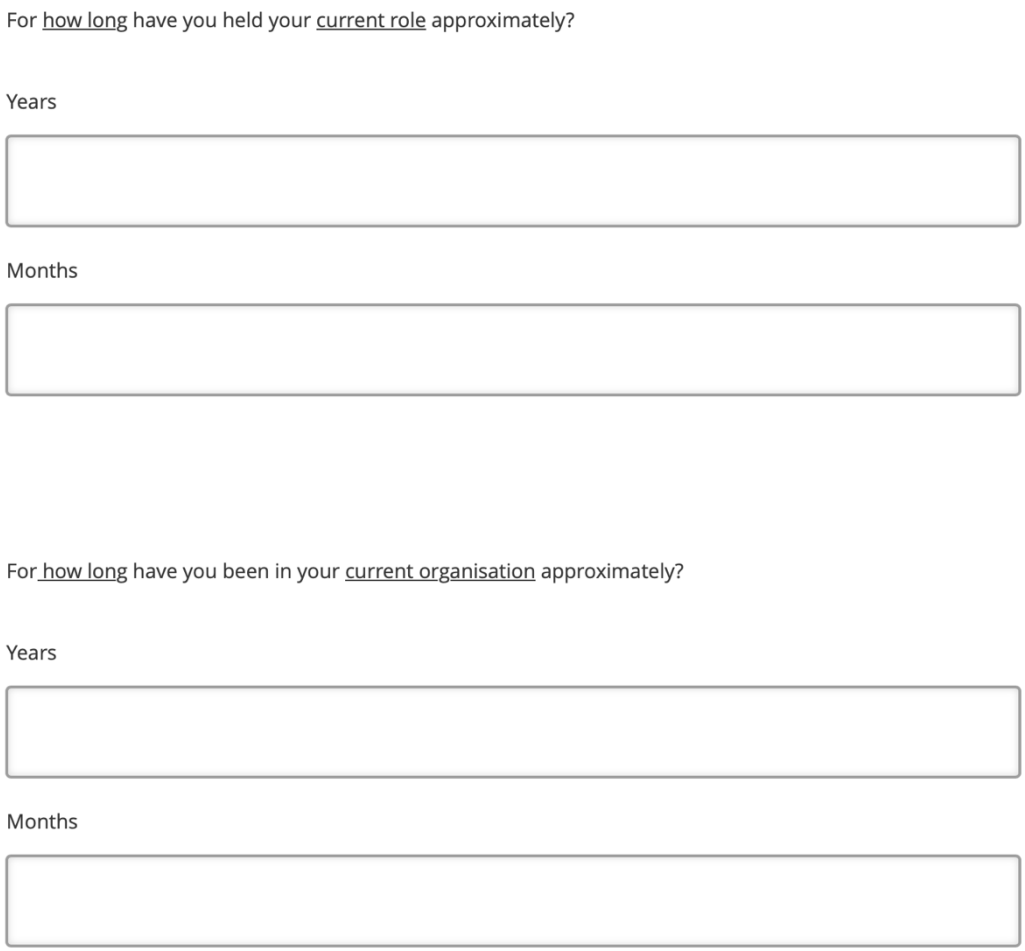


Figure 9: *Survey Questions on Environmental Dynamism*

B. Environment

Please indicate to what degree you agree or disagree with each of the following statements about the environment your organization has been operating in over the past 2 years:

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
Changes happen more quickly and expansively than before.	○	○	○	○	○	○	○
Predicting change has become more difficult and more imprecise.	○	○	○	○	○	○	○
Changes are more complicated and solutions to one problem often impact on other areas and issues.	○	○	○	○	○	○	○
The impact of the changes and reactions to change are increasing unclear.	○	○	○	○	○	○	○

Figure 10: *Survey Questions on Telework*

C. Teleworking

Herein the term 'Teleworking' refers to working from home, remote working or doing normal work activities while away from one's normal workplace.

Please select what types of teleworking are used by your organisation:

- [ ] Home-based teleworking
- [ ] Mobile teleworking
- [ ] Urban and/or rural telecentres

Please indicate the percentage of staff in your organisation who are currently working remotely at least 1 day a week approximately:

Please indicate the average number of days per week the above-mentioned teleworkers are working remotely:

Please indicate whether your organisation used teleworking before the Covid-19 pandemic:

- ◯ Yes
- ◯ No

Please indicate the percentage of staff in your organisation who have been working remotely at least 1 day a week before the Covid-19 pandemic approximately:

Please indicate the average number of days per week the above-mentioned teleworkers have been working remotely before the Covid-19 pandemic:

Figure 11: ***Survey Questions on Management Controls***

D. Management Controls 1

Please indicate the degree to which you agree or disagree with the following statements for your organisation (1 = strongly disagree; 2 = somewhat disagree; 3 = neither agree nor disagree; 4 = somewhat agree; 5 = strongly agree):

	Pre-Covid	Now
Emphasis is placed on complying with rules and procedures.		
Employees are carefully selected based on whether they fit to our organization's values and norms.		
Specific performance targets are created for employees.		
Traditions, values, and norms play a major role in our organisation.		
The achievement of performance targets per employee is being measured and controlled by their respective superiors.		
Emphasis is placed on hiring the best-suited applicants for a particular job position.		
Potential deviations from organisational performance goals have to be explained by the responsible managers.		
In our organisation, high emphasis is placed on sharing informal codes of conduct with employees.		

Figure 12: *Survey Questions on ICT Capabilities*

E. ICT

Herein the term 'Information and Communication Technologies' refers to any electronic device or technology which has the ability to collect, store and send information.

Please indicate the extent to which your organisation uses ICT in the following areas:

	1 Never	2	3 Occasionally	4	5 Very frequently
Access information (e.g., market, customer)	○	○	○	○	○
Enable strategic planning	○	○	○	○	○
Enable cost savings	○	○	○	○	○
Enable competence/skills development for employees	○	○	○	○	○
Maintain collaboration with existing business partners	○	○	○	○	○
Establish business collaborations with new partners	○	○	○	○	○
Enable work flexibility (e.g., work outside the office)	○	○	○	○	○
Handle communication within the firm (e.g., intranet)	○	○	○	○	○
Handle external communication with the firm's stakeholders	○	○	○	○	○
Promote marketing activities	○	○	○	○	○

Figure 13: *Survey Questions on Data-driven Decision-making*

Please indicate the degree to which you agree or disagree with the following statements:

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
We believe that having, understanding, and using data and information plays a critical role.	○	○	○	○	○	○	○
We are open to new ideas and approaches that challenge current practices on the basis of new information.	○	○	○	○	○	○	○
We depend on data-based insights to support decision making.	○	○	○	○	○	○	○
We use data-based insights for the creation of new services or products.	○	○	○	○	○	○	○

Figure 14: *Survey Questions on BA Capabilities*

F. Business Analytics

Herein the term 'Business Analytics' refers to the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions.

Please indicate the degree to which you agree or disagree with the following statements:

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
My organisation uses BA tools/systems to retrieve and use intelligence about products and processes.	○	○	○	○	○	○	○
My organisation uses BA tools/systems to collaborate with individuals inside and outside the organisation.	○	○	○	○	○	○	○
My organisation uses BA tools/systems to search for new knowledge and map a specific type of knowledge.	○	○	○	○	○	○	○
My organisation uses BA tools/systems to allow employees in multiple locations to learn as a group from single (multiple) sources at single (multiple) points of time.	○	○	○	○	○	○	○

My organisation encourages intelligence exploration and experimentation.	○	○	○	○	○	○	○
Senior management support the role of BA in our organisation's success.	○	○	○	○	○	○	○
My organisation expects a high level of participation in intelligence capture, share, and transfer.	○	○	○	○	○	○	○
In my organisation, the vision and objective around the BA are clearly stated and understood.	○	○	○	○	○	○	○
My organisation's structure of departments inhibits exchange and sharing of intelligence.	○	○	○	○	○	○	○
My organisation promotes collective intelligence rather than individualistic acumen.	○	○	○	○	○	○	○
My organisation has processes to facilitate exchange and sharing of intelligence.	○	○	○	○	○	○	○
My organisation facilitates the transfer of intelligence across structural boundaries.	○	○	○	○	○	○	○

Figure 15: *Survey Questions on Management Controls*

G. Management Controls 2

Please indicate the degree to which do you agree or disagree with the following statements for your organisation (1 = strongly disagree; 2 = somewhat disagree; 3 = neither agree nor disagree; 4 = somewhat agree; 5 = strongly agree):

	Pre-COVID	Now
The most important tasks for routine processes are defined by managers.		
Training and development activities for employees are regarded as being very important.		
Employees receive feedback from their superiors concerning the extent to which they achieved their performance goals.		
Our mission statement conveys the organisation's core values to our employees.		
Numerous opportunities are being offered to employees to broaden their range of skills.		
Employees are provided with information on the most important steps regarding the achievement of performance goals.		
Policies and procedures manuals define the fundamental course of processes.		
Top managers communicate the organisation's core values to employees.		

Figure 16: *Survey Questions on Operational Performance*

H. Performance

Please indicate the degree to which you agree or disagree with the following statements for your organisation over the past 2 years:

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
Significant steps of improving production/service processes have been performed in the organization.	○	○	○	○	○	○	○
The efficiency of internal processes in the organization has been increasing in terms of time and cost.	○	○	○	○	○	○	○
Employee productivity has been increasing.	○	○	○	○	○	○	○
The geographic distribution of sales/service activities has been expanding.	○	○	○	○	○	○	○
Operating costs have been reducing.	○	○	○	○	○	○	○
Customer services have been improving.	○	○	○	○	○	○	○