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Strategic Management of Technology-enabled Capabilities: A Dynamic Capabilities Approach to Strategically Aligned Value Creation

by

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I, ___Jónatan Jacobs___ declare that -

the thesis, which I hereby submit for the degree at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I have obtained, for the research described in this work, the applicable research ethics approval. I have observed the ethical standards required in terms of the University of Pretoria's Code of ethics for researchers and the Policy guidelines for responsible research.

Abstract

Organisations are finding it increasingly difficult to create value in the current dynamic, globalised, interconnected, and ever more complex business and technology environments. The Fourth Industrial Revolution (4IR) is set to increase these challenges as a result of the increasing complexity and dynamic changes in market, societal, and technological trends. While current technological trends potentially offer great value to organisations, emerging technological implementations and transformations often fail to realise the desired value creation outcomes.

This research study takes an exploratory sequential mixed method approach to first articulate what the major challenges to technology-enabled value creation efforts entail, before devising a means to address the defined problem statement. Following an initial exploratory study with qualitative interviews, it was determined that the major challenges to technology-enabled value creation initiatives, in the current dynamic environment, can be linked to a dynamic capabilities perspective of strategic management.

This perspective encompasses the dynamic adaptation of enabling capabilities to enact strategic alignment between the external environment and an organisation's value creation system hierarchies. These hierarchies broadly include the organisation's strategies, its strategy execution, and its capability creation, adaptation, and management. Dynamic capabilities are defined from a system perspective and are presented as functioning to enable this desired strategic alignment.

The second phase of this study takes a deductive research approach that builds on the developed theory to develop and test operational hypotheses. This research phase is executed through a descriptive research design using quantitative methods to provide a valid representation of the observed phenomena.

The first part of this representation takes the form of a three-dimentional model to conceptualise the strategic management of technology-enabled capabilities, from a dynamic capabilities perspective on value creation, within the context of the 4IR. This

model consists of and/or correlates with various frameworks that are either referenced or developed within this study from a systems perspective. These include but are not limited to a new perspective on technology-enabled capabilities, a strategic planning roadmapping framework to support execution in practice, and an illustrative system architecture framework for Industry 4.0 to demonstrate conformity with current 4IR related conceptualisations.

This conceptual model addresses an identified need to illustrate the interconnectedness of three different dimensions. These include the dynamic capabilities approach to maintain strategic alignment (enabling functional alignment), across the value creation system hierarchies of an organisation (enabling integration), over the value creation lifecycle (enabling temporal synchronisation). The model thereby serves to provide context to the complex system surrounding the strategic management of technology-enabled capabilities, from a dynamic capabilities perspective on strategically aligned value creation.

The model is tested, by testing hypotheses through quantitative analyses of survey responses from large organisations operating in dynamic environments (such as during the global pandemic in 2020) and the outcomes are discussed. The main hypothesis proposes that organisations with higher strategic alignment capacities, as conceptualised within the presented model, will also have higher value creation capacities within dynamic environments.

This hypothesis is validated by showcasing strong correlations ($\rho = 0.74$) between the defined independent and dependent constructs, which relate to a dynamic capabilities approach to strategic alignment and more effective value creation capacities within large organisations, respectively. This seems to indicate that the hypothesis is correct, meaning that the higher the strategic alignment capacities of organisations are as a function of more effective dynamic capabilities that constitute their dynamic alignment competencies, the higher their value creation capacities are as a function of more effective value creating and capturing competencies.

Furthermore, this seems to give credence to the structure of the conceptual model that gives context to the relationship between strategic alignment (and its elements from a systems perspective on the strategic management of dynamic capabilities) and the value creation system of organisations (and the elements representing this system's function).

The study closes with recommendations for future research, such as to expand on this study with a larger sample, to replicate the study for small and medium sized firms, to explore the identified trends further such as that South African industries have not yet begun actual 4IR related technological transformations, and to define value metrics to assess the value of capabilities that emerging technologies may enable. Lastly, recommendations for the application of the research outcomes in practice are given. These are focussed on the required systems perspective of dynamic capabilities to create dynamic alignment capacities that could maintain continual strategic alignment in the face of dynamic change. Some practical principles are provided, such as for the development of toolkits to perform these functions in practical and structured strategic workshops along with a roadmapping framework to contextualise value creation efforts and their interdependencies over various execution timeframes.

Keywords: Value Creation; Strategic Technology Management; Dynamic Capabilities; Strategic Alignment; Fourth Industrial Revolution

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List of Abbreviations & Acronyms

DCF	Dynamic Capabilities Framework
IM	Innovation Management
KM	Knowledge Management
PM	Project Management
SOI	System of Interest
SM	Strategic Management
SMT	Strategic Management of Technology
SMTC	Strategic Management of Technology-enabled Capabilities

List of Definitions as Defined Throughout the Thesis

Phrase/factor	Definition/Description	Page No.
Capabilities	The ability to do something, which is constituted by three primary elements (i.e. resources and assets, people and their skills, processes and activities). Capabilities can also be defined as the means or ability to create value.	34
Competences	Unique capabilities that may be leveraged to create unique and difficult-to-imitate value.	35
Core Competences	Core competencies are those competencies that form the core of an organisation's competitiveness in its value creation system and that affect its sustainability.	36
Dynamic Capabilities	The ability to dynamically create, adapt, and manage capabilities in response to dynamic challenges imposed on the organisation for the value that it should create and offer. This is essentially a strategic management approach that aims to maintain strategic alignment.	41
Elements	Elements include any products (hardware, software, firmware), processes, people, information, techniques, facilities, services, and other support factors that in combination and when interacting with one another achieve one or more stated purposes of a system, sub-system or assembly.	23
Technology-enabled Capabilities	The ability to do something through technology. A technology-driven capability that enables a value creation process, which is constituted by technology (resources/assets), people (and their skills), and the processes (and/or methodologies) that enable the former elements to be operationalised.	38
Value	Value is any measure of worth assigned to an outcome, such as reaching a goal, addressing a need, or achieving desired	22

	project outcomes that are beneficial to the affected or targeted stakeholders.	
Value Creation	The process of creating the sought value, such as increasing revenue, improving customer satisfaction, reducing cost, increasing efficiency, addressing stakeholder requirements, tapping into key trends, etc.	22
Value Capture	Value capture defines the end of the value creation process where the desired value is realised.	22
Value Offering	The products and/or services offered by the organisation that enable its continued existence. Value offerings also result from value creation efforts.	22
New Value Creation Initiative	An initiative aimed at creating some form of new value for the organisation and/or specific stakeholders that will presumably affect the organisation positively (i.e. the outcomes will be valued).	N/A
Strategic Alignment	The process of continually and strategically aligning (1) an organisation's external environment and its organisational strategy, (2) its organisational strategy and technology strategy, (3) its aligned strategies and its strategy execution, and (4) its strategy execution and the enabling value creation capabilities.	44
Dynamic Alignment	The capacity to adapt dynamically towards maintaining the desired strategic alignment	49
Systems Thinking	A school of thought which focuses on recognising the interconnections between the parts of a system and synthesising them into a unified view of the whole. Systems thinking, as a capability, aims to help better understand the underlying causes of complex behaviour in systems and their interactions, in order to better predict and adjust towards achieving more desirable outcomes	29

1. Background to the Research Study

A problem well stated is a problem half solved – John Dewey

1.1. Chapter Overview

Chapter 1 provides the background to the research study, followed by the problem statement that is focussed on and the corresponding research objectives and questions. An overview of the research study is then given before framing the research roadmap, contribitions and publication(s) that resulted from this research.

1.2. Research Background

1.2.1. The Complex and Dynamic Business and Technology Environment

The industrial landscape is becoming more complex and dynamic (Phaal et al., 2011), and both the business and the technology environments are changing at an ever-accelerating pace (Gius et al., 2018). This pace, which is driven by the pace of innovation and change, is expected to increase further in the 21st century (Phaal et al., 2001). The result is that the future will present higher levels of uncertainty, discontinuity, and complexity (Vojak and Chambers, 2004), with increasingly borderless and dynamic environments (Saritas and Oner, 2004). These conditions pose various challenges to the value creation initiatives of organisations, particularly when reinforced by disruptive technologies and innovations (Christensen, 1997; Christensen, 2006; Teece, 2007; Cheng et al., 2017) and new industrial revolutions (Schwab, 2016; Daemmrich, 2017) that impact the capabilities required for value creation.

The business environment alone is characterised by highly globalised economies, which results in a high degree of interdependence (Haris Aslam & Azhar, 2013) and competition between countries and organisations. Doing business becomes much more challenging due to the reinforced volatility of global economies and markets and shortened technology and innovation cycles. These and other trends, such as the increasing demand for individualised products and services, increase the complexity in value streams and value creation systems (Bauernhansl et al., 2014; Hirsch-Kreinsen & Weyer, 2014; Spath et al., 2013). Organisations

are also increasingly expected to create more kinds of value for a broader range of stakeholders to take social trends into account. The value requirements from stakeholders and customers is thus becoming increasingly complex and multi-dimensional. This extends beyond the actual value offering, but also to how the value is designed, developed, produced, implemented, maintained, and decommissioned. Failing to address the set multi-dimensional requirements in an organisation's value creation system results in a high risk of exposure to negative consequences. This forces more innovation, a greater emphasis on how value is created, and a need to align value creation efforts with external trends and requirements in order to address these challenges (Joyce and Paquin, 2016).

While the scale, dynamics, and complexity of the global marketplace is changing rapidly, so too are the magnitude and the speed of change in the technological environment (Amadi-Echendu et al., 2011). These technological changes are often disruptive, particularly when an emerging technology surpasses the performance of a prior dominant technology design (Schilling, 2013:59). Such disruptive technologies ultimately change how an industry competes and brings strategic challenges and risks to organisations (Christensen, 1997; Teece, 2007).

Disruptive technology typically introduces new competitive platforms, has the ability to initiate new markets, and changes organisations' technological competition status. This is generally achieved through the displacement of an incumbent technology or through the creation of a new capability where none had previously existed (Cheng et al., 2017). There is no organisation, industry, or government that is immune to the effects of technological disruption (Bicak, 2019). In fact, how an organisation uses advanced technology capabilities to create value and address external requirements has become the defining business challenge of our time (Bender et al., 2018).

1.2.2. The added Complexity and Dynamic Changes from the 4th Industrial Revolution (4IR)

When the impact of disruptive technological and innovative change is pronounced, the effects can manifest on multiple levels and lead to new eras in history. Such pronounced technological impacts, when rapid and profound changes occur that disturb the equilibrium, are known as

industrial revolutions and they often last for three or four decades (Daemmrich, 2017). Furthermore, these industrial and associated economic cycles are becoming shorter and so is the time between them due to the increasing rate of change of technology and innovation (Schumpeter, 1934; Amadi-Echendu et al., 2011; Ignat, 2017). During these periods of disruptive change technology (resources), manufacturing (processes), and employment (skills) change rapidly and in synchronicity. This makes industrial revolutions periods of profound change, because key innovations lead to new ways of doing things as new capabilities emerge, not just higher efficiencies or increased production at lower cost (Daemmrich, 2017).

According to recent articles, books, conferences, presentations by technology entrepreneurs, and particularly policy reports issued by the World Economic Forum, a Fourth Industrial Revolution (4IR) has started (Schwab, 2016; Rose, 2016). Regardless of whether the present historical moment is characterised by sufficient levels of rapid and disruptive technological and innovative changes to constitute a new industrial revolution, this time has been characterised by a high degree of anxiety about current disruptive changes that bring strategic challenges to organisations (Kurzweil, 2005; Kelly, 2016; Daemmrich, 2017) and especially to their enabling capabilities.

1.2.3. The Impact on Value Creation Systems and their Constituent Enablers: A Systemic Perspective on Capabilities

Current technological developments, both revolutionary and evolutionary, are causing industries and sectors to appear, disappear, and change; and those that remain experience a blurring or even disappearance of boundaries (White and Bruton, 2011:10; Schwieters, 2016; Atluri et al., 2017). A convergence of disciplines will further accelerate the disintegration of industry boundaries (Schwab, 2016), such that all industries seem to move toward becoming technology industries. As more technologies and industries converge, the role of technology capabilities in value creation systems is set to become more important and strategic. These do not necessarily have to result from radical technological innovations (nor from new entrants displacing incumbents) in order to be disruptive (White and Bruton, 2011:37), as innovations that are disruptive may come from various sources.

Such disruptions may change the constituent factors of capabilities, apart from technology resources, such as the underlying skills or processes or the business models that enable superior or novel value to be created and delivered by these capabilities (Christensen, 2006).

The continual effort to account for these systemic impacts on value creation systems can also be seen in various innovation management frameworks that build on the concept of innovation ecosystems to gain synergies between resources, people (skills), and processes by aligning with the broader external environment (Rabelo and Bernus, 2015; Du Plessis and Pretorius, 2017; Talmar *et al*., 2018; Robaczewska, Vanhaverbeke and Lorenz, 2019).

Figure 1 illustrates a system view of value creation in an organisation. In this view, an organisation is impacted by external requirements, and uses its capabilities (consisting of resources, people, and processes) to create value that is fed back to the environment. An organisation typically implements technology to create new value through a process of inputs, transformations, outputs, and feedback along the entire process (White and Bruton, 2011:15). It also involves the individuals, groups, and departments that form the organisation to enable its value creation efforts, representing a basic input-process-output (IPO) function (Walden et al., 2015:3).

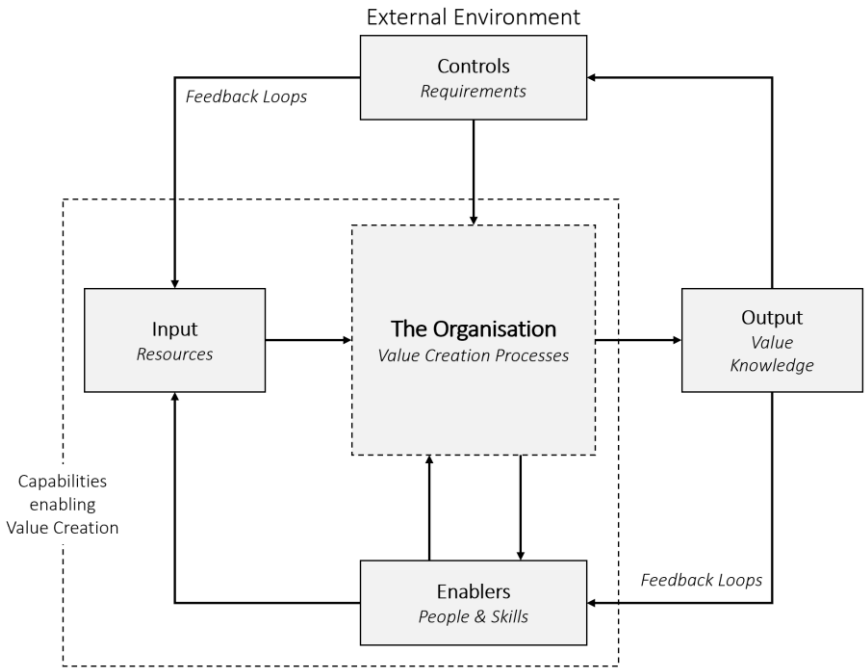


Figure 1: A systems view on value creation by an organisation, adapted from White and Bruton (2011:15) and Walden et al. (2015:3)

The survival and the competitiveness of organisations increasingly depend on whether their value creation systems' constituent capabilities are flexible, efficient, and adaptable (Bauer et al., 2014), allowing them to supply customised value propositions both flexibly and fast and at the lowest cost possible (Bauernhansl, 2014; Dais, 2014). This, in turn, needs to be driven by timely and dynamic adjustments in organisational and technology strategies to ensure that an alignment is achieved and maintained between the organisation's capabilities and the changes impacting its value creation requirements (Cheng et al., 2017).

1.2.4. The Resulting Challenges on the Strategic Management of Increasingly Technology-driven Capabilities

The result is not only increased challenges to organisational and technological strategy development and execution (Sahlman, 2010), but also increased complexity in the strategic alignment of increasingly technology-dependent value creation capabilities. Furthermore, the innovation (i.e., new value creation) systems in the 4IR are increasingly likely to integrate across different scientific and technical disciplines (Schwab, 2016; Daemmrich, 2017). This will require that many skill domains are incorporated into future value creation capabilities (Brabham, 2015). Managers of organisations are faced with difficult decisions about how best to allocate limited resources in the face of the increasing cost, complexity, and risk of technology investments (Phaal et al., 2001), and especially in terms of how to dynamically create and manage their capabilities to enable value creation in these dynamic business and technology environments (Teece et al., 1997; Inan and Bititci, 2015; Pisano, 2017).

These challenges are particularly hard to overcome for countries that face difficulty in developing and maintaining skills and capabilities (Shahid, 2001; Kruger, 2016). Developing and keeping skills is a particular challenge for South Africa considering the large numbers of skilled labour emigrating from the country over various periods of time (Crush, 2000; World Economic Situation and Prospects, 2014; Ferreira and Carbonatto, 2020). Therefore, creating the capabilities required to enable value creation efforts within the 4IR may pose a key challenge to organisations albeit not the only challenge.

Research Phase A of this study sought to gain improved understanding of the challenges faced by South African organisations to create technology-enabled value within the 4IR, and to identify and articulate what the main challenges are that should be focussed on in the subsequent phase.

1.2.5. The Main Challenge identified to the Strategic Management of Technology-enabled Capabilities

The outcome of Research Phase A was the articulation of the main challenge as 'the means to dynamically create and manage technology-enabled capabilities' (as per the definition within this study) 'to enable adaptive value creation systems within dynamic environments'. This corresponded with international research (Teece, Pisano & Shuen, 1997; Inan and Bititci, 2015; Pisano, 2017) and notes from interviewees that the same primary challenge (consisting of multiple facets) is present within the international parts of their global organisations.

This adaptation within dynamic environments is enabled by dynamic capabilities and achieved through 'strategic alignment', which is the process of continually and strategically aligning efforts across an organisation's value creation system hierarchies, including between (1) an organisation's strategy and its external environment, (2) this organisational strategy and its technology strategy, (3) its aligned strategies and their execution (toward value creation), and (4) its strategy execution and the enabling capabilities (Jacobs and Pretorius, 2020).

However, the literature on strategic alignment focusses on alignment between IT strategies and business/organisational strategies (Niederman, Brancheau, & Wetherbe, 1991; Chan & Reich, 2007; Luftman & Ben-Zvi, 2010; Reynolds and Yetton, 2015; Yeow et al., 2018). This has been true for the past two decades (Reynolds and Yetton, 2015) and as such presents a gap in the literature on strategic alignment within the 4IR, since the 4IR consists of digital-, physical-, and biological technology spheres (Schwab, 2016). Similarly, Industry 4.0 as the cyber-physical (IT and Operational Technology (OT)) portion of two of these spheres (Kagermann, Wahlster and Helbig, 2013; Lee, Kao and Yang, 2014; Lasi, Fettke and Kemper, 2014), requires a wider system focus than merely IT. With increasingly dynamic business and technology environments within the 4IR, increasingly shorter lifecycles and more frequent change

(Schwab, 2016), and faster strategic and operating model adaptation (Coltman, Tallon, Sharma, & Queiroz, 2015), strategic alignment may prove even more challenging and important in future.

1.3. Problem Statement

Organisations find it difficult to adapt their value creation systems dynamically, to account for dynamic changes in their environments and align their value offerings and the enabling systems and capabilities to these shifting requirements. The continual expansion of the 4IR will exacerbate these challenges. Consequently, an improved conceptualisation of strategic alignment between an organisation's value creation system hierarchies within the 4IR is needed, that would support a dynamic capabilities perspective on technology-enabled value creation efforts in increasingly dynamic environments (such as technology implementations and transformations towards yielding meaningful business value).

1.4. Research Objectives

The key objectives of the study include:

- Investigate the major challenges that organisations (with either product or service value propositions) face in order to strategically manage technology-enabled value creation efforts in the dynamic (Fourth Industrial Revolution (4IR)) landscape.
- Develop and test a model for the strategic management of technology-enabled value creation that could provide context to the complex system surrounding the required technology-enabled capabilities and strategic alignment to address these major challenges.

1.5. Research Questions

The key research questions aimed at addressing the research objectives are listed in Table 1. The sub-questions for Phase A are listed as (1.1) to (1.6). These served to help answer the main research question (1) of Phase A as described in Chapter 2.

Table 1: Research Questions

Phase	No.	Research Question
A	1	What are the major challenges that South African organisations face in their value creation efforts, enabled by emerging technologies, in the 4IR landscape?
A	1.1	How can a systems perspective assist in defining value creation efforts within organisations and what would such a framework look like?
A	1.2	How can the elements enabling value creation within a value creation system be conceptualised in relation to dynamic environments?
A	1.3	What hierarchies can be assigned to the value creation system of an organisation and how would these hierarchies synchronise within dynamic environments?
A	1.4	How central is the role of technology and innovation in value creation initiatives and how is this expected to change in the future?
A	1.5	Are current technology and innovation initiatives in South Africa focused on emerging technologies associated with the 4IR?
A	1.6	Are the major challenges to creating value through emerging technologies related to the ability to dynamically adapt an organisation's value creation system to align to dynamic changes in its environment?
A	1.7	How do these challenges differ between mature and emerging technologies and across industries in South Africa?
B	2	What elements* constitute a dynamic capabilities approach to strategic alignment?
B	3	How can these elements be conceptualised to support the strategic management of technology-enabled capabilities?
B	4	Are organisations that are more effective at strategic alignment, as conceptualised by the model, also more effective at value creation within dynamic environments?

See Section 3.4.1 for a definition of 'elements' from the systems view applied in this study.

1.6. Research study overview

This research was conducted in two phases (Phase A and Phase B) as part of a mixed method (Exploratory Sequential) research study. Phase A was a qualitative research phase which aimed to gain improved insight and understanding of the problem area (i.e. the major challenges faced in industry to create value in the 4IR landscape), in order to better clarify and articulate the problem statement. Phase B built on this articulation through a quantitative research phase which aimed to develop and test a conceptual model, that would help address the defined problem statement and test associated propositions.

1.7. Research Roadmap

The research roadmap for this study is shown in Figure 2 which summarises the two phases into ten chapters within this thesis. Chapter 1 provides the background to the entire research study while Chapter 2 describes the research design and methodology followed across both Phase A and B. Chapter 3, 4 and 5 then cover Phase A and Chapters 6 to 9 cover Phase B. The final chapter (Chapter 10) contains the collective conclusions and recommendations for the entire research study.

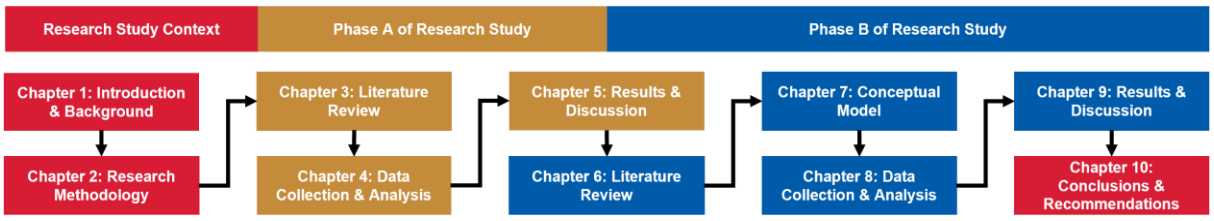


Figure 2: Research Roadmap

1.8. Research Contributions

This study takes a dynamic capability-based view of technology-enabled value creation in the dynamic and complex environment of the Fourth Industrial Revolution (4IR). The study identifies the major challenges faced by organisations in technology-driven value creation efforts, within dynamic environments such as the 4IR, as relating to the ability of organisations to dynamically adapt their capabilities to address dynamic changes in their environments and

markets towards maintaining strategic alignment between their internal value creation systems and between these systems and the external environment.

The study further proposes new frameworks for the systemic conceptualisation of capabilities, technology-enabled capabilities as well as for strategic alignment throughout at organisation's system hierarchies. Lastly, a conceptual model is proposed for the strategic management of technology-enabled capabilities, with a dynamic capabilities approach to strategically aligned value creation. This model serves to contribute to the research gap identified on strategic alignment within the context of the 4IR.

1.9. Research Publications

During the course of this research study, there was one publication and another in review. The published paper is listed in Table 2.

Table 2: List of Publications

No.	Publication title / draft title	Reference	Status
1	*The South African Journal of Industrial Engineering (SAJIE):* The Major Challenges facing Organisations to Create Technology-enabled Value in the Fourth Industrial Revolution: A Dynamic Capabilities Perspective in South Africa	Jacobs and Pretorius (2020)	Published
2	TBC		In review

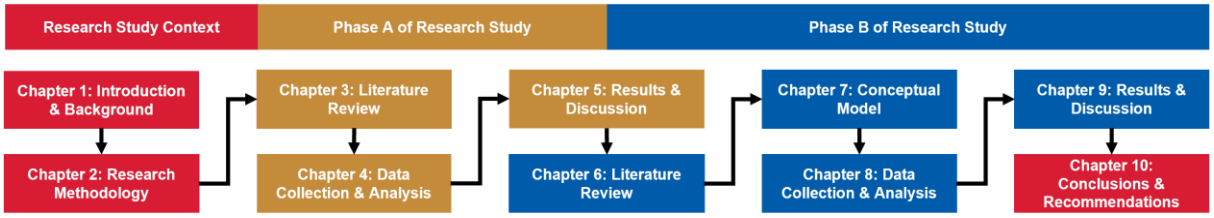
1.10. Chapter Conclusions

In conclusion, Chapter 1 discussed the research background that led to the identified need for this study, before providing the specific problem statement to be addressed. This was followed by the research objectives and research questions. Subsequently, the research study discussed the two research phases of this study before illustrating how the phases and chapters tie in together in the research roadmap. Lastly, the research contributions to the academic realm and the resulting publications were listed. The following chapter, Chapter 2, will cover Research Phase A.

2. Research Design and Methodology

Research is formalised curiosity. It is poking and prying with a purpose – Zora N. Hurston

2.1. Chapter Overview



Chapter 2 covers the research methodology of the study and details how the research was split in two parts, namely Phase A and Phase B.

2.2. Chapter Introduction

This chapter starts with the philosophy underpinning the research study, before discussing the research strategy and the mixed method approach followed. It then covers, for Phase A and B respectively, the research design and method utilised to define and answer the research questions listed. The chapter ends with an overview of the literature review protocol followed in both phases.

2.3. Research Philosophy

The research philosophy adopted in any research study contains important assumptions about the way the researcher views the world and what drives the research strategy deployed (Saunders, Lewis & Thornhill, 2009:109).

Tashakkori and Teddlie (1998:30) contend one should "study what interests you and is of value to you, study in the different ways in which you deem appropriate, and use the results in ways that can bring about positive consequences within your value system". For this reason, pragmatism is intuitively appealing as it argues that the most important determinant of the epistemology, ontology and axiology adopted is the research question. The framing of

research questions impact what is uncovered through the research and should therefore not suggest unambiguously that either a positivist or interpretivist philosophy is adopted. This supports the practical value of a mixed methods study to uncover what is deemed valuable (Saunders, Lewis & Thornhill, 2009:109).

The ontological approach (i.e. the concern of the nature of reality) in this study leans toward objectivism as management is deemed to largely be an objective entity. This objectivism is a result of formal structures within organisations, with operating procedures that need to be adhered to even though application would vary. While aspects of the structure in which management operates may differ, the essence of the function is considered very much the same across organisations of similar size (Saunders, Lewis & Thornhill, 2009:110).

The epistemological approach (i.e. the concern of what constitutes acceptable knowledge in a field of study) is that of critical realism. The philosophical stance taken is that there is a reality independent of the mind. However, our senses used to perceive reality may deceive us and thereby impact what constitutes reality for the observer, which may not be the same as the objective reality (Saunders, Lewis & Thornhill, 2009:114).

2.4. Research Strategy

With the focus stated on uncovering what is of interest through guiding research questions, it follows that the research questions should be clearly defined. Toward this end, the research strategy consists of a combination of strategies with the aim of gathering valid and reliable data to define concise research questions and then answer them both qualitatively and quantitatively.

'Qualitative methods' are generally a synonym for any data collection technique (often an interview) or data analysis procedure (often categorising data) that generates or uses non-numerical data (Saunders *et al*., 2009:151). 'Quantitative methods' are generally a synonym for any data collection (often a questionnaire) or data analysis process (e.g. graph or statistics) that generates or uses numerical data. (Saunders *et al*., 2009:151).

These data collection and analysis techniques may be a single technique (i.e. 'mono method'), or may consist of more than one technique (i.e. 'multiple methods') (Saunders *et al*., 2009:151). When multiple methods are used that are both qualitative and quantitative, the research method is called a 'mixed method' (Saunders *et al*., 2009:152). Mixed method research is "research in which the researcher uses the qualitative research paradigm for one phase of a research study and the quantitative research paradigm for another phase of the study" (Gunasekare, 2015:362).

Bryman (2006) conducted an examination of mixed method studies to determine the main reasons researchers gave for using this approach. Some of the main reasons included:

- Improves triangulation through the use of two or more independent sources of data or data collection methods.
- Improves facilitation of the research study as different methods may be used to aid the research process as necessary.
- Combining methods often allow dovetailing and the methods may compliment one another to fill in gaps.
- Generality may be improved by using independent data sources to contextualise the main study and then using quantitative analysis to provide sense and surety of their meaning.
- Enable the researcher to use an alternative method when the intitial method reveals unexplained results or insufficient data.

The mixed method applied in this study is 'sequential', where one data collection and analysis technique was followed by another that is different. Specifically, this study took an 'exploratory sequential' approach. In the first phase, a qualitative data collection and analysis technique was used to explore a topic. This assisted in formulating the final research question(s) and objectives after improved clarity was obtained about the problem and focus area (Saunders *et al*., 2009:318). This phase was then followed by a quantitative data collection and analysis technique to answer the defined research questions that were formulted with a much clearer understanding of the breadth and depth of the topic (Saunders *et al*., 2009:152).

Phase A of this study involved literature reviews and qualitative interviews with experts to gain unique insights and clarity on the challenges faced in industry to create value in the dynamic 4IR-influenced landscape. This phase identified the major challenges related to the value creation system of organisations. Concise research questions were subsequently developed for Phase B to uncover how these challenges are best addressed in organisations.

Phase B of this study involved a quantitative survey questionnaire to gather information on specific practices and perceived abilities in organisations. This phase focussed on validating hypotheses developed around correlations between the management practices and abilities within organisations.

2.5. Phase A Research Approach

The aim of this phase was to explore what the major challenges are to value creation efforts, that are enabled by technologies (and particularly emerging technologies) within dynamic environments such as the 4IR landscape. The objective was to assist in articulating a clear problem statement to focus on in Research Phase B. The major challenges, as uncovered from Phase A, are published by Jacobs and Pretorius (2020).

2.5.1. Research Design and Method

Exploratory research is useful when a problem is not yet clearly defined (Kotler et al., 2006). Such research is principally conducted through literature surveys, interviews with experts, or conducting focus group interviews. This approach is similar to that of an explorer or traveller seeking to gain insights, understanding and experiences. It is flexible to allow gradual and progressively narrower focus through an exploration process of various potential avenues (Saunders et al., 2009:140). The objective of this research approach is to provide improved insight and understanding of an observed phenomenon that would help to define the problem more clearly and to choose which problem to focus on. Exploratory research can then provide the why, when and how contexts of the observed phenomenon, although it typically lacks the means to quantify the results. These outcomes from the exploratory research then generally require further research (Kotler et al., 2006).

Phase A took an inductive research approach and was executed through an exploratory research design, using multiple data sources to improve triangulation (Tshuma, 2019). The data collection included available literature, conference publications, and structured expert interviews (Tshuma, 2019). The aim was to obtain improved insight into a problem area, in order to support the development of further research propositions that could then be tested (Saunders, Lewis & Thornhill, 2009:134) from a base of increased understanding in a subsequent research phase (Kotler et al., 2006).

The main research question for Phase A was:

- What are the major challenges that South African organisations face in their value creation efforts, enabled by emerging technologies, in the 4IR landscape?

However, before this research question could be answered, the context of the study first needed to be established. An initial and extensive literature survey (see Section 2.7 for the interative and systematic literature review protocol followed) assisted with this and enabled the development of three key sub-questions. These sub-questions guided the primary literature review of Phase A (see Chapter 3) toward creating the definitions and frameworks that set the context within which the main research question was asked. These questions, listed below, aimed to contextualise value creation efforts within organisations and how they are enabled:

1. How can a systems perspective assist in defining value creation efforts within organisations and what would such a framework look like?
2. How can the elements enabling value creation within a value creation system be conceptualised in relation to dynamic environments?
3. What hierarchies can be assigned to the value creation system of an organisation and how would these hierarchies synchronise within dynamic environments?

Following the outcomes and insights gained from Chapter 3 and working toward further unpacking the main research question of Phase A, another four key sub-questions were developed. These guided the subsequent qualitative data collection and analyses (as explained in Chapter 4) of this exploratory research phase. These questions follow the outcomes of the literature review and were focussed on improving understanding and confirming the literature's suggestions around key challenges to value creation efforts (also see Chapter 1 for research background). Focus was placed on those efforts that are driven by emerging technologies, within the dynamic business and technology environments that organisations operate in. The sub-questions (see Chapter 5) to further unpack and understand the challenges identified were:

4. How central is the role of technology and innovation in value creation initiatives and how is this expected to change in the future?
5. Are current technology and innovation initiatives in South Africa focused on emerging technologies associated with the 4IR?
6. Are the major challenges to creating value through emerging technologies related to the ability to dynamically adapt an organisation's value creation system to align to dynamic changes in its environment?
7. How do these challenges differ between mature and emerging technologies and across industries in South Africa?

2.6. Phase B Research Approach

Answering the research questions discussed above (see Chapters 3 to 5) framed the focus of the problem area for further investigation. The second phase of the research study (see Chapters 6 to 9) served to uncover correlations that impact the problem area.

2.6.1. Research Design & Method

Research Phase B built on the preceding exploratory research phase, i.e. the major challenges faced by organisations to create technology-enabled value in the 4IR landscape. This phase took a deductive research approach by building on developed theory in order to develop and

test operational hypotheses. It was executed through a descriptive research design using quantitative methods (using an online quantitative survey questionnaire for data collection) to provide a valid representation of the observed phenomena (Saunders, Lewis & Thornhill, 2009).

The main research questions for Phase B were:

- What elements constitute a dynamic capabilities approach to strategic alignment?
- How can these elements be conceptualised to support the strategic management of technology-enabled capabilities?
- Are organisations that are more effective at strategic alignment, as conceptualised by the model, also more effective at value creation within dynamic environments?

These questions are answered in Chapters 6 to 9.

2.7. Literature Review Protocol

Both research phases contained a systematic literature review. The protocol deployed was to perform scoping searches of the general topic to understand the topic broadly and uncover key themes that help inform initial research questions. These research questions guided the key words used in searching for publications. The sources utilised were as proposed by the university and then further expanded upon based on the list of applicable references within the publications.

The titles and abstracts of seemingly relevant publications were first screened for relevance to the research question. Publcations that were deemed irrelevant were discarded and those that were deemed relevant were further screened based on the introduction and conclusion sections. Depending on the topic, date ranges were also specified in the searches to filter for relevance. For example, in the fields of strategic management and technology management it was deemed useful to have a much broader date range to understand how the field has developed over time, while the topics of the 4IR and dynamic trends were focussed on five to ten year ranges depending on the number of publications found.

The full text of the publications considered as relevant were examined and the relevant data extracted in summary forms within tables and matrices. Once fifteen or more references were used for extraction, the summary data was compared, and contradictions highlighted and considered for removal. The collected summary was then further synthesied and worked into the dialogue as applicable for the focus of the literature review. The process was repeated as research questions were answered and new research questions formulated until the final versions presented earlier emerged from the exploratory phase.

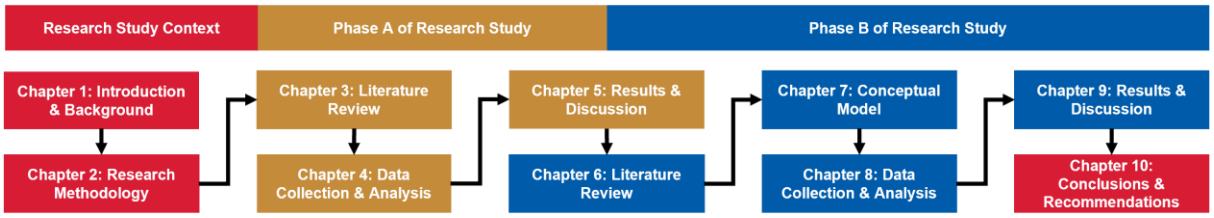
2.8. Chapter Conclusions

This chapter summarises the research methodology applied to yield the results in the subsequent chapters. The chronological development and answering of the research questions stated above will become clear as the reader reads through the following chapters.

3. Phase A: Literature Review

The best answers to the enormous problems we are struggling with always starts with asking the right question – Clayton Christensen

3.1. Chapter Overview



Chapter 3 initiates Research Phase A. The aim of this phase was to explore what the major challenges are to value creation efforts that are enabled by emerging technologies, toward articulating a clear problem statement to focus on in Research Phase B. The main research question for Phase A was:

- What are the major challenges that South African organisations face in their value creation efforts, enabled by emerging technologies, in the 4IR landscape?

Before this research question can be answered, the context of the study first needs to be established. Three key sub-questions guided the literature review of Research Phase A toward creating the definitions and frameworks that set the context within which the above research question is asked. These questions aimed to contextualise value creation efforts within organisations and how they are enabled:

1. How can a systems perspective assist in defining value creation efforts within organisations and what would such a framework look like?
2. How can the elements enabling value creation within a value creation system be conceptualised in relation to dynamic environments?
3. What hierarchies can be assigned to the value creation system of an organisation and how would these hierarchies synchronise within dynamic environments?

3.2. Chapter Introduction

This chapter contains the literature review of Phase A. The chapter first defines 'value' and 'value creation' within the context of this study. Following this, systems and systems thinking is explored toward highlighting the systemic perspective taken throughout the rest of the study. The role of capabilities and strategic alignment in value creation efforts is discussed next toward framing the dynamic capabilities perspective applied within the study. The literature study ends by considering what activities and processes constitute strategic alignment through a dynamic capabilities approach. The relationship between these literature components is conceptualised in Figure 3 which uses Figure 1 from the research background in Chapter 1 on the dynamic 4IR environment as context. The development of Figure 1 is covered under the 'systems' section.

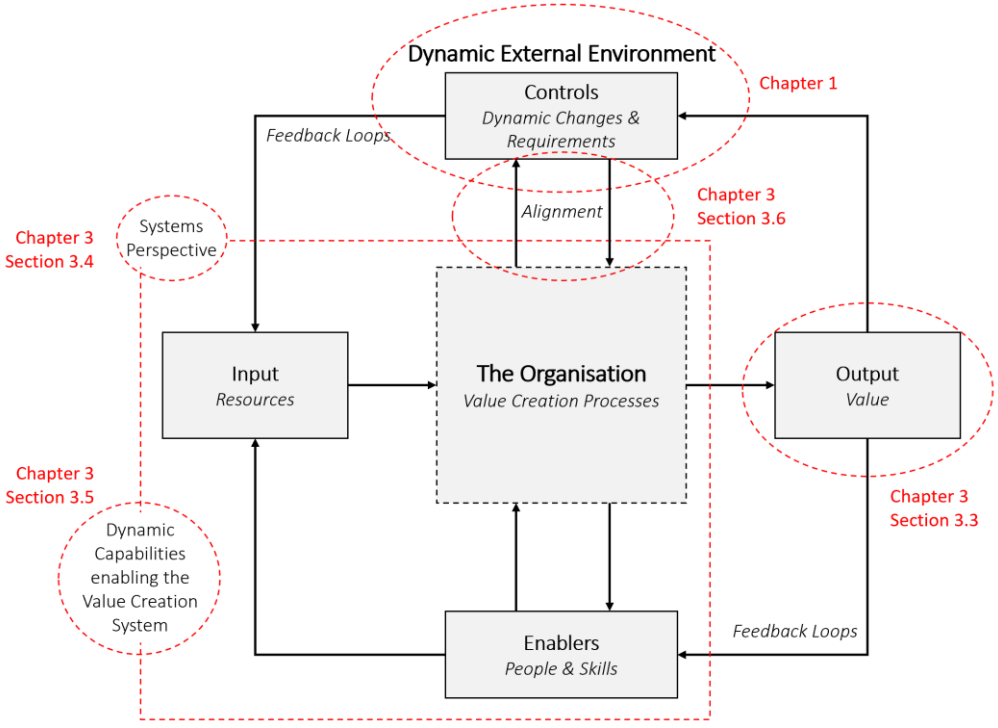


Figure 3: Conceptualisation of the relationship between the literature components within Chapter 2 and the research questions

3.3. Value and Value Creation

The concept of 'value' has been a subject of debate for at least two thousand years (Haksever et al., 2004). In modern times, humans largely use and interact with formal and informal organisations to obtain or enable the value they seek through products and services (i.e. the value offering of organisations). The purpose of an organisation may, therefore, be defined as the need to create, offer and in return capture value to ensure its continued existence (Ansoff, 1979; Haksever et al., 2004).

In this organisational sense, 'value' is defined as any measure of worth assigned to an outcome, such as reaching a goal, solving a problem, or addressing a need, that is beneficial to the affected or targeted stakeholders – including but not limited to customers (Baier, 1969:40; Haksever et al., 2004; Walden et al., 2015).

It follows that 'value creation' is the process of creating and ultimately capturing the sought value, such as increasing revenue, improving customer satisfaction, making improvements to existing value offerings, creating new value offerings, reducing cost, increasing efficiency, addressing stakeholder requirements, tapping into key trends, etc. (Sahlman, 2010; White and Bruton, 2011). 'Value capture' defines the end of the value creation process where the desired value is realised (Ansoff, 1979; Haksever et al., 2004; Sahlman, 2010).

3.4. Systems, Systems Thinking, and the Perspective on Value Creation in an Organisation

While this study does not focus on any systems' theories, it takes a systems perspective to unpack the major challenges faced to value creation efforts within the 4IR as well as in framing the various concepts, definitions and models presented within this thesis. The purpose of this section is, therefore, to describe the lense through which the rest of the study developed.

3.4.1. Systems and Related Definitions and Concepts

The International Council on Systems Engineering (INCOSE) defines a 'system' as "an integrated set of elements, subsystems, or assemblies that accomplish a defined objective. These elements include products (hardware, software, firmware), processes, people,

information, techniques, facilities, services, and other support elements". ISO/IEC/IEEE 15288 defines a system as a "combination of interacting elements organised to achieve one or more stated purposes" (Walden *et al*., 2015:5).

A system is a construct or collection of different elements that together produce results not obtainable by the elements alone. These bounded and interrelated elements represent the system within the context of a paradigm (Phaal, Farrukh & Probert, 2001; Cloutier *et al*., 2008). Where a paradigm in this context describes the established assumptions and conventions that underpin a particular perspective on a management issue (Phaal, Farrukh & Probert, 2001).

According to Walden *et al*. (2015:7), these system elements may be systems (typically called sub-systems) of their own, with their own subordinate system elements, or they may be atomic (meaning they may not be decomposed further). It is the integration of the system elements that establish the relationship between the effects that organising the elements has on their interactions and how these effects then enable the system to achieve its purpose. Grouping the subsets of elements within a system produces a 'system hierarchy', which can be used to represent the system through a partitioning relation, as shown in the example in Figure 4.

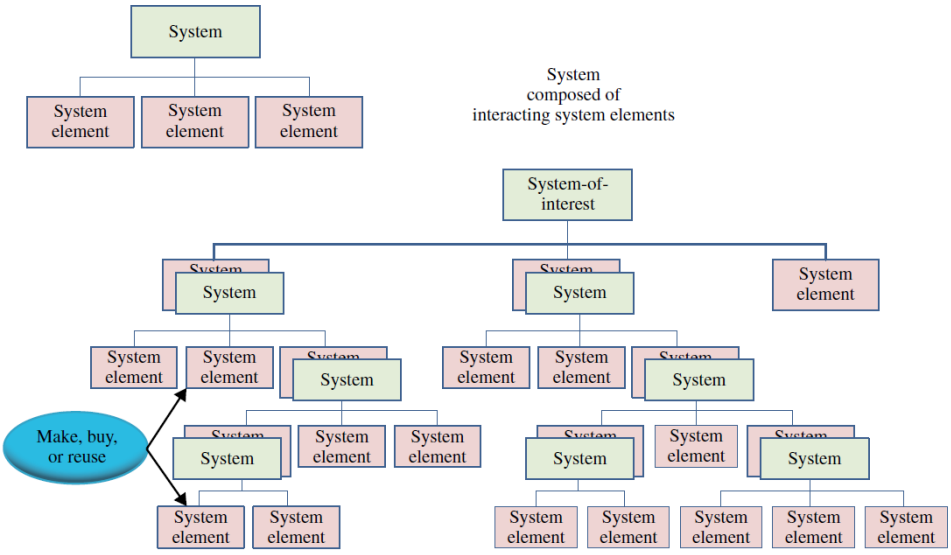


Figure 4: Representation of the hierarchy within a system (taken from Walden *et al*., 2015:7)

When systems are particularly large, and when a system of interest (SOI) has its elements as managerially and/or operationally independent systems, they are called a "system of systems" (SoS). See an example of an SoS in Figure 5. SoSs usually achieve results that are unachievable by the individual systems alone (Walden *et al*., 2015:8).

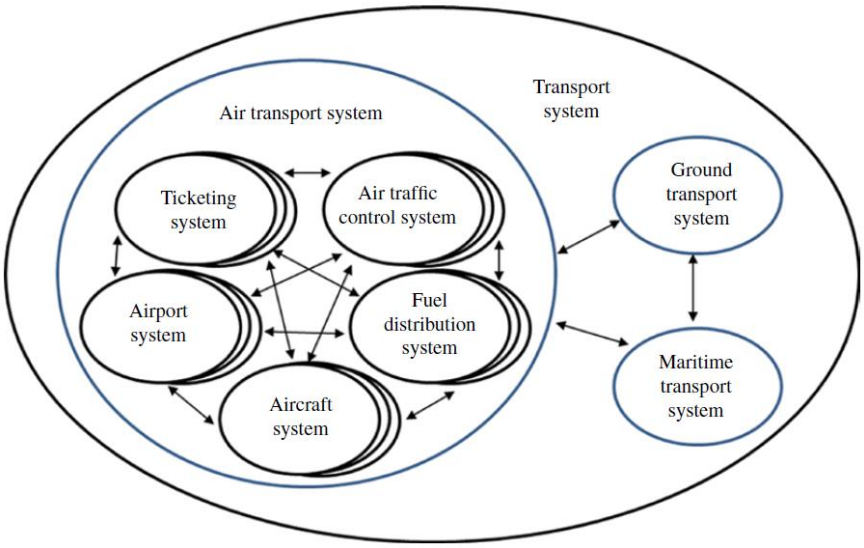


Figure 5: System of Systems (SoS) Example through a Transport SoS (Walden *et al*., 2015:8)

A system is thereby bounded by a "line of demarcation" between the SOI and its constituent elements and its greater context. However, its boundary may cause it to be isolated or permeable depending on the system (e.g. a toaster versus a city). The system's boundary affects its interaction with other elements outside of its boundary. These external elements may collectively be called the operating environment, context, or user environment. The functionality of the SOI is then typically expressed in terms of its interaction with the external environment, particularly with its users for man-made systems (Walden *et al*., 2015:6).

Systems can be either naturally occurring or man-made. Man-made systems, as considered in ISO/IEC/IEEE 15288 are created and utilised to provide products or services in defined environments for the benefit of users and other stakeholders (Walden *et al*., 2015:5). Or in other words, those systems that are created and utilised to create value within defined environments for defined stakeholders (including customers or users).

According to Walden *et al*. (2015:6), these man-made systems are engineered by humans, where engineering can be regarded as "the practice of creating and sustaining services, systems, devices, machines, structures, processes, and products to improve the quality of life by getting things done *effectively* and *efficiently*". 'Systems engineering' (SE), as defined by INCOSE, is "an interdisciplinary approach and means to enable the realisation of successful systems. It focusses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem: operations, costs and schedule, performance, training and support, test, manufacturing, and disposal. SE consider both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs" (Walden *et al*., 2015).

Comprehensive feedback mechanisms may be found in cybernetics theory, where links have previously been established to management theories (De Wet, 1995). However, on a more basic level the dynamics of a system may be illustrated in terms of their lifecycle processes that represent some form of input-process-output (IPO) function, as shown in Figure 6. This IPO approach is one way that systems and systems engineering processes may be performed and represented (Walden et al., 2015:3) even though not necessarily the optimal way.

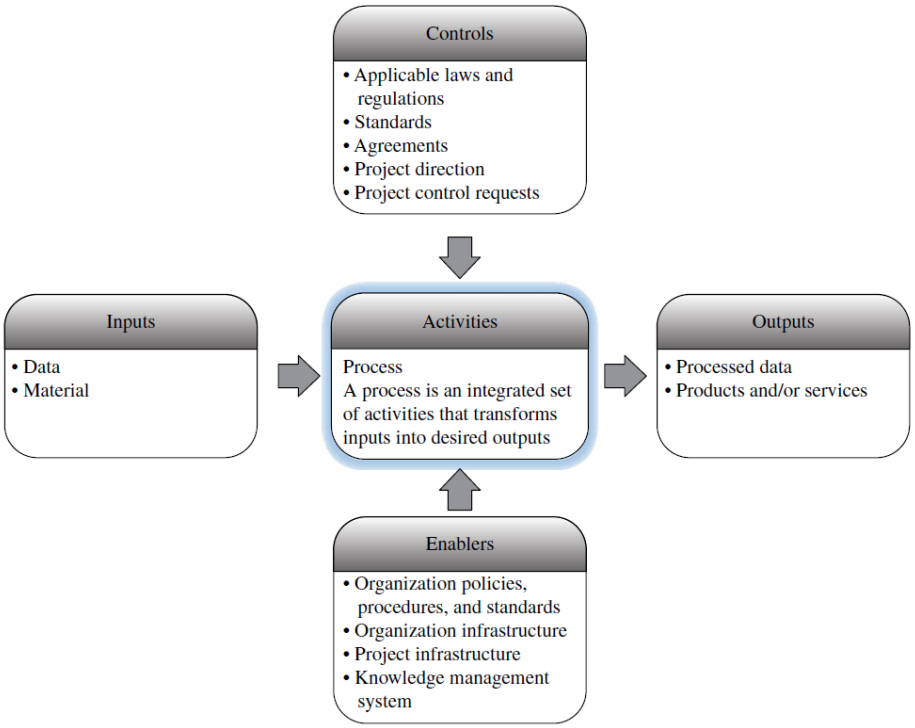


Figure 6: IPO Framework Example (Walden *et al.*, 2015:3)

An organisation can then be generically represented as an IPO system, as shown in Figure 7.

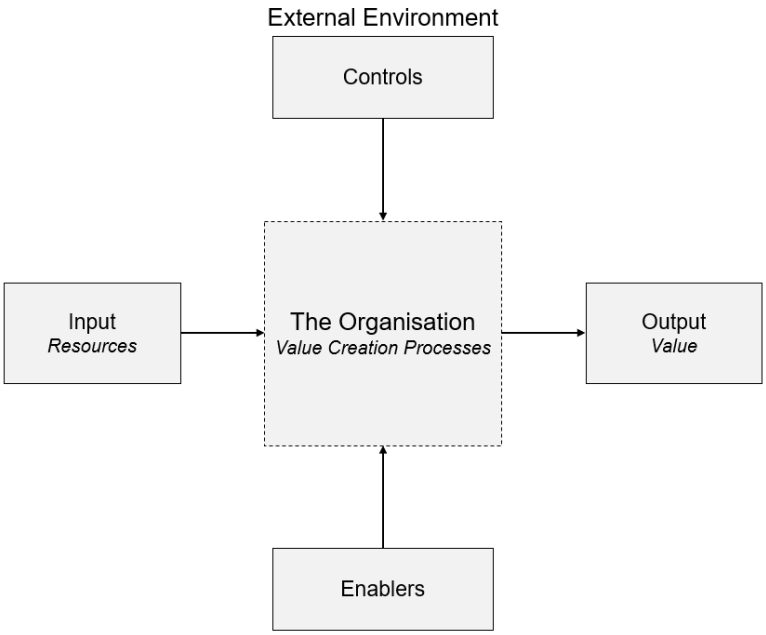


Figure 7: System IPO Framework of an Organisation, adapted from Walden *et al.* (2015:3)

Note that the organisational boundary is indicated as a dotted line to show that it is not a closed system, but instead it is influenced by and responds to the external environment. The external environment (e.g. trends in the market, society, technology, etc.) places requirements on the types of value (output) it wants from the organisational system. This in turn affects the value creation processes and systems within the organisational system that are involved in creating value for the external environment (i.e. the customers and other key stakeholders). New value, for example, would typically place a greater focus on innovation processes and innovation enabling systems.

White and Bruton (2011:15) provide more detail as to how a systems view presents the organisation as an association of interrelated and interdependent parts (or elements), as shown in Figure 8. They further discuss such a systems approach in the context of implementing technology to create new value as involving a framework of inputs, transformations, outputs, and feedback along the entire process. It also involves individuals, groups, and departments that form the organisation and the external environment that impacts the organisation (White and Bruton, 2011:15).

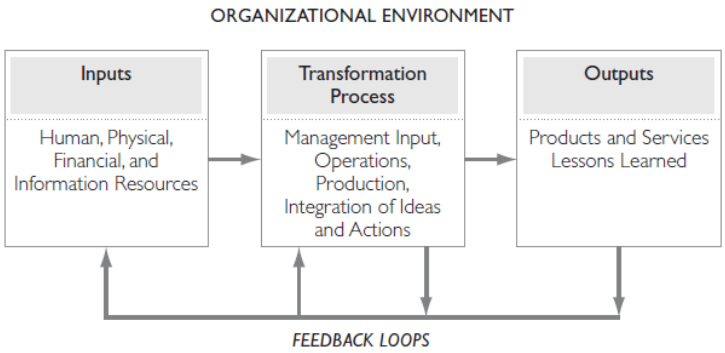


Figure 8: Systems view of organisations (White and Bruton, 2011:15)

Figure 8 can then be combined with Figure 7 to develop Figure 9 as a more comprehensive framework to represent a systems view of an organisation. Within this framework, the resource inputs from the external environment may include material, consumables, financial resources and other types of resources necessary for the creation of the desired value output. These resources are utilised by the value creation processes within the organisational system in order to develop the value that is fed back to the external environment (customers, key

stakeholders, etc.). Knowledge also results from the learning that takes place during this process which should again be fed back into the skills and processes that enable the organisation's value creation.

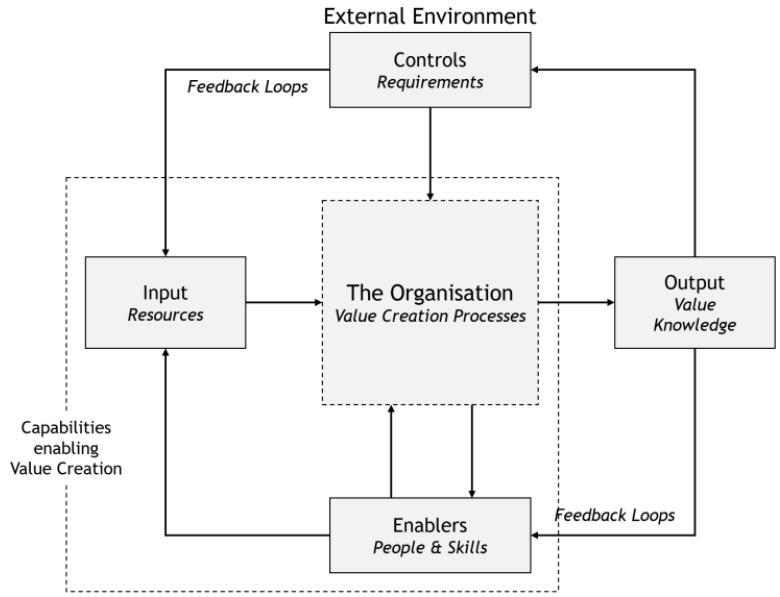


Figure 9: Systems View Framework of an Organisation, adapted from White and Bruton (2011:15) and Walden *et al*. (2015:3)

The feedback loops indicate a bi-directional exchange between the organisation and its enablers. The external environment also influences the available resource inputs, indicating that the value output may influence the input that is received. This highlights a system view of the exchange that may affect the sustainability of the organisation, e.g. if the value output meets the needs of key stakeholders, they may be inclined to support a positive feedback loop that provides resources in return.

3.4.2. Systems Thinking and its Role in Value Creation

Mattessich (1982) originally described 'systems thinking' as being "first and foremost a point of view and a methodology arising out of this viewpoint". For McCarthy (2003) it is an established body of knowledge that seeks to understand how entities (social, technical, economic, biological, etc.) function. As a discipline, systems thinking is more than a collection of tools and methods as it is also an underlying philosophy (Goodman, 2018). However, the

term “systems thinking” can mean different things to different people (Walden *et al.*, 2015:18; Goodman, 2018).

For Lannon (2018), systems thinking is “a school of thought which focuses on recognising the interconnections between the parts of a system and synthesising them into a unified view of the whole”. Goodman (2018) describes it as also being a “diagnostic tool”. In perhaps a more generalised manner, Arnold and Wade (2015) derived a cross-disciplinary definition from the literature on systems thinking and proposed that it is “a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects. These skills work together as a system.”

It is greatly beneficial to develop knowledge and skills (and the capability) that can be utilised in performing a deep analysis of problem or opportunity situations for which system responses are required (Walden *et al.*, 2015:18). Systems thinking, as a capability, aims to help better understand the underlying causes of complex behaviour in systems and their interactions, in order to better predict and adjust towards achieving more desirable outcomes (Arnold and Wade, 2015).

Purdehnad, Wexler and Wilson (2018) state that systems thinking is evolving as an alternative to the reductionism paradigm of thinking, which is the belief that everything can be reduced to individual parts and that analysis (i.e. gaining knowledge of the system) can be done by simply understanding its parts (i.e. the elements). Instead, systems thinking is a lens through which to view the world with an expansionism paradigm (i.e. the belief that a system is always a sub-system of some larger system). It thereby uses synthesis instead of analysis to explain the role within the larger system it forms part of. Purdehnad, Wexler and Wilson (2018) further refers to Russell Ackoff who stated that “analysis is useful for revealing how a system works, but synthesis reveals why a system works the way it does”.

Many methodologies are derived from the systems thinking worldview, a few examples include interactive planning, soft systems thinking, and system dynamics. Regardless of the

approach, the essence of systems thinking resides in the concept of 'systemic wholeness', which is the attempt to look at the whole instead of the parts/elements. Failing to consider the systemic properties, as derived from the interaction of the elements, often leads to sub-optimisation of the performance of the whole (Purdehnad, Wexler and Wilson, 2018). Meaning, not taking a systemic approach may result in reduced value creation. Therefore, in an increasingly complex, globalised, and system of systems future, it can be said that systems thinking is becoming an increasingly important capability (Arnold and Wade, 2015).

3.4.3. Emergence, Complexity, Dynamics, and Adaptive System Behaviour

The system's 'state' can then be expressed in terms of the values assigned to its attributes and how steady or constant they remain over a period of time. An 'attribute' of a system or element in the system is an observable characteristic or property, e.g. the speed of an aircraft. Attributes are represented by 'variables', which is a symbol or name that identifies the attribute. Variables are not necessarily measurable; however, a 'measurement' is the outcome of a process in which the system of interest interacts with an observation system under specified conditions. The outcome of the measurement is the assignment of a 'value' to a variable (Walden *et al*., 2015:6).

'Dynamic behaviour' of a system is the evolution of the system state over time. Whereas the 'system life cycle' is the evolution of the system of interest from inception to retirement. 'Emergent behaviour' is the behaviour of the system that cannot be understood exclusively in terms of the behaviour of the individual system elements (Walden *et al*., 2015).

According to Bondar *et al.* (2017), emergent behaviour is the behaviour of a system that does not depend on its individual elements, but instead depends on their relationships to one another. "Emergence is when some totally new phenomenon emerges out of the collective behaviour of much simpler parts where the individual simpler parts are responding through simple rules to their local environment". Such behaviour can be seen in biological systems and physical systems. It is also an inherent nature of a SoS, where the emergent behaviour is characteristics (or attributes) that arise from the cumulative actions and interactions of the

constituents of a SoS. In emergence, there is no simple way to relate the functions of the elements to the functions of the whole (Bondar *et al.*, 2017).

Bondar *et al.* (2017) further argues that the indirect and hidden influences of SoSs are not present in single systems, and that these are the primary mechanisms behind emergent behaviour. This makes the traditional hierarchical functional decomposition no longer valid due to the non-linear characteristics of emergent behaviour. However, since the emergent behaviour is non-existent in each component system, the hierarchical functional decomposition is still applicable to the component system level. Understanding and harnessing these emergent behaviour effects is important for successfully interfacing with systems to create value (Bondar *et al.*, 2017).

According to McCarthy (2003) complex systems theory (also sometimes called complexity theory or complexity science) is a branch of systems thinking. Complex systems theory has similar theoretical and applied motivations to that of other systems concepts, "in that they all seek to model and understand the behaviour of systems". However, the distinctive stance taken by complex systems theory is that it is concerned with systems that exhibit (McCarthy, 2003):

1. "A configuration made up of a large number of elements;
2. Significant interactions among these elements;
3. Organisation in the system."

These three system features generate three highly related characteristics of a complex system, namely non-linearity, emergence, and self-organisation. From this it may be noted that complex systems theory acknowledges that certain systems learn and evolve, and that they cannot be fully described by a single rule. It is, therefore, "a theory that seeks to understand how the system elements and interactions self-organise to create new configurations" (McCarthy, 2003).

There is a rapid growth in complex systems in the world. This is largely driven by increased interconnectedness and globalisation that increasingly adds complexity to technical and social

systems and the way in which systems interact. International trade ties economies together in powerful and complex feedback loops and changing elements, such as policy changes, have difficult to predict consequences on various systems. Technological advancement in particular creates new and increasingly complex systems, which seem to increasingly be interdependent on other systems (Arnold and Wade, 2015).

In this new technology era, heralded in by the Fourth Industrial Revolution (4IR), technology systems, social systems, economic systems and other systems will likely increase in complexity. Advances in technology, for example in networked communications, digitisation and the Internet of Things (IoT) (which is the expanding system of interrelated and interconnected computing and sensory devices across the Internet), combined with human-machine interfaces to enhance technology-enabled human capabilities, will require reliable interoperability between systems in SoS environments (Bondar *et al.*, 2017). These global grids and other complex systems will also likely display increasingly emergent, self-organising and complex adaptive behaviour, especially as smart-technologies and smart-systems become more prominent. This will make it increasingly important to take a systems approach and to apply systems thinking to value creation through technology-driven systems that interface with other systems both within and outside of the organisation.

According to McCarthy (2003), the term “complex adaptive system” refers to systems that are complex, but where the active elements that constitute the system are referred to as ‘autonomous agents’. In organisations, such agents would be the decision-making entities, for example the operators, control systems, managers, designers, etc. These agents “receive and process local information to create the events, outputs and internal dynamics of the system”. The behaviour of an agent is influenced by goal driven operating rules, which are called ‘schemata’.

Organisations have schemata (e.g. strategies and plans) for various issues (e.g. what products and services to provide, what technology to use, how to design and manage production facilities, etc.). This is different from biological systems that ‘blindly’ changes over time. However, organisations still display complex adaptive system behaviour as “the ability to

consciously alter its system configuration and influence its current and future survival" (McCarthy, 2003).

McCarthy (2003) argues that technology management and strategic technology management face complex adaptive systems challenges that revolve around emerging and non-linear trends (e.g. information and knowledge growth, globalisation of technology, accelerating rate of diffusion, etc.). "If an entity (technological, social, or economic) evolves, then a complex adaptive systems approach provides a framework to study the evolutionary and systems processes."

3.5. A Dynamic Capabilties Perspective on Value Creation Systems

With the described system perspective, a systems view will further be applied to defining 'capabilities' and 'dynamic capabilities' and their role in dynamic value creation systems.

3.5.1. Capabilities and their Role in Value Creation

A 'capability', in the simplest sense, implies "the ability to do something" (Teece, 2014), such as to make a decision or take an action toward achieving an objective. An 'ability', in turn, can be described as being constituted by the skills of a person as its basic building blocks (Romanowska, 2001). Capabilities are also constituted by activities, which may be strategic or operational (Teece, 2014). However, in order for the performance of an activity to constitute a capability, the capability must have reached some threshold level of practised or routine activity (Cetindamar et al., 2009), i.e., became embedded in processes. This corresponds with Winter's (2003) sentiment that a capability is a collection of routines that enable an organisation to perform some activity on a consistent (repeatable) basis, where 'routine' refers to a "repetitive pattern of activity" (Cetindamar et al., 2009), i.e., processes or procedures.

In the organisational context, capabilities relate to how an organisation can harness and organise the skills of people in the context of its available facilities, infrastructure, equipment, or tools through appropriate organisation in order to achieve certain objectives

(Romanowska, 2001). Helfat (1997) suggested that organisational capabilities allow organisations to create new products and processes and respond to changing market circumstances. O'Regan and Ghobadian (2004) further elaborate that an organisational capability is the ability to perform a coordinated task by using organisational resources, for the purpose of achieving a particular end result. Consequently, 'organisational capabilities' can be defined as an organisation's capacity to deploy its tangible or intangible resources in order to perform a task or activity or improve performance (Inan and Bititci, 2015), i.e., to create some form of value.

Grouping these elements and structuring them in a framework yields the 'Organisational Capability Framework' shown in Figure 10. As per this framework, from a systems perspective, capabilities are an emergent property from the interaction of the following elements (Romanowska, 2001, Winter, 2003, Cetindamar et al., 2009, Teece, 2014, Inan and Bititci, 2015):

- The 'resources' that enable the desired outcomes, such as the organisation's facilities, infrastructure, equipment, physical tools, finances and other assets.
- The 'people' that utilise or interact with those resources and assets for a specific purpose, including their skills, abilities, expertise and tacit knowledge.
- The 'processes' that organise the execution of the activities, through decision-making and action, that enable the interaction between these elements to realise the desired outcomes. These are often captured in various routines, procedures, intellectual tools, methods, models and explicit knowledge.

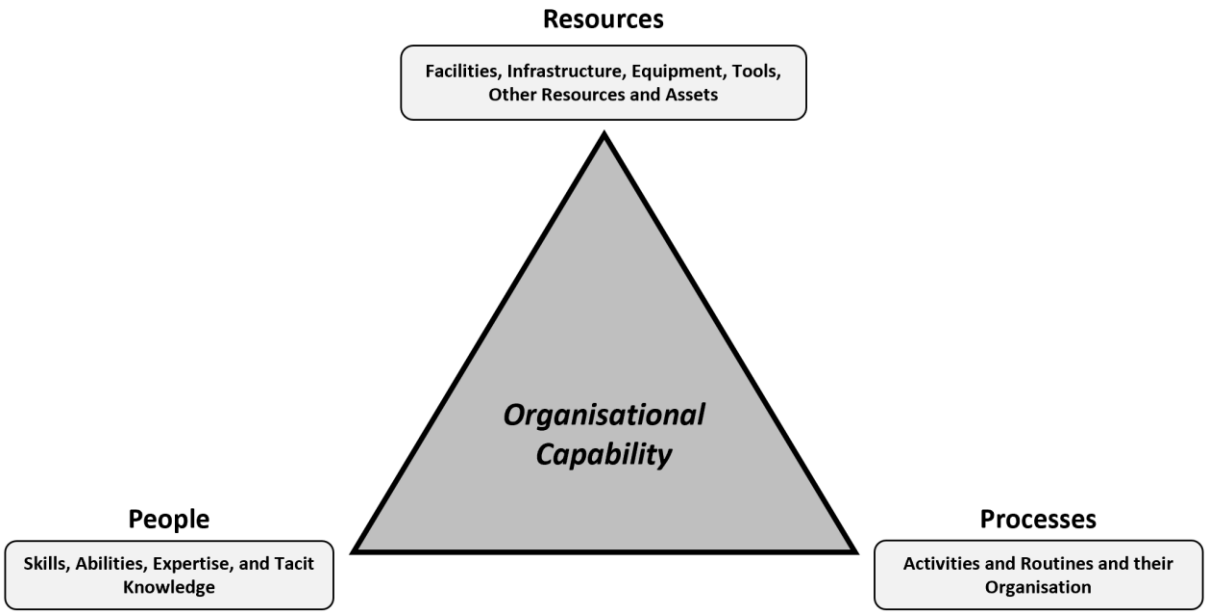


Figure 10: Organisational capability framework, adapted from Romanowska (2001), Winter (2003), Cetindamar et al. (2009), Teece (2014), and Inan and Bititci (2015)

3.5.2. Competencies, Core Competencies, and their Relationship to Capabilities

Romanowska (2001) refers to Davey (1998), who defined 'competencies' as the combination of various capabilities that are linked through processes. Processes are therefore also an element that links various capabilities to achieve a specific purpose. Competencies describe how an organisation collectively integrates and manages its key capabilities, including the constituent resources and people (abilities and skills), through processes, to unlock some form of specialised expertise. This harmonious integration may include, for example, those capabilities necessary for managing the market interface, building and managing an effective infrastructure, and technology capabilities to create and capture value (Schilling, 2013:118).

Schilling (2013:117) agrees that capabilities contribute to a competency, and further defines a 'core competency' as the "harmonised combination of multiple resources and skills that distinguish an organisation in its marketplace". Schilling adds that core competencies distinguish an organisation strategically. Similarly, Prahalad and Hamel (1990) define a core competency as the bundle of skills and technologies that enables a company to provide a particular perceived benefit (value) to customers, which cannot easily be imitated. Therefore,

core competencies draw on and integrate competencies and capabilities that are distributed across the organisation (Romanowska, 2001). This includes and depends on the management of relationships and knowledge across different functions and business units, and often also across the supply chain (Schilling, 2013:118).

Javidan (1998) provided a framework for the hierarchy of how organisational resources, capabilities, competencies, and core competencies relate to one another. This framework, shown in Figure 3, also indicates how value increases higher up the hierarchy, along with the difficulty of obtaining each level in the hierarchy.

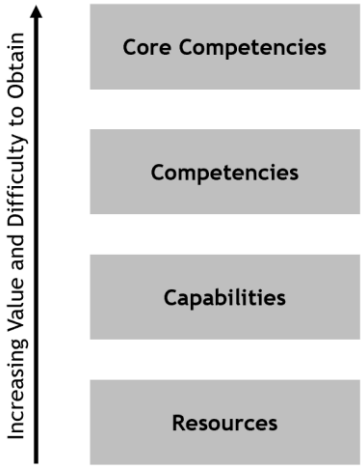


Figure 11: Competencies hierarchy framework, adapted from Javidan (1998)

It follows that capabilities can also be defined as the means or ability to create value, whereas competencies may be defined as unique capabilities that may be leveraged to create unique and difficult-to-imitate value; and core competencies are those competencies that form the core of an organisation's competitiveness in its value creation system and that affect its sustainability. It is therefore preferable to develop competencies and core competencies from capabilities in competitive environments. However, since capabilities form the foundation of value creation (however distinctive) across different types of organisation, they are proposed as the unit of analysis, particularly since capabilities also provide the means to adapt to changing circumstances, while competencies may 'lock' organisations into certain path dependencies (where the organisation can go).

3.5.3. Innovation, Innovation Capability, and its Role in Enabling Value Creation

Christensen (2019) defines 'innovation' as a "change process by which an organisation transforms labour, capital, materials, or information into products and services of greater value". This definition indicates that capabilities realise value through a process of change, i.e., innovation is not part of the ordinary. Innovation can also be defined as doing something new (i.e., a product, process, or service) that is of value. This newness in value is not limited to the world or market, and can include newness to an organisation (Hobday, 2005).

Schilling (2013:18) defines innovation more broadly as "the practical implementation of an idea into a new device or process". White and Bruton (2011:19) state that innovation is simply defined by some as "invention plus exploitation". However, they themselves believe innovation is more encompassing, and also includes the process of developing and implementing the invention. These authors (White and Bruton, 2011) refer to the definition of Rubenstein, where innovation is "the process whereby new and improved products, processes, materials, and services are developed and transferred to a plant and/or market where they are appropriate". There can thus be newness of the product or process, newness of the usage, or a combination of both.

From this, innovation is defined as the process whereby new value is created and captured. 'Innovation capability' can then be simply defined as the capability to innovate, where innovation capability enables the resulting innovation, which leads to the desired new value creation for the organisation. Innovation capability is necessary in order to create new value in response to the dynamic challenges and processes of change faced by organisations. These changes and challenges may result from changing requirements and impacts from customers, stakeholders, and competitors, and require different responses. Therefore, innovation capability enables the pursuit of ever-changing strategies to ensure the survival and growth of the organisation in its dynamic environment, by adapting the organisation's value offering and how it is created, in order to maintain its alignment with its environment.

3.5.4. Technology, Technology-enabled Capability, and its Role in Enabling Value Creation

Burgelman, Maidique & Wheelwright (2001:4) defined technology by saying that "technology refers to theoretical and practical knowledge, skills and artefacts that can be used to develop products and services as well as their production and delivery systems". Technology can be embodied in "people, materials, cognitive and physical processes, plants, equipment, and tools".

White and Bruton (2011:15) defined technology as "the practical implementation of learning and knowledge by individuals and organisations to aid human endeavour. Technology is the knowledge, products, processes, tools, and systems used in the creation of goods or in the provision of services". Or, in the context of this study, the latter part can simply be replaced with '…used in the creation of value'. This definition has a strong systems view of what 'technology' is and does.

Various definitions imply that there is a process involved in technology, that change is an outcome of technology, and that technology involves a systematic approach to delivering the desired outcomes (improvements, objectives, and outputs), i.e., value (White and Bruton, 2011:15). Technology is also described as an enabler to satisfy market needs (Mahmood et al., 2013) and as a key driver of innovation and sustainable business growth (Phaal et al., 2001). In fact, technological innovation has become the most prominent driver and enabler of improved competitiveness in response to competitive challenges (Lahovnik and Breznik, 2013; Schilling, 2013:1).

Technology plays a significant role in (and is a major source of) productivity, innovations, business model development, economic growth, and wealth generation in the socio-economic environment in various value creation systems (Sahlman, 2010; Mahmood et al., 2013). Technology can be seen as the enabler and key driver of value creation in the context of enabling innovation (exploring new possibilities), exploiting existing certainties (capabilities and competencies), or addressing specific challenges (shifting stakeholder requirements, or new business objectives for improved operational excellence, increased revenue, reduced costs, improved efficiency, etc.) (Phaal et al., 2001; McCarthy, 2003; Sahlman, 2010;

Mahmood et al., 2013). This may be interpreted to mean that technology and technological innovation exist to add value to an organisation and/or to society (White and Bruton, 2011:13).

However, more than technology enablers (e.g., components, equipment, hardware, or software) is necessary to create value. What organisations need is 'technology capabilities' to address needs in line with value creation initiatives (Cetindamar et al., 2009). Information Technology (IT) and Information Systems (IS) scholars have coined the term 'IT-enabled capabilities' to express an organisation's proficiency in exploiting its IT resources, competences and capabilities (El Sawy & Pavlou, 2008). However, IT-enabled capabilities are generally only conceptualised as an aggregation of IT resources and skills (Wade and Hulland, 2004). This lacks the process element required to organise efforts towards enabling the pursuit of goals.

Considering the definition of a capability, the term a 'technology-enabled capability' is defined here as the ability to do something through technology, e.g., making decisions or taking actions, that are enabled by technology, to achieve an objective. This may include or overlap with innovation capability, where the focus is on technological innovation or creating some new value enabled by technology.

Technology-enabled capabilities constitute more than the physical or digital technological resource. It also contains the knowledge (know-why, know-what, know-how) of an organisation to support its reason for existing, which relates to both the science and engineering aspects and to the process and management aspects (Phaal et al., 2004; Desouza, 2005, Du Toit, 2007). This technological knowledge comprises both explicit (i.e. artefacts such as tools, procedures, and guidelines) and tacit (such as abilities, training, and experience) knowledge (Phaal et al., 2001). Technology-enabled capabilities also consists of the people and their skills that realise the technology-enabled capabilities when they bring the necessary technological resources and knowledge aspects together (Du Toit, 2007). Considering the perspective of the Organisation Capability Framework, technology-enabled capabilities

further require the addition of a process element as shown in the Technology-enabled Capability Framework (Figure 12).

From this perspective, people (using their skills and abilities) interact with technology resources through various processes that enable a given value creating effort. This framework resembles and relates to the often-cited People-Process-Technology framework, however, it was developed based on the definition of capabilities as put forth earlier in this study (Figure 10). The framework combines both a process and systems perspective on technology-enabled capabilities to help unpack and understand the elements involved within a capability and how they interact to enable value creation.

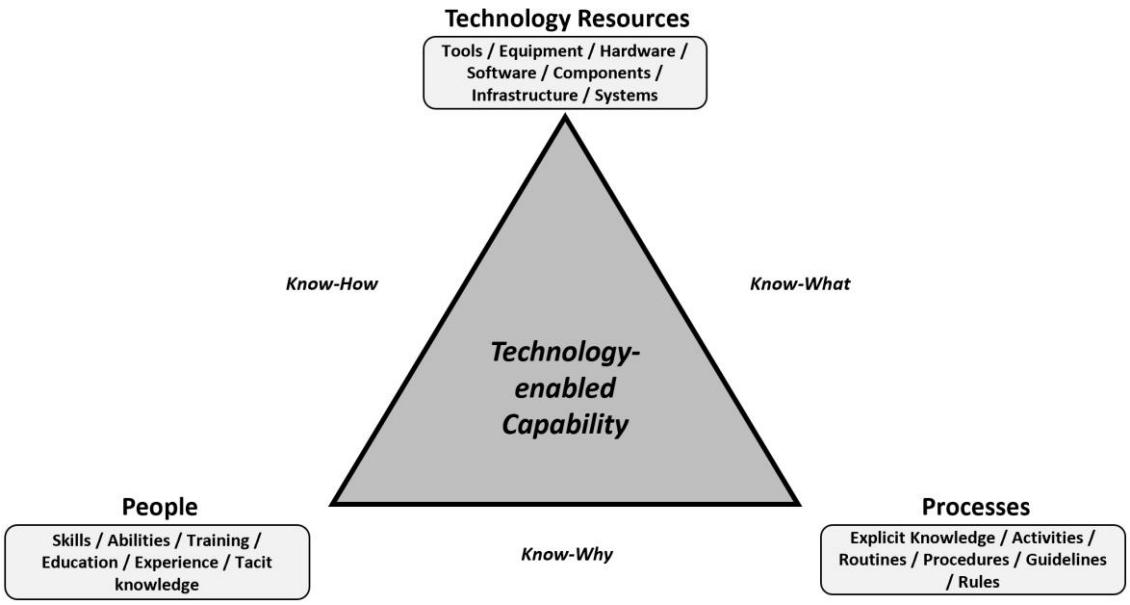


Figure 12: A Technology-Enabled Capability Framework, adapted from De Wet (2001), Burgelman et al. (2001:4), Du Toit (2007), Cetindamar et al. (2009), and White and Bruton (2011:15)

3.5.5. Dynamic Capabilities and their Role in Enabling Value Creation

'Corporate agility', or 'strategic flexibility', is both a key concern and a differentiator for organisations as it refers to the capacity of organisations to deal with changing environments (Teece, Pisano & Shuen, 1997; Zhao and Wang, 2020). This agility requires increasing levels of adaptability of the capabilities within value creation systems (Bauer et al., 2014). In short, dynamic changes require dynamically adapting capabilities. As such, the dynamic capabilities

perspective provides a useful conceptualisation of how organisations differentiate their value creation systems and value offerings in turbulent environments (Teece, Pisano & Shuen, 1997; Wetering, Mikalef & Pateli, 2017).

The concept that capabilities influence strategy and thus value creation initiatives can be dated back to Andrews (1971). However, according to Pisano (2017), attempts to formalise a 'capabilities-based' approach to strategic management stemmed from the work of Teece and Pisano (1994), Teece et al. (1997), and Eisenhardt and Martin (2000) on 'dynamic capabilities'.

Teece et al. (1997) defined 'dynamic capabilities' as the organisation's "ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments". Considering the definitions given on capabilities and competencies, the word 'competencies' from the above definition could perhaps be replaced with 'abilities'. As Teece et al. (1997) also stated, dynamic capabilities "reflect an organisation's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions".

Dynamic capabilities refers to a way to dynamically create, adapt, and manage capabilities in line with, or in response to, dynamic strategic and external requirements (e.g., from market, business, and technology environments, or from internal strategies) (Teece et al., 1997; Inan and Bititci, 2015). Since organisations are especially challenged to revise their routines of activities when the environment is dynamic (Inan and Bititci, 2015), a dynamic approach to adaptation is becoming increasingly important in the current 4IR landscape.

Eisenhardt and Martin (2000) proposed a view that focused on specific organisational processes that integrate, reconfigure, gain, and release resources to achieve new resource configurations. Helfat et al. (2007:4) later noted that scholars of dynamic capabilities defined dynamic capability in more general terms as "the capacity of an organisation to purposefully create, extend, and modify its resource base". Teece (2007, 2014) suggested that dynamic capabilities could be disaggregated into three broad capacities — sensing, seizing, and transforming — which together form a dynamic capabilities framework (DCF). Sensing refers

to the capacity to sense dynamic changes within the environment that may have a disruptive impact the organisation's value creation system, or within the organisation's value creation system that may in turn impact its environment, that could lead to value creating opportunities if addressed or seized. Seizing refers to the capacity to mobilise efforts and capabilities toward seizing the identified opportunity or to achieve alignment with the dynamic changes. Transforming refers to the capacity to adapt the value creation system through dynamic capabilities, by executing the mobilised effort toward capturing the value by achieving alignment with the sensed dynamic changes.

Inan and Bititci (2015) described operating capabilities as those organisational capabilities that enable the organisation to execute its main operating activities on an on-going basis. Dynamic capabilities are then described as the ability of an organisation to reconfigure its operating capabilities in an attempt to adapt and evolve the organisation. They are the organisational and strategic routines that enable organisations to achieve new resource configurations as markets emerge, collide, split, evolve, and die. They are thus change-oriented capabilities that help to redeploy and reconfigure the resource base to meet changing customer and stakeholder requirements and competitor strategies (Inan and Bititci, 2015).

Essentially, Teece's concept of dynamic capabilities states that what matters for business is corporate agility, which is the capacity to (1) sense and shape opportunities and threats, (2) seize opportunities, and (3) maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the organisation's intangible and tangible assets/resources (Teece et al., 1997; Teece, 2018).

Despite a significant body of literature on the topic, Pisano (2017) points out that there is a lack of a common understanding of what dynamic capabilities are, what they mean for strategy, and how an organisation can manage them coherently. Therefore, dynamic capabilities are understood and defined here as the ability to dynamically create, adapt, and manage capabilities in response to dynamic challenges imposed on the organisation for the value that it should create and offer. This is essentially a strategic management approach that aims to maintain the alignment between the external environmental and market

requirements, the organisation's strategies, its value creation in order to realise the strategies, and the capabilities required to realise the value creation (i.e. system hierarchies). Such an approach is embedded in the key activities of the strategic management process (shown in Figure 5), which include (Certo et al., 1995; White and Bruton, 2011:41):

- Formulating/developing organisational strategy and planning (or strategic planning);
- Implementing/executing organisational strategy; and
- Exercising evaluation (or monitoring) and control.

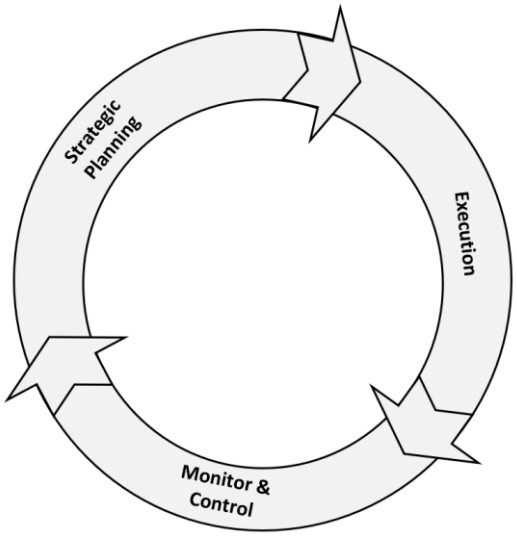


Figure 13: Key activities in the strategic management process, adapted from Certo et al., (1995) and White and Bruton (2011:41)

3.6. Strategic Alignment and the Impact on Value Creation

3.6.1. Strategic Alignment

The literature on 'strategic alignment' focuses on the alignment of information technology (IT) strategies with business/organisational strategies (Niederman, Brancheau, & Wetherbe, 1991; Chan & Reich, 2007; Luftman & Ben-Zvi, 2010; Baker et al., 2011; Reynolds and Yetton, 2015; Alexandre et al., 2016; Yeow et al., 2018). The collective term 'organisational strategy' will be used to account for a single strategy, or for various combinations of corporate, business, and functional strategies, where the sub-division of an organisation's strategy into multiple strategies typically depends on its size and complexity (Pearce II and Robinson, 2011:6).

Strategic alignment is described as “applying IT in an appropriate and timely way and in harmony with business strategies” (Luftman & Brier, 1999:109); or as “the degree to which the IT mission, objectives, and plans support and are supported by the business mission, objectives, and plans” (Reich & Benbasat, 2000:82); or simply as “using IT in a way consistent with the firm’s overall strategy” (Palmer & Markus, 2000:242).

A lack of alignment between business and IT strategies has been noted among the key challenges that cause IT investments and implementations to fail (Henderson and Venkatraman, 1993; Alyahya and Suhaimi, 2013:85). In fact, a failure to align organisational and IT strategies strategically may lead to significant opportunity and financial costs (Bruce, 1998). Misalignment can also cause internal tension (Yeow et al., 2018) and a disconnect between an organisation’s strategy and its operating model, resulting in confusion and a negative impact on value creation efforts (Atmar et al., 2019). Historical imbalances between technology ‘push’ and market ‘pull’ have even resulted in business failure (Probert et al., 2003). According to McKinsey & Company (Bender et al., 2018), alignment remains a persistent struggle for organisations. Among the current digital strategy transformation trends, there are examples of enterprise-wide transformations that ‘come up short’ simply because leaders have a difficult time creating coherent strategies that stitch together their digital priorities with other major business objectives.

Similarly, information systems (IS) research and practice on improved strategic alignment between IT and business (on various organisational levels) has been shown to impact performance positively (Reich & Benbasat, 1996; Chan, Sabherwal, & Thatcher, 2006; Gerow, Grover, Thatcher, & Roth, 2014; Renaud, Walsh, & Kalika, 2016), which may lead to improved value creation, such as improved efficiencies, reduced costs, improved customer and/or supplier relationships, and the ability to create new products or solutions (Davenport, 1995; Weiss & Anderson, 2004). Strategic alignment has also been argued to be a source of competitive advantage (Baker et al., 2011).

This focus on the alignment between IT strategies and organisational strategiess has been the case for the past two decades (Reynolds and Yetton, 2015). It can be argued that this reveals

a gap in the literature on strategic alignment in the 4IR, since the 4IR consists of digital, physical, and biological technology spheres (Schwab, 2016). Even in the Industry 4.0 context, as the cyber-physical (IT and operational technology (OT)) integration of two of these spheres (Kagermann et al., 2013; Lee et al., 2014; Lasi et al., 2014), the literature is lacking, or at least primarily focused on the IT/digital sphere — i.e., on data and their computation as part of the continued extension of the Third Industrial Revolution (Daemrich, 2017).

Apart from a technology focus, the research on strategic alignment also largely focus on the alignment between two layers of a value creation system and not on alignment across various or all hierarchical levels. Some examples include the strategic alignment between market trends and capabilities (Sardana, Terziovski and Gupta, 2016; Hutton and Eldridge, 2019) although this alignment alone is shown to correlate strongly with increased value creation.

With increasingly dynamic business and technology environments in the 4IR, alignment may prove even more challenging in future. Organisations undergo and face a great deal of faster and more frequent change, while their operating and strategic models are also adapted more frequently (Coltman, Tallon, Sharma, & Queiroz, 2015). Organisations also have increasingly digitised or digitalised their operations and processes (Bharadwaj, Sawy, Pavlou, & Venkatraman, 2013; El Sawy, 2003). This too has notable implications for alignment (Bharadwaj *et al.*, 2013; Coltman *et al.*, 2015). For technology implementations and transformations to yield meaningful value in this environment, strategic alignment is necessary between each of a value creation system's hierarchies, as discussed in Table 3.

Table 3: Strategic alignment between a value creation system's hierarchies

Alignment between:	References
The external environment and market and the development of the organisational strategy.	Certo, Peter and Ottensmeyer, 1995; Pillkahn, 2008:81; Sahlman, 2010; White and Bruton, 2011:181; Mahmood et al., 2013; Schilling, 2013

The organisational strategy and the technology strategy.	Burgelman et al., 2001; Walsh, 2004; Dodgson et al., 2008; Sahlman & Haapasalo, 2009; White and Bruton, 2011:32
The developed and tightly knitted strategies and the strategy execution, implementation, or operational activities.	Henderson and Venkatraman, 1993; White and Bruton, 2011:181; Mahmood et al., 2013
The strategy execution or operations (i.e., the value creation level) and the enabling technology capabilities, such as processes, skills development, infrastructure, and other resources.	Henderson and Venkatraman, 1993; Whalen, 2007; Tallon, 2008; Alyahya and Suhaimi, 2013:84; Carvalho et al., 2013

From Table 3, 'strategic alignment' is defined here as the process of continually and strategically aligning (1) an organisation's external environment and its organisational strategy, (2) its organisational strategy and technology strategy, (3) its aligned strategies and its strategy execution, and (4) its strategy execution and the enabling value creation capabilities.

Figure 14 is an illustration of strategic alignment in the context of an organisation's value creation system, based on the outcomes within Table 3. Figure 14 contains multiple hierarchies, consistent with a systems view (and technology roadmapping), feedback loops representing the alignment processes, and process flows in the form of a 'flow diagram' that represents the flow of events for value creation initiatives. Figure 14 also illustrates how the system hierarchies may consist of multiple sub-layers or variations for each of the primary hierarchies that need to be accounted for in each specific context.

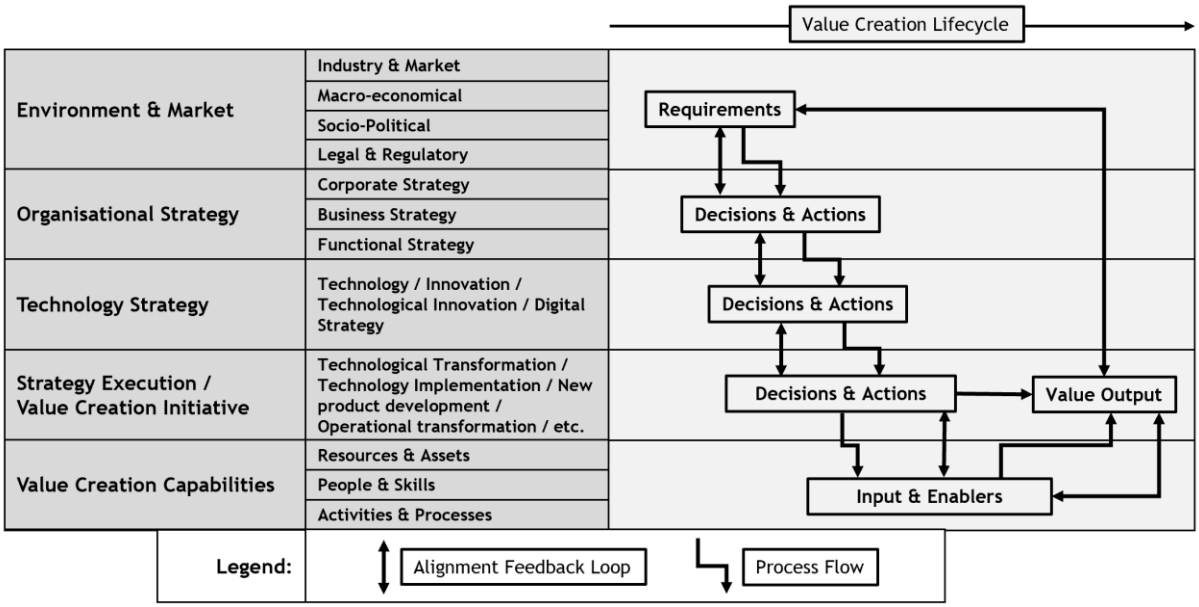


Figure 14: A conceptual representation of strategic alignment in an organisation's value creation system

Alignment with the external environment may include the fit between the organisation's strategies and the macroeconomic, social, political, technological, environmental, legal, market, and other factors and trends impacting the organisation. It has been noted that organisations struggle, in general, to adapt to new trends, especially social and technological trends, and to optimise their investment processes and strategic decisions in line with new opportunities or threats in the environment (Pillkahn, 2008; Sahlman, 2010; Mahmood et al., 2013).

On the strategy development level, the increased prominence of technology in value creation, competitiveness, survival, and addressing environmental requirements largely drives the need for the increased integration (alignment) of technology and organisational strategies (Walsh, 2004; White and Bruton, 2011:32). Strategic alignment here supports effective communication and coordination of strategy execution, particularly through systematic technology management activities over the product (or the value creation) life-cycle (Sahlman & Haapasalo, 2009). Therefore, during strategy development, it is necessary to consider the technology aspects that constitute the company's value system (Porter, 1985). Alternatively, the technology strategy has to be derived from the business/organisational strategy in

support of (i.e., aligned with) its needs (Burgelman et al., 2001; Momaya & Ajitabh, 2005; Mei & Nie 2008; Dodgson et al., 2008).

On the strategy execution level, continual alignment between the strategy formulation process and the execution levels is necessary to ensure that outcomes match objectives and goals (Mahmood et al., 2013). Furthermore, the relationship between technological capabilities and strategic objectives is increasingly important, since decisions that do not incorporate technological capability considerations for the creation of new value are unsustainable (Carvalho et al., 2013). Value creation (particularly through innovation) also requires the alignment of priorities between all of the functions (and interest groups) responsible for successfully creating the desired value (Probert et al., 2003). The ability to create, modify, and maintain this alignment — while business and other conditions change, new opportunities arise, and new capabilities are developed — can mean the difference between capturing the benefits of being a market leader or being a market follower (Whalen, 2007).

3.6.2. Dynamic Capabilities and the Link to Strategic Alignment

Strategic alignment is a moving target, and executives continually evaluate market trends, competitors, and new innovations in order to stay competitive. This generates fluidity in the organisation's strategy, which makes alignment more difficult (Weill and Broadbent, 2002). And with technology also continually changing (Phaal et al., 2001; Amadi-Echendu et al., 2011), it is increasingly difficult for strategies and capabilities to remain aligned (Luftman and Brier, 1999; White and Bruton, 2011).

A shift of focus from alignment as an end-state or fixed goal to the aligning process itself has provided a useful perspective (Karpovsky & Galliers, 2015; Street, Gallupe, & Baker, 2017). This has spurred suggestions of maintaining dynamic synchronisation between strategies and other functions, as suggested by Mithas, Tafti and Mitchell (2013:513). Since strategy has been noted as being implemented via a series of processes that occur over time (Tallon, 2008), this suggests that strategic alignment forms a continual part of strategy execution. This

perspective places a stronger emphasis on the monitoring and control activities in strategic management as a way to maintain strategic alignment (Certo, Peter and Ottensmeyer, 1995).

A dynamic synchronisation (or dynamic alignment) perspective is also supported when considering the findings from McKinsey & Company that executives are more likely to adopt a 'rolling strategy' in the current environment, as opposed to traditional three- to five-year strategies (Atmar et al., 2019). Alignment is, therefore, a continual process of aligning with the moving target of emerging strategy. And aligned strategies (such as digital strategies) are inherently multi-functional (Bharadwaj et al., 2013). This requires alignment between, and even the simultaneous development and reconfiguration of, IT (or other technological) and business resources across multiple organisational processes (Yeow et al., 2018).

A dynamic alignment approach, i.e. the capacity to adapt dynamically towards maintaining the desired strategic alignment, is also supported by the argument from various researchers that planned action alone does not lead to successful strategic alignment. To align with a shifting goalpost, both intended (planned) and emergent aligning actions are required during the aligning process in order to pursue planned changes and to manage emerging issues (Street, 2006; Karpovsky & Galliers, 2015; Marabelli & Galliers, 2017; Yeow et al., 2018). This explains why studies have begun to link alignment with the organisation's ability to sense and respond to dynamic changes (Tallon & Pinsonneault, 2011; Marabelli & Galliers, 2017), as opposed to simply seeing the strategic value of alignment as how the state of alignment influences organisational performance.

Baker, Jones, Cao & Song (2011) suggested that strategic alignment can be conceptualised as a management capability, where such a capability fits the description of dynamic capabilities from the DCF perspective on strategic management (Teece et al., 1997; Baker et al., 2011). Similarly, Yeow, Soh & Hansen (2018) conducted a five-year longitudinal study on applying a dynamic capabilities approach to alignment. Their study showed a close link between organisational capabilities and alignment, and that alignment is brought about through the sensing, seizing, and transforming capacities (i.e., the dynamic capacities) of the DCF and its associated aligning actions. This is congruent with the dynamic capabilities strategic

management view, in which strategy is seen as being tightly linked to the three dynamic capacities of the DCF (Teece, 2014).

Yeow et al. (2018) conceptualise dynamic capabilities as being composed of both broad organisational capacities (i.e., sensing, seizing, and transforming) and specific decisions and actions that work together to effect organisational change as part of each capacity. For example, the sensing capacity consists of scanning, learning, and calibrating activities involved in the identification, development, co-development, and assessment of technological opportunities in relationship to (i.e., aligned with) customer needs (Teece, 2014:332), as well as sensing environmental changes and/or internal decisions (Yeow et al., 2018).

The seizing capacity consists of designing, selecting, and committing activities, such that the organisation mobilises resources to address the needs and opportunities identified by the sensing capacity in order to capture value. Seizing plays a critical role in the alignment between identified opportunities in the external environment and actions to create value from it. The seizing capacity is also involved in the decision-making about what specific changes to make across and in the organisational system (its activities and processes), in order to create and capture the desired value (Teece, 2007; Teece, 2014; Yeow et al., 2018).

The transforming capacity consists of leveraging, creating, accessing, and realising activities to enable continual renewal in the modification and alignment, co-alignment, realignment, and redeployment of assets, resources, processes, and/or organisational functions (Teece, 2007; Teece 2009; Yeow et al., 2018). The transforming dynamic capacity enables the reconfiguration of existing resources to align them with the new strategy. Creating or acquiring new resources or complete capabilities through this capacity also enables alignment with both existing gaps and future strategic goals. This provides a useful way to examine and enact the aligning process, since it focuses on the actions taken by organisations to change their capabilities (i.e., resources and assets, people and skills, activities and processes) to adapt to dynamically changing environments (Yeow et al., 2018).

3.6.3. Activities and Processes Associated with Dynamic Capabilities Constituting Strategic Alignment Capacities

To understand how dynamic capabilities influence strategic alignment and dynamic adaptation in practice, it is necessary to unpack one of the elements of the organisational capability framework – namely the activities and processes involved in the strategic management of technology-enabled value creation.

Yeow et al. (2018) conceptualised dynamic capabilities as being composed of specific activities that work together to effect organisational change within each of the DCF capacities (i.e. sensing, seizing, and transforming). Similarly, other scholars have noted those activities that constitute dynamic capabilities and thereby enable strategic alignment, namely (1) sensing, (2) coordinating, (3) learning, (4) integrating, and (5) reconfiguring (Protogerou, Caloghirou & Lioukas 2012; Wetering, Mikalef & Pateli, 2017). Such activities (forming the required processes and routines) that enact strategic alignment can be considered as the 'Processes' element of dynamic capabilities. In turn, these dynamic capabilities would then aggregate into the DCF Capacities (instead of the other way around) which function as 'Strategic Alignment Capacities'.

Yeow et al. (2018) expanded on these activities associated with dynamic capabilities that enable the Strategic Alignment Capacities. For example, for them the sensing capacity consists of scanning, learning, and calibrating activities involved in the identification, development, co-development and assessment of technological opportunities in relationship to (i.e. aligned with) customer needs (Teece, 2014). As well as sensing environmental changes and/or internal decisions (Yeow et al., 2018).

The seizing capacity consists of designing, selecting, and committing activities whereby the organisation mobilises resources to address needs and opportunities identified by the sensing capacity in order to capture value. Seizing plays a critical role in alignment between identified opportunities in the external environment and action to create value from it. The seizing capacity is also involved in the decision-making on what specific changes to make across and

within the organisational value creation system in order to create and capture the desired value (Teece, 2007; Teece, 2014; Yeow et al., 2018).

The transforming capacity consists of leveraging, creating, accessing, and realising activities to enable continued renewal in terms of the modification and alignment, co-alignment, realignment, and redeployment of assets, resources, processes, and/or organisational functions (Teece, 2007; Teece 2009; Yeow et al., 2018). The transforming capacity enables the reconfiguration of existing resources to align them to the new (and shifting) strategy. Creating or acquiring new resources or capabilities, through this capacity, also enables alignment to both existing gaps and future strategic goals (Yeow et al., 2018).

To focus the activities constituting dynamic capabilities on technology-enabled capabilities, the Technology Management (TM) activities of Gregory (1995) (shown in Figure 24) should be integrated as well, i.e. identification (I), selection (S), acquisition (A), exploitation (E), and protection (P) of technology capabilities (Phaal et al., 2004). Cetindamar, Phaal & Probert (2009) highlighted a clear link to dynamic capabilities through these TM activities and further added "learning (L)" as a sixth TM activity, to account for the necessary feedback loop to capture and internalise experience.

Since the DCF is typically associated with competitive performance (Teece, Pisano & Shuen, 1997; Teece 2009, Pisano, 2017), the Strategic Alignment Capacities (as defined in this study) are instead termed Sensing, Coordinating and Responding to account for strategic alignment efforts that have a value focus not necessarily associated with competitiveness (e.g. focusing on the survival of the organisation during a global pandemic). Table 4 presents a summary of the discussion on dynamic capabilities enabling the Strategic Alignment Capacities and lists examples of related activities or terminologies. These activities do not necessarily take place in any chronological order and are instead initiated in various and iterative sequences as well as different aspects of an organisation.

Table 4: Dynamic alignment processes and activities throughout the dynamic alignment capacities

Strategic Alignment Capacity	Dynamic Capability enabling Alignment	Related or Constituent Activities or Processes	Reference
Sensing	Sensing	Scanning, identifying, monitoring	Ambrosini and Bowman (2009); Inan and Bitici (2015); Katkalo *et al*. (2010); Lahovnik and Breznik (2013, 2016); Pisano (2017); Teece (2007, 2009); Yeow *et al*. (2018)
	Assessing	Analysing, evaluating	Cetindamar *et al.* (2009); Katkalo *et al*. (2010); Pisano (2017); Protogerou, Caloghirou & Lioukas (2012)
Coordinating	Coordinating	Selecting, choosing, committing, mobilising, planning, seizing	Katkalo *et al*. (2010); Inan and Bitici (2015); Lahovnik and Breznik (2013, 2016); Pisano (2017); Protogerou, Caloghirou & Lioukas (2012); Teece (2007, 2009); Yeow *et al*. (2018)
	Acquiring	Designing, developing, co-developing, purchasing, building, creating	Cetindamar *et al.* (2009); Katkalo *et al*. (2010); Lahovnik and Breznik (2016); Pisano (2017)
Responding	Utilising	Implementing, leveraging, accessing, exploiting, executing, realising	Cetindamar *et al.* (2009); Inan and Bitici (2015); Katkalo *et al*. (2010); Lahovnik and Breznik (2016); Pisano (2017); Teece (2007, 2009); Yeow *et al*. (2018)

	Learning	Studying, investigating, understanding, measuring, recording, analysing	Cetindamar *et al.* (2009); Inan and Bitici (2015); Lahovnik and Breznik (2013); Pisano (2017)
	Modifying	Integrating, implementing, changing, aligning, co-aligning, redeploying	Katkalo *et al*. (2010); Lahovnik and Breznik (2013, 2016); Pisano (2017); Protogerou et al. (2012); Wetering, Mikalef & Pateli (2017); Teece (2007, 2009); Yeow *et al*. (2018)
	Reconfiguring	Re-aligning, controlling, calibrating, adapting, renewing, improving, transforming	Katkalo *et al*. (2010); Lahovnik and Breznik (2013, 2016); Pisano (2017); Wetering, Mikalef & Pateli (2017); Teece (2007, 2009); Yeow *et al*. (2018)
	Protecting	Securing, safeguarding	Cetindamar *et al.* (2009)

3.7. **Chapter Conclusions**

The literature overview discussed the components shown in Figure 3 in response to the research questions listed in Section 3.1. This included the system's perspective applied to the study. It then defined 'value creation' as the pursuit of realising value by addressing a need or achieving a goal. Creating and capturing value was stated to be the purpose of an organisation and doing so requires capabilities that are on a high level of analysis constituted by resources and assets, people and skills, and activities and processes.

In the 4IR environment, technology and innovation capabilities play a particularly important role, since new value creation approaches or outcomes are often required to address dynamic requirements from internal and external changes, and technology is the primary enabler of value creation initiatives. This led to the definition of technology-enabled capabilities.

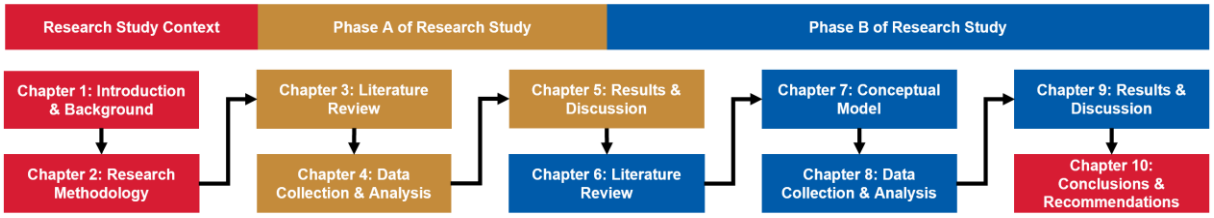
Furthermore, the dynamic capabilities perspective on the strategic management of such technology-enabled capabilities was shown to enable the adaptation of capabilities to align with dynamic changes in the external environment. Strategic alignment was defined as the process of continually and strategically aligning the levels of an organisation's value creation system hierarchies, which includes alignment with its external environment. It was stated that dynamic capabilities serve to enable this strategic alignment, thereby creating corporate agility.

These literature outcomes shape the propositions and the research design and method to test these propositions. This builds toward collecting data and analysing the data to answer the main research question of Research Phase A, as discussed in the next two chapters.

4. Phase A: Data Collection and Analysis

There is only one good, knowledge, and one evil, ignorance - Socrates

4.1. Chapter Overview



The main research question for Phase A was:

- What are the major challenges that South African organisations face in their value creation efforts, enabled by emerging technologies, in the 4IR landscape?

A further four key sub-questions were developed following the outcomes of the literature review. These questions aimed to further increase insight into the problem area and to confirm the literature's suggestions around key challenges to value creation efforts. Focus is placed on those efforts that are driven by technology and emerging technologies within the dynamic business and technology environments that organisations operate in. The sub-questions to unpack this required understanding are:

4. How central is the role of technology and innovation in value creation initiatives and how is this expected to change in the future?
5. Are current technology and innovation initiatives in South Africa focused on emerging technologies associated with the 4IR?
6. Are the major challenges to creating value through emerging technologies related to the ability to dynamically adapt an organisation's value creation system to align to dynamic changes in its environment?
7. How do these challenges differ between mature and emerging technologies and across industries in South Africa?

4.2. Chapter Introduction

Based on the understanding developed during the literature reviews preceding this part of the study, certain propositions were drawn up in relation to the sub-questions listed above. This chapter lists these propositions, framed in a research model following Chaper 3's outcomes, and discusses the qualitative data collection and analysis methods of expert interviews to test the propositions and thereby answer the sub-questions.

4.3. Conceptual Research Model and Propositions

The conceptual research model for Phase A is shown in Figure 15, which indicates how the propostions stated in Table 5 tie in with the conceptual illustration of 'strategic alignment' from Figure 14 (developed in Chapter 3).

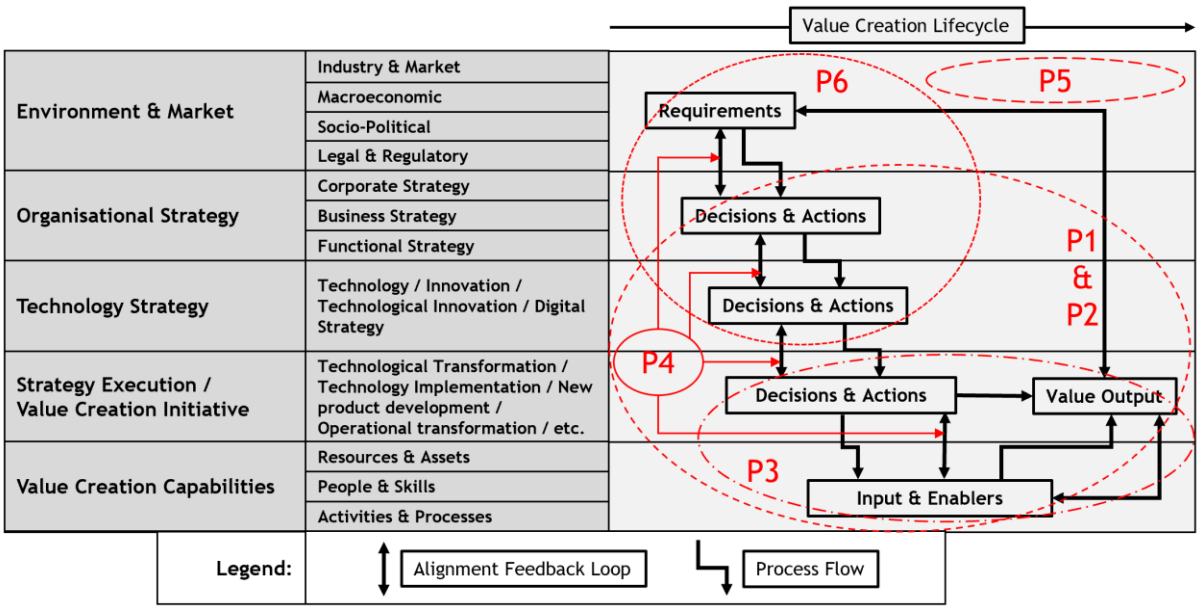


Figure 15: Conceptual Research Model (Research Phase A)

The propositions listed below are in response to the research questions in the beginning of this chapter.

Table 5: Propositions (Research Phase A)

Proposition no.	Proposition
P1	Technology and innovation play a central role in current value creation initiatives, and will become more important and central to enable value creation in future.
P2	The current major emerging technology initiatives in South African industries largely focus on digital technologies.
P3	The major challenges that organisations face with creating new value through emerging technology initiatives largely stem from the difficulty of dynamically creating, adapting, and managing the required value creation capabilities to enable the technology initiative.
P4	Another major challenge stems from the difficulty of dynamically maintaining strategic alignment throughout the value creation lifecycle.
P5	These challenges are representative of typical South African industries, although some may face higher levels of pronounced challenges in different areas.
P6	Emerging technology initiatives bring greater challenges to organisations in their value creation initiatives, due to the higher levels of complexity associated with these technologies.

4.4. **Data Collection: Qualitative Interviews**

The data collection consisted of qualitative interviews with predetermined and standardised questions. The data collection was done cross-sectionally over the period preceding the research survey. A non-probability sampling approach was followed. The respondents were contacted from the researcher's network of experts and additional interviews were set up through further 'snowball method' referrals until convergence was identified in the responses (which was at 9-10 responses) (Saunders, Lewis & Thornhill, 2009).

Twelve (12) semi-structured interviews with predefined questions (as listed in Table 6 in relation to the propositions they aim to validate) were conducted with experts from the three largest technology consulting firms operating in South Africa. The interviews lasted

approximately sixty minutes. These were global firms that typically rank in the top five consulting firms globally (in revenue or performance) that consult in the fields of strategy, management, operations, and technology.

The interviewees from these firms were experts consulting in the field of technology-enabled value creation, working across strategy and operations, although they were primarily focused on either strategy (six interviewees) or operations (six interviewees). Each of them had experience in emerging and disruptive technology implementation or transformation initiatives to create business and/or stakeholder value for their clients. Furthermore, each had insights into implementing or transforming their own internal business and value creation processes through similar current emerging technology trends. Although these interviewees worked in the South African branches of these international firms, it should be noted that they work closely with their international counterparts, and so could contrast their perspectives on South African companies and industries with their global perspective. However, their primary experience was in South Africa and therefore the data utilised were only from responses related to South Africa.

Once lockdowns were introduced, the interviews went from face-to-face to online. Where further clarity was needed afterward, the interviewees were contacted again telephonically or via email. However, the transcripts were not sent to interviewees for comment as experience indicated extremely low responses on such practice.

The questions were open-ended and the respondents were left to discuss in detail what their perspectives were. Open-ended (or simply open) questions allow respondents to define and describe a situation or event from which extensive insights may be obtained. These are typically used for semi-structured interviews (Saunders *et al*., 2009:337). During the interviews, the interviewees were questioned on how they would define some of the concepts in question (e.g. strategic technology management, 4IR, emerging technologies, etc.). The definitions as captured for this study were then provided to ensure that all interviewees had the same context of the topics discussed.

Table 6: Interview questions

Proposition no.	Interview question no.	Interview question
1	1	What is the current role (i.e., central or supporting) and importance of technology and innovation (i.e., new value) in creating value in/for organisations?
	2	How is this role expected to change in future in the changing technological environment as we progress into the 4IR?
2	3	What are the major types of emerging technology implementation and transformation initiatives taking place in South African industries that relate to the 4IR?
3 & 4	4	What are the major challenges faced by organisations across industries in South Africa, and by the consulting firms themselves, in creating value that is enabled by emerging technologies?
5	5	Do these challenges differ across industries?
6	6	Do these challenges differ between more mature versus more emerging technologies?

4.5. Qualitative Data Analysis

The analytic induction technique was used for the data analysis of the qualitative interview outcomes. Johnson (2004:165) defined 'analytic induction' as "the intensive examination of a strategically selected number of cases so as to empirically establish the causes of a specific phenomenon". In an analytic-inductive-led approach to analysing qualitative data, the analysis begins with a less-defined explanation of the phenomenon to be explored that is not derived from existing theory (Saunders *et al*., 2009:508). This is a suitable approach to the 4IR environment when clear theoretical links are yet to be established. The explanation (or proposition) is then tested through a purposefully selected case study, which may be conducted through in-depth interviews that would allow the phenomenon to be explored. The inductive and incremental way of collecting and analysing qualitative data provides this process with the ability to lead to the development of well-grounded explanations (Saunders *et al*., 2009:508).

The qualitative interview data obtained from the interviews were first transcribed from the recordings, then cleaned and summarised (condensed) before categorising (grouping) the condensed data into themes, as described by Saunders, Lewis & Thornhill (2009:490). Some of the interview questions were closed-ended, while others were open-ended. For the closed-ended questions, the number of responses was counted for each answer category to derive a quantitative representation of the qualitative data (Saunders, Lewis & Thornhill, 2009:497). Open-ended responses were also recorded and analysed as noted above, in which interviewees discussed the intended closed-ended questions in more detail. The categorisation enabled the derivation of insights and the identification of patterns from the interviewee responses, as discussed under the results section. The responses that related to each category (or theme) per question were counted to derive a quantitative representation of interviewee perspectives.

4.6. Chapter Conclusions

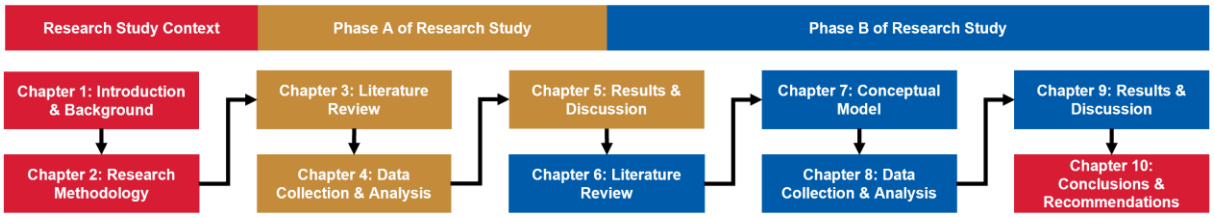
This chapter discussed the research questions developed from the improved understanding resulting from the literature review. It then listed the propositions posed following the literature review of Phase A. The data collection and analysis techniques were then described

to contextualise the qualitative method followed. The next chapter covers the results obtained from this approach and these results are discussed toward answering the main research question of Phase A.

5. Phase A: Results and Discussion

One cannot conceive anything so strange and so implausible that it has not already been said by one philosopher or another - René Descartes

5.1. Chapter Overview



5.2. Chapter Introduction

The interview outcomes are presented in this chapter, for this exploratory approach ending Phase A. The results relating to the identified major challenges to value creation initiatives in the 4IR context are discussed, in response to the main research question of Phase A. The chapter closes with conclusions on the findings and the identified major challenges, as well as what it means for the rest of the study – i.e. for Research Phase B.

5.3. Interview Results

The outcomes for the derived categories of the qualitative interviews are discussed in this section for each interview question. A figure is shown for each question, indicating the derived categories from the responses and the quantitative number of responses for each category out of the total of twelve interviewees. The results for Question 4 yielded two distinct categories, which are discussed separately with a figure for each category indicating the total number of responses that correlate with the specific category.

5.3.1. Question 1 – What is the current role (i.e., central or supporting) and importance of technology and innovation (i.e., new value) in creating value in/for organisations?

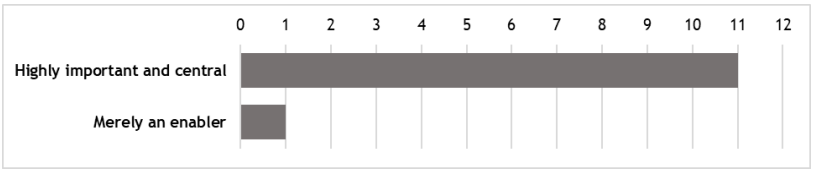


Figure 16: Q1 — Qualitative representation per response category

Eleven out of twelve interviewees agreed that technology is central to value creation and can no longer be seen as having only a supportive role in the current dynamic environment. One interviewee perceived technology to merely be an enabler of (supporting) value creation, which does not necessarily make it central— although this statement depended on the type of value to be created and its complexity.

5.3.2. Question 2 – How is this role expected to change in future in the changing technological environment as we progress into the 4IR?

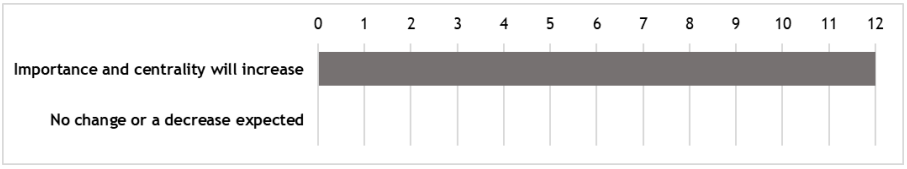


Figure 17: Q2 — Qualitative representation per response category

All interviewees expect technology to become more central to value creation initiatives, and the prevalence and importance of both technology and innovation is expected to increase, particularly in the 4IR. This is especially true in terms of harnassing emerging technologies and disruptive innovation or adapting to change to survive their impact.

5.3.3. Question 3 – What are the major types of emerging technology implementation and transformation initiatives taking place in South African industries that relate to the 4IR?

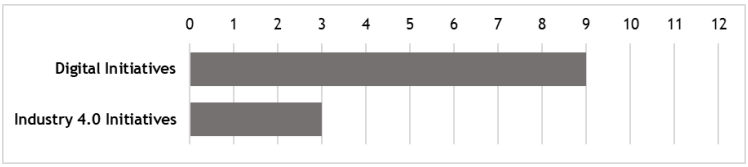


Figure 18: Q3 — Qualitative representation per response category

From the responses on the type of emerging and disruptive technology initiatives taking place in South Africa and in the organisation's global network, it was found that two main categories can be defined. These include digital (with project examples spanning across digital transformations, digital strategies, digitalisation of processes, advanced and/or predictive analytics, AI and machine learning, process automation, digital platform business models, and more) and Industry 4.0 (as the term for cyber-physical integration, or digital and physical emerging technology integrations to deliver technology capabilities for project examples provided, such as smart factories, smart cities, advanced robotisation, system automation, digital twins, integration of complex technology systems, drones with analytics capabilities, and other examples).

Out of the twelve respondents, nine indicated that they were primarily involved in digital initiatives with very limited or no involvement in Industry 4.0 initiatives. The remaining three respondents indicated that they were primarily involved in Industry 4.0 (cyber-physical) type initiatives, but that they were also (or have been) involved in digital initiatives that do not involve Industry 4.0 related solutions that integrate digital (cyber) technologies with physical technologies. The involvement of these respondents in particular technology solution focus areas represent the business focus areas of their respective organisations, which cater for current market demands. These projects typically involve a number of experts and therefore bears some resemblance of the general technological focus areas of the respective organisations and, therefore, of their customers across South African industries.

5.3.4. Question 4 – What are the major challenges faced by organisations across industries in South Africa, and by the consulting firms themselves, in creating value that is enabled by emerging technologies?

The reported challenges to technology enabled value creation in the current business and technology landscape spanned across various organisational value creation system levels. Each interviewee discussed the major challenges applicable to their focus area. These reported major challenges were categorised and compared to the literature on dynamic capabilities and strategic alignment, by using the elements of dynamic capabilities and strategic alignment from the literature study (as described through Sections 3.5 and 3.6)

The categorisation proved somewhat difficult due to the interrelated nature of dynamic capabilities and strategic alignment, as was found in the literature study. For example, interviewees may report difficulty with achieving fit between strategies and execution (i.e. strategic alignment between two of the value creation system hierarchies) while also reporting difficulty with adapting technology solutions to the rolling strategy (i.e. creating dynamic capabilities to adapt to dynamic changes).

It was found that all of the reported major challenges, in response to the interview question, could be grouped under either (or both) capability-related challenges (Figure 19) and/or strategic-alignment-related challenges (Figure 20). Twelve and eleven interviewees reported on each category respectively as the major challenges they faced in technology-enabled value creation efforts. The examples on interviewee responses have significant overlaps although most responses were grouped as appropriate. Links to the literature definitions to connect the reported challenge to the wording within this study are shown in brackets.

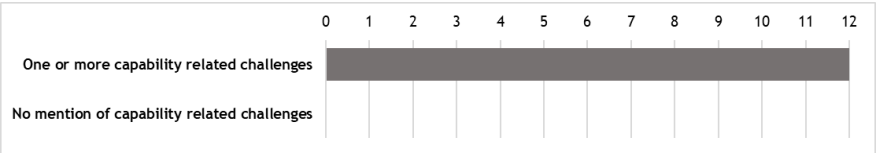


Figure 19: Q4A — Qualitative representation per response category

The reported challenges (largely) associated with dynamic capabilities spanned across all the organisational levels (i.e. across the hierarchies in a value creation system as conceptualised in Figure 14) and across all phases of value creation processes. Examples of 'capability-related' challenges as reported during the interviews included:

- Identifying and deciding which strategic technologies (technology resources/assets) to focus on for sensing opportunities;
- Accurately assessing (sensing) the potential value and disruption potential of emerging / still-maturing technologies;
- Taking multiple factors into account (systems thinking capability) when assessing complex requirements that impact the value creation initiative to capture (seize) an opportunity or address customer needs (dynamic changes in external requirements);
- Taking a systems approach and identifying the necessary system elements to consider for implementation or adaptation per value creation initiative (i.e. creating technology-enabled capabilities instead of focussing on implementing technology resources/tools);
- Matching technologies to business needs (i.e. also an alignment challenge) and prioritising focus areas to capture (seize) opportunities;
- Balancing market/value-pull versus technology-push approaches to find (sense) new value creation initiatives as a result of new technology (technology trends signalling new emerging capabilities);
- Identifying, creating, and modifying the resources, processes, and/or skills (i.e. capabilities) needed by a new technology initiative (i.e. also an alignment challenge although associated with dynamic capabilities);
- Managing change (coordination), reconfigurations (transforming), and adoption requirements (people element required for new capability creation);
- Managing and transferring the necessary knowledge (tacit knowledge in the people and skills element or explicit knowledge in the activities and processes element) to create the required value and/or to implement the technology solutions (i.e. to create the capability from the loose elements);

- Integrating new and old technology infrastructure and systems (resources required to enable capability);
- Assessing the actual value created and assigning it correctly throughout the organisation and throughout the value creation system hierarchies and value creation processes (aligning the actual enabling capabilities to value creation efforts consciously in order to align dynamic capability management efforts to future strategic goals); and,
- Identifying and adapting the processes, methods, and tools used for decision-making to suit the dynamic value creation needs for which they are to be deployed, e.g. moving to Agile methods and integrating such a process change coherently into the existing capabilities (i.e. the activities and processes element required to create capabilities that can execute steps toward creating value). Nine respondents noted such challenges with identifying, selecting, adapting, and/or implementing the required methods and tools for decision-making and action.

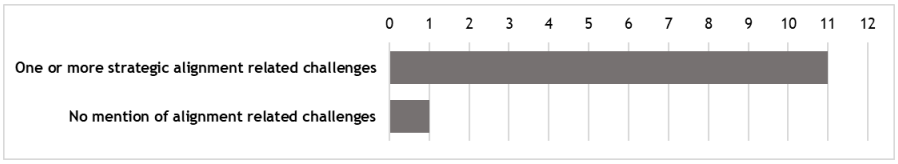


Figure 20: Q4B — Qualitative representation per response category

The following are reported examples of challenges that related to alignment (or fit) as per the definition and noted challenges associated with strategic alignment (from Section 3.6). Some overlap remains, but the responses were grouped as appropriate. These included:

- Achieving and maintaining alignment between the external market, environmental trends, and the development of the organisation's strategy/ies;
- Taking a business-led value creation focus and identifying enabling technologies as opposed to attempting to 'plug in' new technologies, i.e. achieving and maintaining alignment between business/corporate/organisational strategies and technology/technological innovation strategies;
- Achieving and maintaining alignment between the developed strategy and its execution, such as the implementation or transformation initiative;

- Managing bottom-up versus top-down approaches in a dynamic environment (bi-directional alignment);
- Achieving and maintaining alignment between various strategy execution efforts to create the desired value, particularly avoiding silos and integrating value creation initiatives to align with strategic goals;
- Strategically managing the value creation process, including developing organisational and technology strategies, executing strategies, and monitoring and controlling the execution to maintain alignment while adapting execution as needed;
- Managing stakeholder expectations and resistance to change largely based on a 'sunk cost' mindset relating to the legacy systems and infrastructure, i.e. failing to realise misalignment between current capabilities and the changing requirements imposed upon the organisation;
- Executing and delivering on technology solutions to create the expected value, due to the difficulty associated with building and modifying capabilities to keep up with dynamic trends (aligning value creation initiatives to shifting goal posts resulting from dynamic external changes);
- Achieving and maintaining alignment between value creation initiatives, while experiencing shortened and more dynamic lifecycles and strategic timelines;
- Monitoring and controlling value creation efforts to align with strategic goals while also adapting dynamically as needed;
- Achieving and maintaining alignment between various organisational functions and/or project teams (i.e., reducing 'silo' work); and,
- Creating new and modifying existing capabilities to align with new technology initiatives and dynamic changes in the environment (including, but not limited to, specific aspects such as modifying resources and infrastructure, upskilling employees, adapting processes, and adopting new methodologies, etc.).

5.3.5. Question 5 – Do these challenges differ across industries?

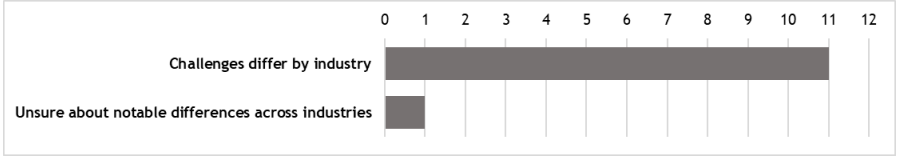


Figure 21: Q5 — Qualitative representation per response category

Eleven of the twelve interviewees noted that the reported challenges differed somewhat between industries, although there was a lot of overlap. The differences were stated to relate to the dominant culture and resistance to change (readiness levels to adopt emerging technologies) in the senior management of the larger organisations in the various industries. Another primary reason that was reported related to the prevalent capabilities to support or enable emerging technology implementations or transformations and the organisation's ability to dynamically adapt these capabilities. One interviewee was uncertain whether there were notable differences between industries, and noted that all seemed to struggle with the same core problems of alignment and developing and executing coherent strategies.

5.3.6. Question 6 – Do these challenges differ between more mature versus more emerging technologies?

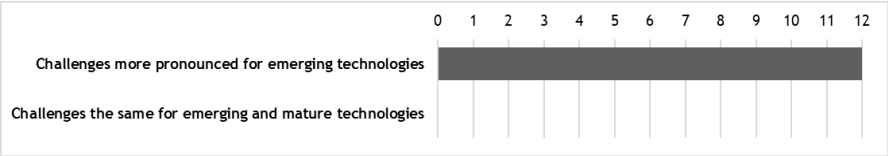


Figure 22: Q6 — Qualitative representation per response category

All twelve interviewees indicated that the reported challenges are more complex, dynamic, and profound when the technology initiatives involve emerging and/or disruptive technologies rather than more mature technologies. The identified correlating factor was the scale of complexity — i.e., the higher the complexity of the technology initiative (in terms of scale, scope, system interfaces and implications, etc.), the more pronounced the challenges of creating value from the initiative.

5.4. Discussion of Findings

The results are discussed below in line with each of the propositions stated in Section 3.

5.4.1. Proposition 1 – Technology and innovation play a central role in current value creation initiatives, and will become more important and central to enable value creation in future.

Hyphothesis 1 was shown to be correct, with eleven out of twelve interviewees agreeing that technology and innovation are central to value creation initiatives, and all interviewees agreeing that technology and innovation will only become more central to value creation initiatives in future, particularly as the 4IR unfolds. This highlights the importance of technology-enabled capabilities for organisational value creation initiatives. It also highlights the growing importance of taking a capability perspective, particularly on technology and innovation capabilities, of an organisation's value creation system.

5.4.2. Proposition 2 – The current major emerging technology initiatives in South African industries largely focus on digital technologies.

Proposition 2 was shown to be correct, with all interviewees indicating their involvement in emerging technology initiatives relating to the digital technology sphere, and only three indicating involvement in Industry 4.0 (cyber-physical) technology initiatives. This highlights the fact that South African industries are actively involved in emerging technology implementations or transformations. The interviews also indicated that these initiatives aim to alter their value creation systems in some way through emerging technologies, in order to create some form of value that addresses business goals or stakeholder needs. However, these largely focus on digital initiatives — i.e., increased data and computation initiatives to enable value creation efforts — and not 4IR-specific initiatives (integrating digital and biological technology spheres with the digital sphere).

5.4.3. Proposition 3 – The major challenges that organisations face with creating new value through emerging technology initiatives largely stem from the difficulty of

dynamically creating, adapting, and managing the required value creation capabilities to enable the technology initiative.

Proposition 3 was partly shown to be correct, since all interviewees noted that the major challenges to value creation stem in some form from dynamic changes and the resulting complexity of some or multiple capability-related factors. These capability factors related largely to creating, adapting, or managing the associated people, abilities, skills, knowledge, processes, and activities required to make decisions and take action in the value creation process or system. Apart from challenges with system integration, few of the reported challenges mentioned the actual technical aspects, such as the resources and assets (e.g., technology systems, infrastructure, software) other than referring to the abilities and tools required for technology, systems, trends, or other assessments.

What is clear, however, is that proposition 3 considered the capability-related challenges to be largely concentrated on the strategy execution level (see Table 5). These included the capabilities necessary for executing a value creation initiative to achieve the strategic objectives. However, the interview results indicated that the challenges that stem from dynamic capabilities span all the hierarchies of the value creation system. In fact, based on the interview results, the conceptual model in Figure 14 would need to be expanded to account for a third dimension to represent the strategic management activities involved in dynamically creating, adapting, and managing the capability elements throughout the value creation system of an organisation.

5.4.4. Proposition 4 – Another major challenge stems from the difficulty of dynamically maintaining strategic alignment throughout the value creation lifecycle.

Proposition 4 was shown to be correct, with numerous challenges to achieving and maintaining alignment on various hierarchical levels being noted. Since strategic alignment requires alignment across all the levels noted in Section 2.4, any misalignment will have a detrimental effect on value creation efforts, as confirmed by the interviews. The added dimension to the conceptual model in Chapter 4 also represents the dynamic capabilities (i.e.,

the dynamic capacities and constituent activities) approach needed to achieve and maintain strategic alignment throughout the value creation hierarchies and lifecycle.

It was also identified that the two major challenges foreseen from propositions 3 and 4 are highly interrelated and not easily seperable since dynamic capabilities (as the major challenge from proposition 3) form the means of enacting strategic alignment. The conceptual model in Chapter 4 shows this interrelated nature.

5.4.5. Proposition 5 – These challenges are representative of typical South African industries, although some may face higher levels of pronounced challenges in different areas.

Proposition 5 was partly shown to be correct, in that all industries experience the identified challenges in some form or another. However, it was noted that the degree of the challenges differs between industries.

5.4.6. Proposition 6 – Emerging technology initiatives bring greater challenges to organisations in their value creation initiatives, due to the higher levels of complexity associated with these technologies.

Proposition 6 was shown to be correct, since all respondents indicated that the technology initiatives that they were involved in were significantly more complex, and faced greater challenges when emerging technologies were involved. This further confirms the expected increase in the complexity of the strategic management of technology-enabled capabilities to create value in organisations, due to increased complexity that will result from 4IR related evolutionary and revolutionary expansions.

5.5. Chapter Conclusions

This chapter covered Research Phase A and answered the main research question laid out in Section 3.1. Refer to the propositions from Table 5 (Section 4.3) and the corresponding interview questions from Table 6 for information on how the sub-questions (Section 4.1) were tested. These sub-questions, and the conclusions of the subsequent findings that tie to each of them, are summarised in chronological order as the conclusions to this chapter.

1. How central is the role of technology and innovation in value creation initiatives and how is this expected to change in the future?

Interviewees indicated that both technology and innovation have a central role in value creation initiatives and further expect that these will play a more important and strategic role in future. This is particularly true for emerging technologies and disruptive innovation. This highlights the growing importance of technology-enabled capabilities as defined and conceptualised in Section 3.5.4.

2. Are current technology and innovation initiatives in South Africa focused on emerging technologies associated with the 4IR?

On a more granular level, the validation of proposition 2, based on the expert interviews, indicates a current trend of placing a greater emphasis on digital technologies and initiatives. This seems to indicate that South Africa focuses more strongly on the continual expansion of the Third Industrial Revolution (3IR) than on the new initiatives of the 4IR (consisting of the digital, physical, and biological technology spheres (Schwab, 2016)) or of Industry 4.0 (consisting of the digital/cyber and physical technology spheres (Lee, Bagheri and Kao, 2015)). This may be attributed to the large-scale pervasiveness of digital technologies in most emerging technology trends; or it may be attributed to a lack of other technology focus areas in South Africa.

3. Are the major challenges to creating value through emerging technologies related to the ability to dynamically adapt an organisation's value creation system to align to dynamic changes in its environment?

In this research phase trends were identified that indicate that the major challenge lies with dynamically adapting value creation systems in order to align with dynamic changes within the environment. This challenge was further elaborated on by indicating that the identified major challenges faced by organisations, in creating technology-enabled value in the 4IR, can be attributed to the difficulty of dynamically creating, adapting, and managing the underlying capabilities that enable an organisation's value creation system.

These trends in the challenges experienced by organisations were identified by categorising the challenges reported by the interviewees from a cross-industry perspective. See the open-ended research question, "*what are the major challenges faced by organisations across industries in South Africa, and by the consulting firms themselves, in creating value that is enabled by emerging technologies?*", i.e. Question 4 under Section 5.3.4.

These identified trends further correlate with the dynamic capabilities theory and perspective on strategic management and with the research on strategic alignment. This encompasses the difficulty of adapting capabilities to address dynamic changes, and of maintaining strategic alignment throughout an organisation's value creation system hierarchies while doing so.

Linking dynamic capabilities and strategic alignment, within the literature overview, brought the perspective that the purpose of dynamic capabilities are to some extent to work towards achieving and maintaining strategic alignment throughout an organisation's value creation system hierarchy, i.e. between (1) the external environment and the organisational strategy, (2) the organisational strategy and technology strategy, (3) the aligned strategies and strategy execution (to create value), and (4) strategy execution and the enabling value creation capabilities. The conceptualisation of the link between dynamic capabilities and strategically aligned value creation efforts, throughout the organisational value creation system, was

identified to require a 3-dimensional conceptualisation in order to reduce the associated complexity.

Chapter 6 contains the literature overview of Research Phase B, which aims to cover the elements that constitute a dynamic capabilities approach to strategic alignment toward addressing the identified major challenges discussed in this chapter. This will enable the development of the conceptual model in Chapter 7, which expands the conceptualisation of strategic alignment from Figure 14 into a three dimensional model to represent the strategic management activities involved in dynamically creating, adapting, and managing the dynamic capability elements identified in Chapter 2 throughout the value creation system of an organisation.

4. How do these challenges differ between mature and emerging technologies and across industries in South Africa?

These challenges were also found to be more pronounced when the technology initiatives involve emerging and/or disruptive technologies rather than more mature technologies. The reason for this stems from the increased complexity and dynamic nature associated with emerging technologies. With most of South Africa's industries and organisations still focussing on Digital initiatives (i.e. expanding on the 3IR) and some Industry 4.0 initiatives, this seems to indicate that the identified challenges may be exacerbated in future as the 4IR unfolds due to the increased complexity and dynamisism associated with it. Conceptualising the interplay between the identified elements within this chapter, may add value to addressing these growing challenges as the 4IR unfolds.

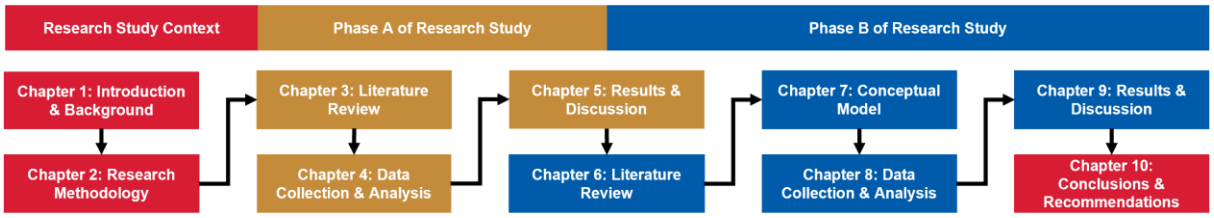
Lastly, it was noted that the details of the reported challenges differ by industry although an industry analysis was not done. Interviewees stated that these industry differences relate to the dominant culture and resistance to change (readiness levels to adopt emerging technologies) in the senior management of the larger organisations in the various industries. The major challenges, as reported, were however present across industries indicating that the identified main challenge is experienced across industries, although what constitutes the

dynamic capabilities and strategic alignment challenges within an industry would be different. This breakdown was not done within this study.

6. Phase B: Literature Review

If we knew what it was we were doing, it would not be called research, would it? - Albert Einstein

6.1. Chapter Overview



Chapter 3, 4 and 5 posed the research question, "What are the major challenges that South African organisations face in their value creation efforts, enabled by emerging technologies, in the 4IR landscape?". It was found that these major challenges relate to the ability of an organisation to adapt to dynamic changes in its environment. This ability to adapt was identified to constitute a dynamic capabilities approach to maintaining strategic alignment throughout the value creation system hierarchies of an organisation including its external environment. This environment was found to not be the 4IR as of yet, but instead largely still focussed on 3IR expansions. It was highlighted that the growing dynamic and complex nature associated with the 4IR is likely to increase these challenges.

Chapter 6 contains the initiation of Research Phase B in the form of the literature review building on the articulation of the identified major challenges from Research Phase A. This literature review aims to further unpack the purpose of and relationship between dynamic capabilities and strategic alignment within the context of this study, by answering the research question:

- What elements constitute a dynamic capabilities approach to strategic alignment?

6.2. Chapter Introduction

The literature review unpacks the theoretical background for the conceptual model within a dynamic capabilities perspective on the Strategic Management of Technology-enabled Capabilities (SMTC) for strategically aligned value creation. This chapter, therefore, focusses on the solutions and approaches found to addressing the identified major challenges from Chapter 5.

The elements of an SMTC approach are first unpacked and framed, which include the primary capability domains that influence the elements of dynamic capabilities within organisations. Following this, principles are discussed for the development of a dynamic capabilities toolkit for achieving and maintaining strategic alignment by bridging the theorectical and practical domains of the topic. The chapter ends by defining futher elements for the external environment that influences the context of the study.

6.3. The Strategic Management of Technology-enabled Capabilities (SMTC)

6.3.1. Strategic Management (SM)

A 'dynamic capabilities' approach ultimately falls within the field of Strategic Management (SM) (Teece, Pisano & Shue., 1997). According to Nag, Hambrick and Chen (2007), SM "deals with the major intended and emergent initiatives taken by general managers, on behalf of owners involving utilisation of resources, to enhance the performance of firms in their external environments". It explicitly covers aspects of linking (aligning) environment, society, enterprise, organisation, management, people, knowledge, outcomes, and value creation (Sahlman, 2010). SM is also defined as a continuous, iterative, cross-functional (multi-disciplinary) process aimed at keeping an organisation as a whole (i.e. as a system) appropriately matched (aligned) to its environment (Certo, Peter and Ottensmeyer, 1995).

SM is concerned with the policy that an organisation adopts to create, enhance and sustain its capabilities based on its environment toward achieving its objectives (Ansoff, 1979). It enables management to optimise the execution of an organisation's strategy/ies in order to realise its strategic objectives, while achieving optimal return on investments and better

organisational performance as a whole (Ansoff, 1979; Sahlman, 2010). SM is particularly important in the complex and changing business and technological environment where strategies are adapted in shorter intervals to account for external dynamic requirements (Sahlman, 2010; Mahmood et al., 2013).

This alignment is achieved by managing a series of steps, from the external requirements and trends, through to the organisation's strategies, defining its value creation efforts (initiatives and processes to realise them), and the required capabilities to create and capture the desired value. These steps, or key activities (shown in Figure 23), form elements of SM capabilities that link to the dynamic capabilities' perspective of how to achieve and maintain strategic alignment (Certo, Peter and Ottensmeyer, 1995; White and Bruton, 2011:41, Jacobs and Pretorius, 2020):

- Strategic Planning, i.e. Formulating/developing strategy/ies and planning their execution;
- Executing (or implementing) the strategy/ies based on the plans; and,
- Performing evaluation/monitoring and control activities to maintain alignment.

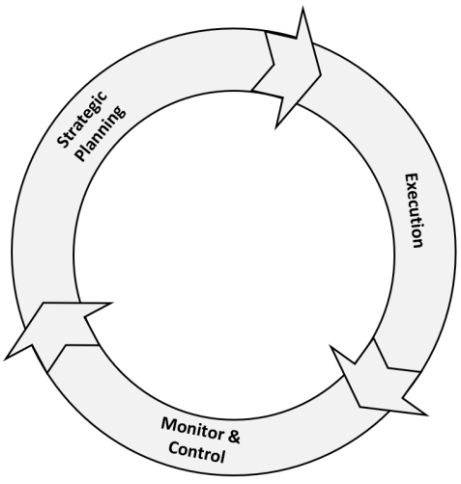


Figure 23: Key Activities in the Strategic Management Process (Certo, Peter and Ottensmeyer, 1995; White and Bruton, 2011:41)

6.3.2. Technology Management (TM)

To integrate the effective use of technical knowledge and skills surrounding technology, Technology Management (TM) is required (Jin and Zedtwitz, 2008). TM provides a systematic

approach to decision-making regarding technology, as the means to address customer needs and to achieve organisational goals. It is an implicit activity, or process of activities, that intertwines an organisation's management with its value offering's development and management (Sahlman & Haapasalo, 2009).

White and Bruton (2011:16) cite a common definition of TM where it is defined as "linking engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organisation." TM is also described as the development and exploitation of technological capabilities that are continuously changing (Best, 2001). In short, TM enables value creation that is affected or enabled by technology in some way, through the management of technology-enabled capabilities. To compete successfully, continue to exist, and create value sustainably, organisations must establish effective TM capabilities. These capabilities stem from the TM activities/processes, shown in the TM Framework (TMF) in Figure 24, across various strategic, innovation and operational business processes (Cetindamar, Phaal and Probert, 2009).

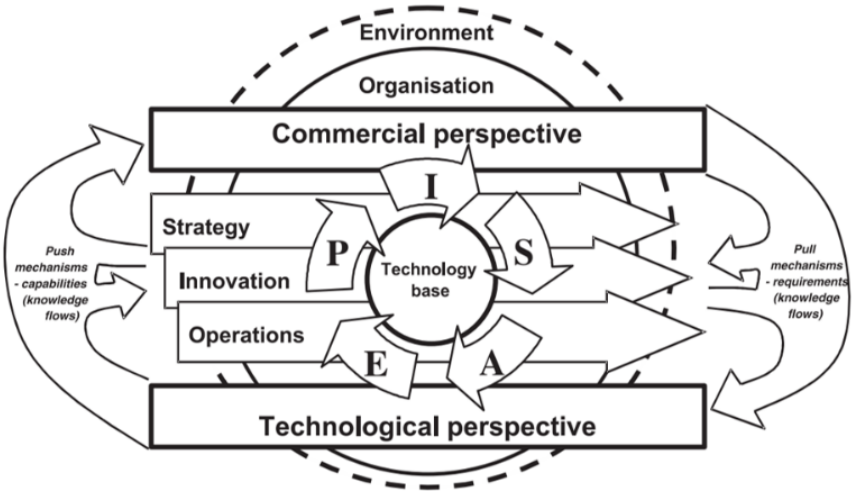


Figure 24: The Technology Management Framework (Probert et al., 2000; Phaal, Farrukh and Probert, 2004)

According to Cetindamar, Phaal and Probert (2009), TM needs to be understood in a way that captures its dynamic nature as well as managerial aspects. For this reason, the TMF is based on and closely linked to dynamic capabilities theory. This includes the idea that technology is

a resource to create value offerings, through technological capabilities that are developed through effective TM activities and processes by the appropriate people with the required knowledge base (Cetindamar, Phaal and Probert, 2009).

Researchers have previously recognised the dynamic nature of managing technology driven value creation efforts and realised that increasing the effectiveness of such efforts is tied to increased synchronicity between hierarchies and processes (Pretorius and De Wet, 1999). They also recognised that this relationship may be conceptualised in a 3-dimentional model as shown in Figure 25, which represents a technology assessment framework to assess levels of synchronisation and thereby the effectiveness of technology-enabled value creation efforts.

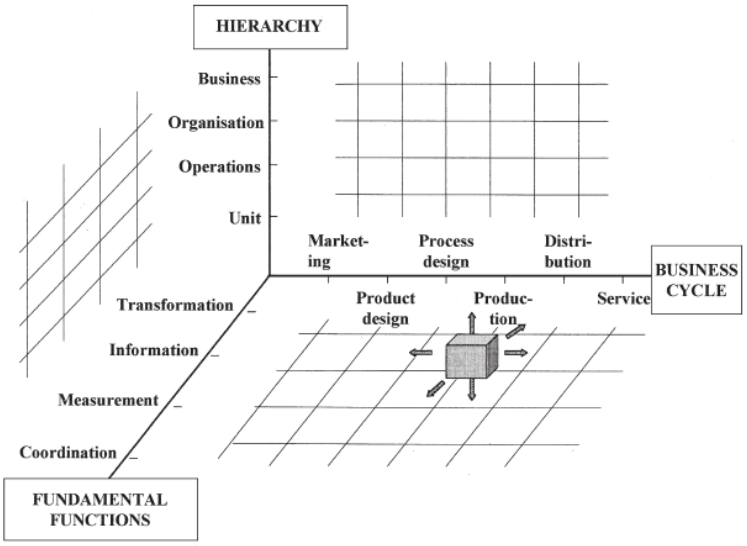


Figure 25: A basic framework for technology assessment (Pretorius and De Wet, 1999)

Both frameworks also emphasise the knowledge flows that must occur between the commercial and technological functions in the organisation. There needs to be alignment between the broadly defined strategy, innovation and operational processes if TM is to be effective (Phaal, Farrukh and Probert, 2004). The TMF also highlights that an appropriate balance must be struck between market 'pull' (requirements and needs) and technology 'push' (technology-enabled capabilities), to align the market and technology domains.

Regardless of the cause of change, managers need to align the market and technology domains (Cetindamar, Phaal and Probert, 2009).

6.3.3. The Strategic Management of Technology (SMT)

To create value within the current business and technological environment as it progresses deeper into the 4IR, the management of technology for organisational benefit requires effective processes and systems to be put in place to align technology capabilities to strategic goals now and in the future. To achieve strategic alignment, the impact of dynamic changes that bring potential threats and opportunities need to be assessed and responses coordinated to account for potentially disruptive and emerging technologies and markets (Christensen, 1997; Phaal et al., 2004; Phaal et al., 2011).

As such, increasing complexities and dynamic changes raises the necessity of both TM and SM capabilities in order to effectively create value (Sahlman, 2010). An approach to TM that helps align organisational strategy, value offering(s), strategic goals, and technology capabilities is therefore increasingly important (Sahlman & Haapasalo, 2009). To account for this need and improve strategic alignment in technology-enabled value creation efforts, it is necessary to integrate the SM and TM fields in the form of the Strategic Management of Technology (SMT) (Sahlman, 2010). The SMT refers to the integration of these capabilities, where the monitor and control activity from SM is particularly lacking in most TM definitions (White and Bruton, 2011:17).

The SMT aims to help link (align) organisational strategies and technologies strategies (Vernet and Arasti, 1999), and contains aspects of explicitly aligning organisational strategies with its value creation systems, its value offerings (products/services) and their creation and revenue model, along with the required technology-enabled capabilities (Sahlman & Haapasalo, 2009). This corelates with the definition from White and Bruton (2011:17) that it serves to enable “the linking of different disciplines to plan, develop, implement, monitor, and control technological capabilities to shape and accomplish the strategic objectives of an organisation”.

Since the SMT refers to the integration of SM and TM, which are both multi-disciplinary fields, it is necessary to understand which fields to draw capabilities from (particularly frameworks, methods, processes and tools that structure the necessary activities and processes) in order to realise effective SMT-related practices. The primary disciplines and knowledges areas, as shown in Figure 26, include (Cetindamar et al., 2009; White and Bruton, 2011):

- Innovation Management;
- Project Management; and,
- Knowledge Management.

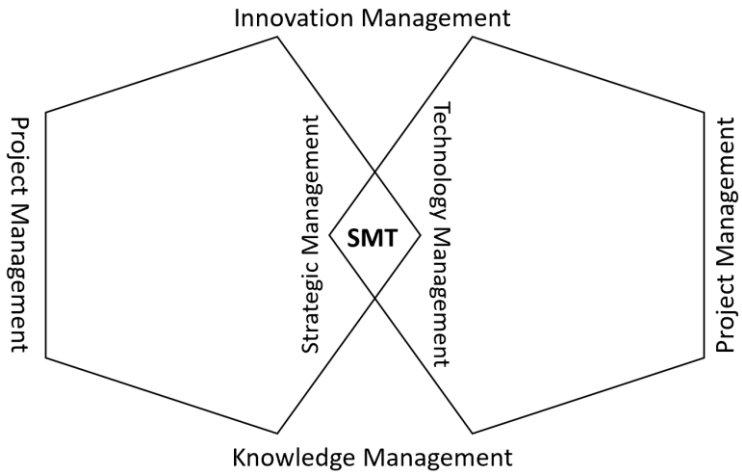


Figure 26: SMT Constituents Framework

It should be noted that each of these disciplines have their own models, frameworks, methods and tools for coordinating the processes associated with their focus areas within the larger value creation lifecycles of the various system hierarchies. These primarily focus on supporting the planning, execution, and monitoring and control of new value initiatives (unique programmes or projects) or standard operations toward achieving the desired value (White and Bruton, 2011:181).

6.3.3.1. Innovation Management (IM)

Christensen (2019) defined innovation as a "change process by which an organisation transforms labour, capital, materials, or information into products and services of greater value." Innovation can also be defined as creating and/or providing something new of value,

such as a product, process or service, to the world, the market, society, or an organisation (Hobday, 2005). Innovation Management (IM) directly involves the management of the discovery and development of such new value offerings (White and Bruton, 2011:23). The major focus in IM is how to recognise potential value and how to assimilate and apply knowledge commercially in value offerings. The scope of IM entails the management of innovation throughout the organisation, from ideas to commercialisation (Sahlman, 2010).

TM relates to IM within the context of how to acquire knowledge and transfer technologies into innovative products or services (Sahlman, 2010), i.e. where technology is involved to create new value offerings. However, the management of technology is seen to involve a broader scope of continuing and nurturing existing technology than does innovation. In the context of technology-enabled value creation efforts, the management of innovation requires technology, but the management of technology does not necessarily require innovation (White and Bruton, 2011:19). It should be noted that, as with TM, IM also requires specific methods and tools for execution if value creation is to succeed (White and Bruton, 2011:21).

6.3.3.2. Project Management (PM)

Kazmi (2008) stated that Project Management (PM) is of utmost importance in strategy implementation/execution. PM is also noted as being sorely absent and neglected from existing frameworks on strategy execution and SM in general. White and Bruton (2011:181) draws a comparison between innovation and projects stating that both are either new or unique. This degree of uniqueness requires specific and systematic processes to get to the desired outcome (value). As such, when creating value that is new or unique the use of PM processes, methods and tools for the execution of value creation projects is appropriate and advised. PM, as a discipline, also has the methods and tools to support the planning, execution, and monitoring and control of technology and innovation projects toward achieving the desired value (White and Bruton, 2011:181).

6.3.3.3. Knowledge Management (KM)

Knowledge Management (KM) is the processes that combine data, information and the knowledge and learning from individuals in a synergistic manner. An organisation needs to

manage its knowledge in a way that leads to the acquisition, selection, organisation, sharing and leveraging of information and expertise that adds value in line with its reason for existence (White and Bruton, 2011:349). KM aims to add and create value by more actively leveraging know-how, experience, and judgment resident within and outside of an organisation (Easterby-Smith and Lyles, 2003). It comprises a range of practices and tools used by organisations to identify, create, represent, and distribute knowledge for reuse, awareness and learning (Cetindamar et al., 2009). As such, KM serves a critical role in dynamic capabilities to optimise and update the knowledge required by both the people and process elements.

6.3.4. A Framework for the Strategic Management of Technology-enabled Capabilities (SMTC)

Considering the given context of the SMT, the Strategic Management of Technology-enabled Capabilities (SMTC) serves to highlight the role of dynamic capabilities in this process. Its aim is to manage value creation systems and their enabling capabilities toward creating value within dynamic environments by maintaining strategic alignment. Figure 27 represents a conceptual framework for the SMTC. It combines the Technology-Enabled Capability Framework, the key activities from SM, and the Strategic Alignment Capacities for a dynamic capabilities perspective.

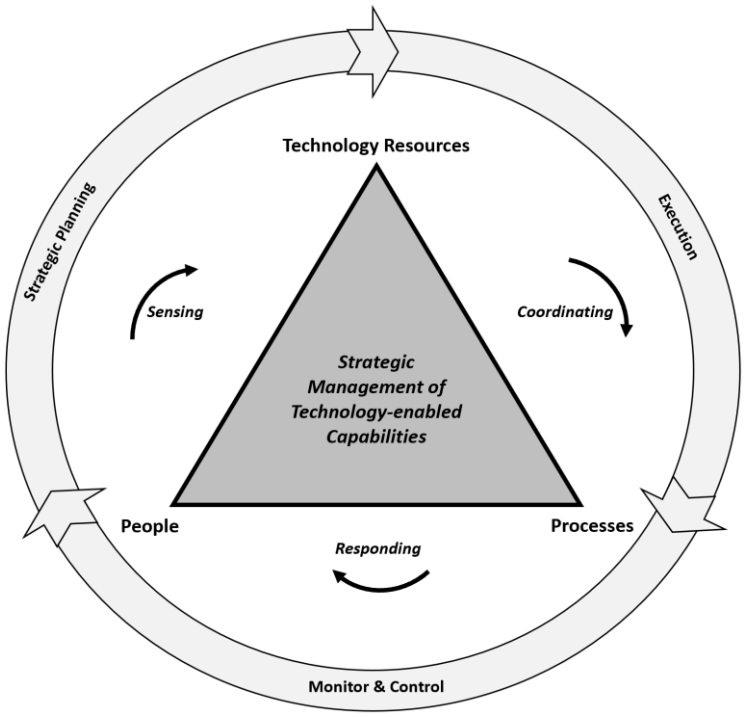


Figure 27: A Framework for the Strategic Management of Technology-enabled Capabilities (SMTC)

6.4. Models, Frameworks, Methods and Tools and their Roles in Value Creation

The role of the models, frameworks, methods and tools that enable action and decision-making by providing structure to the activities and processes involved in the various capabilities discussed need to be defined. However, there is little consistency in the literature on their definition, development and application (Phaal et al., 2001). In this paper, a framework is understood as something that supports understanding and communication of the structure and relationship within a system for a defined purpose. While models have a similar function, they also support the understanding of the dynamic interaction between the elements of a system or how it might work (Phaal *et al*., 2001). According to White and Bruton (2011:28), the management of technology and innovation, in a strategic context, should be understood and described as a systems model. They defined a model as "a representation of a complex process or interaction that allows us to use a simplified picture to better understand complex and abstract ideas".

Phaal et al. (2001) noted that conceptual frameworks and models exist largely in the mind and require practical devices/tools to interface with the real/practical world, in terms of development (induction) and application (deduction). In moving from conceptual models or frameworks to application, the following terms are defined (Phaal et al., 2001; Cetindamar et al., 2009):

- A process is an approach for achieving an objective, through the execution of interrelated or interacting activities that transform inputs into outputs.
- A procedure is a series of steps for operationalising and formalising a process.
- A technique (or method) is merely a structured and explicit way of completing part of a procedure (or process).
- A tool is a way to facilitate (or guide) the practical application of a technique (or method).

6.4.1. Toolkit Development Principles: Framing the Processes of the SMTC

According to Phaal et al. (2006), the "effective management of technology requires practical management tools to support decision-making and action". Similarly, Kerr et al. (2013) maintains that strategy should be seen as something that individuals and managers do, as opposed to something that an organisation has. Therefore, the practical activities involved in the SM of technology-enabled capabilities, including strategic alignment, has a strong link to the tools and methods for enabling action and decision-making (Kerr et al., 2013). Methods and tools therefore play a critical role in the development and modification of capabilities as they directly inform the process element of the Organisational Capability Framework. However, methods and tools are continually adapted to provide the necessary coordination required for effective capability development. Current Agile methods for more efficient and cost-effective software development capabilities is one example (Berruti et al., 2018; Jacobs and Pretorius, 2020).

Considering how wide the SMTC scope is, it should be noted that the specific tools and methods necessary or potentially useful is very broad as well. The importance of identifying, selecting, using and managing such tools should not be underestimated. This is particularly true since the use of formalised tools has been shown to positively affect value creation efforts. For example, Oerlemans et al., (2013) found a strong moderating effect between the use of technology management tools and innovation outcomes (i.e. new value creation). However, their research also indicated an inverted U-shape where an overuse of tools eventually leads to decreased benefits. This highlights the importance of a structured management approach to tool selection and application, where focus is placed on the required capabilities to align with the value creation goals in question.

Phaal et al. (2000) stated that "the effectives of these tools is limited by a lack of fundamental understanding of the structure and application of management tools, together with generally poor levels of awareness of what tools are available". Organisations also have difficulty with selecting, adopting and integrating individual tools into a toolkit that must be implemented within their current organisational processes and systems (Kerr et al., 2013). These challenges are exacerbated by the sheer number of different tools and approaches available, from

various fields and in cross- and inter-disciplinary areas, that may potentially be adopted and applied (Phaal et al., 2000).

Kerr et al. (2013) suggest that a core set of powerful, flexible, scalable and modular tools should be identified that are sufficient for exploring, shaping and implementing possible solutions across a wide array of strategic issues. They quote Whitney (2007) who noted that the assembly of a toolkit used by managers, usually consists of a "favourite collection of tools" that have been built through discovery and experience. This highlights the role of organisational learning to both develop a toolkit and also to adapt its use (processes) to the specific context in which it is used (value focus), in combination with what (resources), and by whom (people and skills). The capability system perspective discussed in this paper supports a structured approach to such modifications.

6.5. The External Environment: The Fourth Industrial Revolution (4IR) Context

6.5.1. Defining an Industrial Revolution & the 4IR

Incremental and radical technological change and trajectories can be understood in terms of technology S-curves, which represents technical performance as a function of time or research effort (Phaal, Farrukh and Probert, 2004; White and Bruton, 2011). As a technology matures, substantial improvements in performance become impossible due to economic or technical constraints (Phaal, Farrukh and Probert, 2004). Mature technologies enable a dominant design to be adopted by most producers. This is the result of a general consensus about attributes and functionality required and typically results in the creation of a stable architecture that the industry focusses its efforts on (Schilling, 2013:59). However, at (or while approaching) the top of its S-curve, where improvements reduce significantly, technologies compete with potential replacements. When this takes place with a dominant design technology, the result is a turbulent environment until a new dominant design emerges (Phaal, Farrukh and Probert, 2004).

Since the magnitude and speed of change in technological developments has been accelerating (Amadi-Echendu et al., 2011), disruptive impacts are pronounced as a result of

technological and dominant design changes (Schilling, 2013:59). When these disruptive impacts manifest rapidly and on multiple levels of value creation systems, the skills and processes required to use the changing technological resources must change accordingly. This leads to new ways of doing things as new capabilities emerge and previous ones are displaced or altered. Such rapid and profound changes may cause an industrial level revolution over the span of a few decades (Cheng, Huang and Ramlogan, 2017; Daemrich, 2017).

This has been evident across the previous three Industrial Revolutions where changes occurred in the widely used technologies (e.g. steam power, electricity, mass production, precision milling, and computing power). However, changes also occurred in the prevalent innovation systems (i.e. the ways of organising, executing and financing innovation), the organisation of labour (i.e. the skills, places and ways of working), and the methods and means of production and consumption. In short, Industrial Revolutions change the way value is created, captured and consumed. These aspects only rarely change together and in a rapid manner. However, when they do, the impacts are significant, consequential, and ultimately manifests on a global scale (Daemmrich, 2017).

According to recent articles, books, conferences, presentations, and particularly policy reports issued by the World Economic Forum, a Fourth Industrial Revolution (4IR) has started (Schwab, 2016; Rose, 2016). Schwab (2016) defined the 4IR as a "fusion of technologies that is blurring the lines between the physical, digital, and biological spheres". Apart from the technology resources, the value creation systems in the 4IR will likely integrate different scientific and technical disciplines and incorporate many skill domains into value creation processes (Brabham, 2015). This convergence of disciplines will accelerate the disintegration of industry boundaries (Schwab, 2016) as technology plays an increasingly important role in enabling new capabilities across the different value creation focus areas of different industries.

6.5.2. Models and Frameworks Representing Industry 4.0 and Relating to the 4IR

Current models relating to the 4IR largely focus on conceptualising 'Industry 4.0', which is the technology trend associated with the increasing advancement and convergence of the digital

and physical technology spheres. This is often referred to as a "cyber-physical" integration with the potential to bring a paradigm change for production systems in the form of "smart manufacturing" (Dorst et al., 2015). In Germany this technology convergence trend is called "Industry 4.0" (Kagermann, Wahlster and Helbig, 2013; Lasi et al., 2014), in the USA the "Industrial Internet of Things (IIoT)" (Veile et al., 2018), and in China "Internet Plus" or "Made in China 2025" (Keqiang, 2015).

In these definitions the integration of the biological technology sphere, as part of the 4IR (Schwab, 2016), is absent. However, Industry 4.0 may represent the transition phase from the Third Industrial Revolution to the Fourth - at a time when what is still evolutionary expansions of the first three revolutions, and what is a revolutionary disruption of a fourth, is not yet clearly articulated. Therefore, an Industry 4.0 framework to represent the system architecture of current disruptive technology trends may provide a useful context for a conceptual model.

Figure 28 illustrates such a framework. It shows hierarchical layers of the Digital (i.e. cyber) technologies within the cyber-physical system in relation to the 5C Reference Architecture (left) from Lee et al. (2018) and the Reference Architecture Model for Industry 4.0 (RAMI 4.0) (right) adapted from Lin et al. (2017). These models represent the internal organisational system enabled by Industry 4.0 capabilities. However, the RAMI 4.0 model in particular notes that beyond the internal vertical integration there is also horizontal integration throughout the value stream (i.e. with suppliers and customers). This indicates the integration of different systems (i.e. different RAMI 4.0 models), creating a system of systems (SoS) (see Section 3.4.1) within the Industry 4.0 environment. The complexity and dynamism of SoSs would further increase as the 4IR expands (see Section 1.2) as the requirements (controls) and enablers (capabilities) create multi-faceted sytemic impacts due to the complex interactions within such SoS environments.

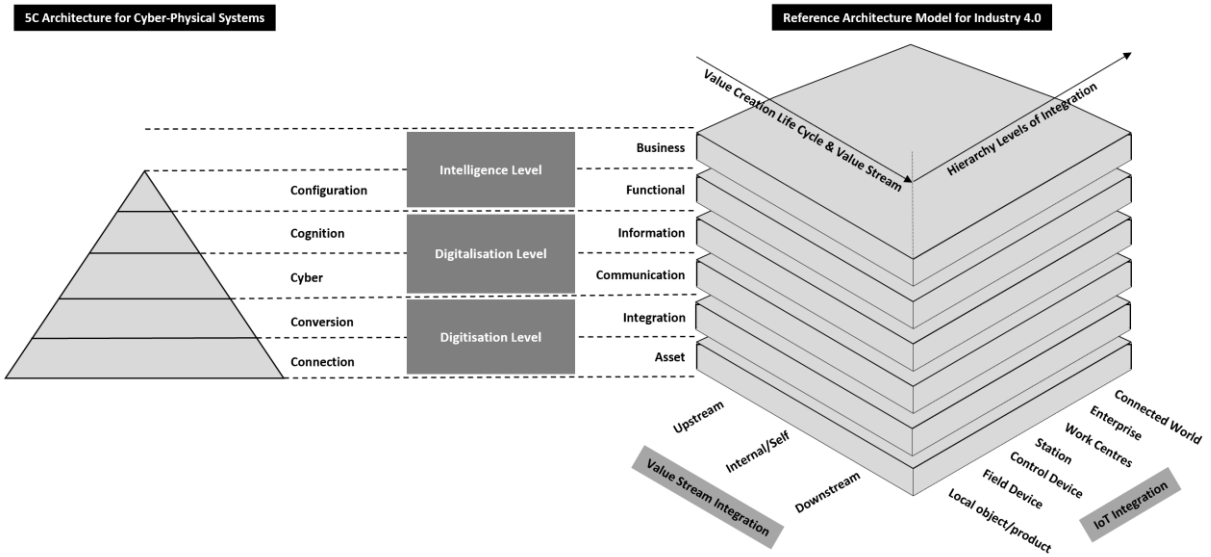


Figure 28: Illustrative Industry 4.0 System Architecture Framework, adapted from Lin et al. (2017) and Lee et al. (2018)

Within the current example, these layers (from the bottom up) may be conceptualised as follows (Lin et al., 2017; Lee et al., 2018):

- The Asset/Connection layer represents the physical technology assets, devices or components (i.e. resources) that connect the physical system to the digital backbone. These assets generate data that should be used in line with the purpose of the overall system, as derived in the Business layer.
- The Integration/Conversion layer represents the amalgamation of the collected data from the assets into a useful format. These two layers are typically represented by the term 'digitisation' which refers to the generation of or conversion into useful digital data.
- The Communication/Cyber layer represents the communication medium or system that transports the collected information from the integrated platform to a server (local or cloud-based).
- The Information/Cognition layer represents the structuring, sense making and analyses of the collected data within the server(s) in order to turn it into comprehensible information within a specified format. These layers typically represent the term 'digitalisation' which is the application of digital technologies to improve or automate processes. The digital technologies within this layer often support data

analytics, decision-making and reasoning methods to recommend adjustments, stabilise production, or monitor the health of a machine or asset.

- The Functional/Configuration layer represents the interface with the management system responsible for the technology application. While automation may be built into and across the previous layers, this layer typically represents the illustration of information for the purpose of decision-making related to the system operation and maintenance.
- The Business layer represents the business-level decisions and objectives that the technology system should serve or support. This may include various business/organisational and strategic objectives which drive the requirement analyses for the technology system's design and development to enable the desired value creation. These upper two layers may be represented as the "Intelligence" layers where insights are derived from the lower levels and where decisions are made that influence the functionality of the levels below.

Considering the increasing importance of the 4IR in technology-enabled capabilities, it is useful to consider these system architecture frameworks when developing conceptual models aimed at assisting with the strategic management thereof. A correlation can be recognised between the hierarchies in Figure 28 and the strategic alignment hierarchies in terms of the alignment between business (strategy), execution (decision-making to support action that drive value creation), and the enabling capabilities (where the Industry 4.0 System Architecture Framework focusses mainly on the technology resources and lacks the other capability elements).

6.6. Chapter Conclusions

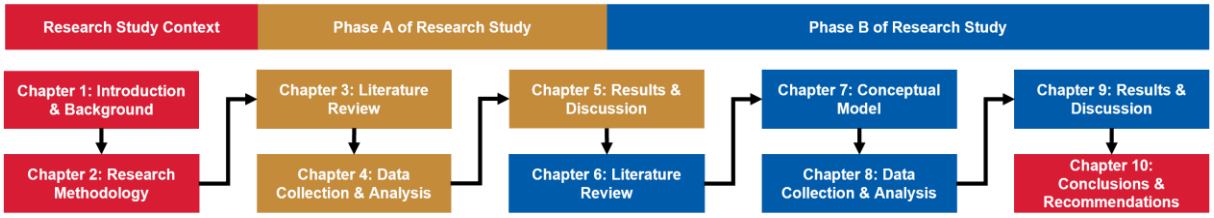
In response to the first research question of Phase B, the literature review focussed on the elements of a dynamic capabilities approach to the strategic management of technology-enabled value creation in order to create strategically aligned value within the 4IR. These included the fields of strategic-, technology-, innovation-, knowledge-, and project management as the primary sources to frame for both conceptualising and managing dynamic technology-enabled capabilities toward strategically aligned value creation efforts.

Furthermore, principles associated with the development of a toolkit to help structure and inform the 'processes and activities' elements of dynamic management capabilities were put forth as identified from the literature. Lastly, frameworks that have shown to improve strategic alignment in practice were discussed and the basis upon which they were built will further inform the next chapter. All frameworks developed throughout this study have served to improve the conceptualisation of the elements involved in the strategic management of technology-enabled value creation and these form the building blocks of the conceptual model in Chapter 7.

7. Phase B: The Conceptual Model

… Essentially, all models are wrong, but some are useful – George Box

7.1. Chapter Overview



Chapter 7 consolidates the frameworks that were developed for the conceptualisation of the key concepts and elements discussed in Chapters 3 to 6. This chapter aims to answer the research question:

- How can these elements be conceptualised to support the strategic management of technology-enabled capabilities?

The result is the 3-dimensional conceptual model of the study.

7.2. Chapter Introduction

The conceptual model is presented within this chapter along with a brief description of its constituent frameworks as presented in previous chapters. This is achieved by first providing practical elements and frameworks for strategic alignment in practice before conceptualising the 3D model as idenfitied to be required in Chapter 5.

7.3. Practical Elements for a Model for the Strategic Management of Technology-enabled Capabilities

To support the practical application application and testing of the theoretical model, such as in strategic workshops, the following frameworks were identified for integration into the model development.

7.3.1. A Roadmapping-based Framework for Enabling Strategic Alignment over the Value Creation Lifecycle

As noted in the previous chapter, there are many tools that can address or assist in addressing the issue of alignment which makes selection difficult. This poses a challenge since conflicting tools waste effort or even damage results (Probert et al., 2003). Strategic alignment should preferably be planned and managed through flexible approaches that enable a systems view of the whole instead of focussing on single layers (e.g. strategy) or single technology spheres (e.g. IT/Digital).

The most prominent framework (and tool) that provides flexibility, conceptualises system hierarchies, and enables strategic alignment is technology roadmapping (Phaal et al., 2001; Whalen, 2007; Carvalho et al., 2013). Roadmapping, as a framework for strategic management in action, improves the alignment (or integration) between strategic and technology management (Groenwald, 1997) and between the strategic, business/operational and technology perspectives of an organisation (Carvalho et al., 2013). Figure 29 is a schematic of a multi-layered roadmap used for aligning value creation efforts, from the market down to the resources required to create value for it.

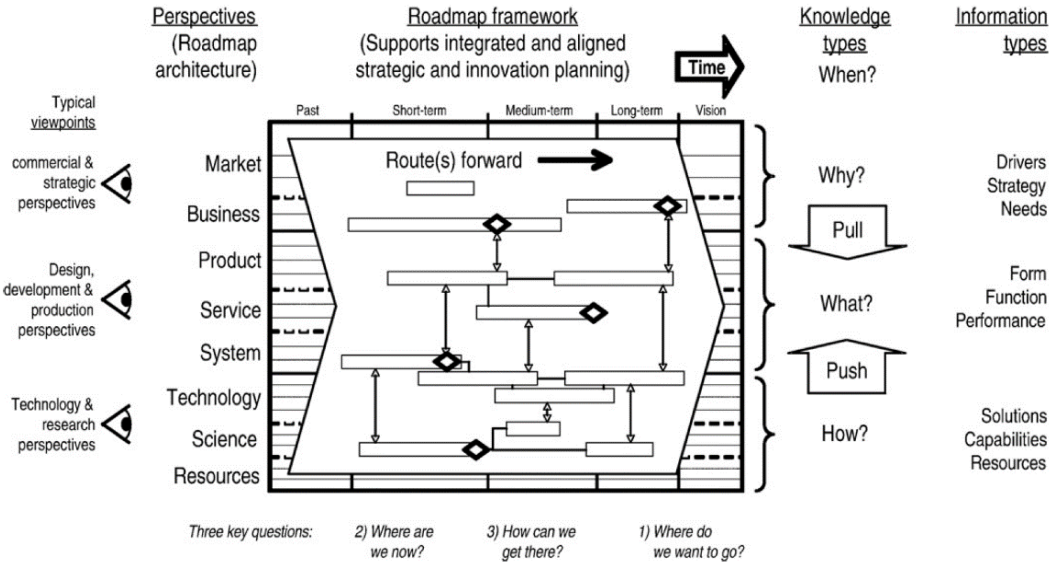


Figure 29: Schematic of a multi-layered roadmap for aligning strategy (Phaal and Muller, 2009)

Roadmaps are dynamic and flexible and can be adapted to various strategic and value creation contexts. They have an inherent alignment function that stems from their systems framework where the architecture provides a coherent and holistic structure that serves as a common language. Within this structure the business or system and its components, including their development and evolution, can be explored, mapped and communicated in a concise manner (Phaal and Muller, 2009).

Figure 30 shows (on the left) a Strategic Planning type roadmap framework that focuses on the development of a vision of the future of an organisation over various strategic timelines. Mapping the future vision enables the identification of gaps as compared to the current position of the organisation. Strategic options may then be explored to bridge these gaps by taking a systemic approach to mapping the necessary value creation efforts that would close those gaps toward capturing the desired value (Phaal et al., 2004).

Figure 30 further shows (on the right) how these layers relate to the strategic alignment hierarchy within the value creation system hierarchy framework of Figure 14. The Market layer was expanded to include the External Environment to account for dynamic trends. The Business layer was expanded to include Organisational and Technology strategies. The Product layer was changed to the Value Initiative layer to account for strategy execution, normal operations driving value offerings, or unique efforts such as innovation projects that aim to create value following the strategic intent. The last three layers were consolidated into the Capabilities layer as per the framework in Figure 14, where ‘Organisation’ refers to the processes involved in organising the technology resources and human skills. These generic layers may be adapted (changed, expanded, or consolidated) to suit individual needs. In practice, a swimlane diagram approach has proven useful to align and connect functions, efforts or other elements within the framework.

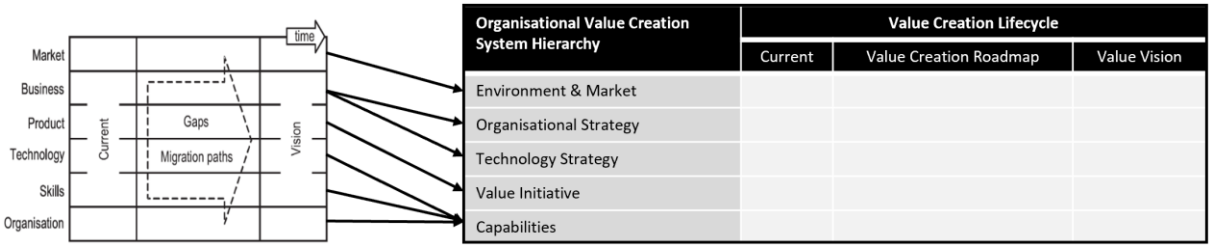


Figure 30: Strategic Planning type Roadmap (Phaal, Farrukh and Probert, 2004) and the Roadmapping Framework for the SMTC

7.3.2. A Value Creation Lifecycle Framework

Ker et al. (2013) suggests that when applying methods and tools from one's toolkit, it should be in a 'lightweight' manner. This is based on the premise of "start small and iterate fast" to have enough flexibility and avoid being too prescriptive. A 'lightweight" approach, in this sense, corresponds with 'agile approaches'. This principle is particularly useful in a workshop setting, such as when developing strategic technology roadmaps. Modifying the use of methods and tools should support discussion and aid decision-making for the specific focus and group size applicable to the strategic management effort. It is important to note that the objective is to work towards a mutual understanding in order to reach an agreement on how to carry out an action, based on an informed and thought through basis (Ker et al., 2013).

In support of this principle, Ker et al. (2013) proposed a 'Generic Lightweight Process' (see Figure 31) to facilitate and structure the use of methods and tools in agile workshop-based strategic sessions. This process is based on iterative divergent-convergent phases, of taking holistic perspectives before synthesising and narrowing in towards the focal point. The process can also be tailored to suit specific needs, while functioning as a guideline for the overall value creation process. The overall process should cover the macro-level broad steps for the organisation in the short-, medium- and long-term, which should take into consideration how alignment will be achieved between the initiative(s) and other core business/strategic deadlines/timelines. It should also consider the micro-level steps, including workshops to develop the roadmap on the value creation initiative(s). Other factors to consider when developing specific initiatives (or resulting projects) from this generic process include (Ker *et al.*, 2013):

- Ownership (a clear link to organisational purpose and a problem owner);
- Scope (boundaries for the domain of interest);
- Focus (the focal issue driving the need);
- Aims (goals and objectives that the organisation aims to achieve in terms of realising value);
- Resources (the level of resources the organisation is willing to commit in terms of people, infrastructure, equipment, effort, finances, etc.);
- Participants (a multi-functional team with the required skills); and,
- Processes (the organisation of the resources and people to form capabilities that enable execution).

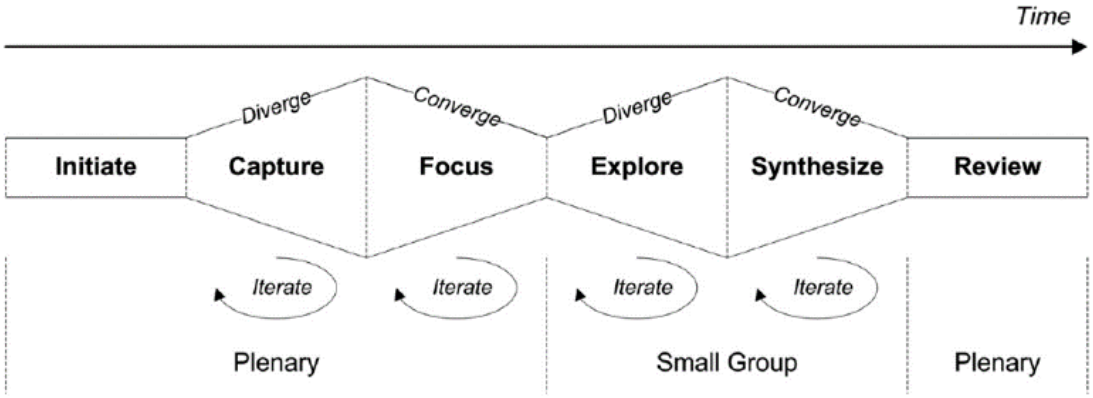


Figure 31: "Generic Lightweight Process" to facilitate and structure the use of strategic technology management tools in workshop-based strategic sessions (Ker et al., 2013)

Using the generic lightweight process as the base, the Value Creation Chain (VCC) was developed (see Figure 32) by including more detail on activities within the phases. Its development was done by considering the common elements from various models, frameworks, methods and tools applicable to value creation processes within the scope of the SMTC Constituents Framework (Figure 26). These included elements from strategic management (e.g. Pillkahn, 2008; Pearce II and Robinson, 2011; Stalk and Stewart, 2019), technology management (e.g. Phaal *et al.*, 2004; Schilling, 2013; Cetindamar, Phaal & Probert, 2016), innovation management (e.g. White and Bruton, 2011; Dam & Siang, 2019), project management (e.g. White and Bruton, 2011; Steyn *et al.*, 2016), and knowledge management (e.g. Mortara *et al.*, 2009).

The VCC is a conceptualisation of an iterative process, consisting of divergent and convergent phases. These phases are represented as loops, with specific generic activities for each of two generic loops. Various iterations through the generic activities may be required within each loop, creating multiple loops before the process continues to the next phase (hence the term 'chain'). In turn, each loop must converge on a point (a decision, plan or action). The learning that takes place during iterations or at the convergent points must feed back into either loop to instigate new iterations.

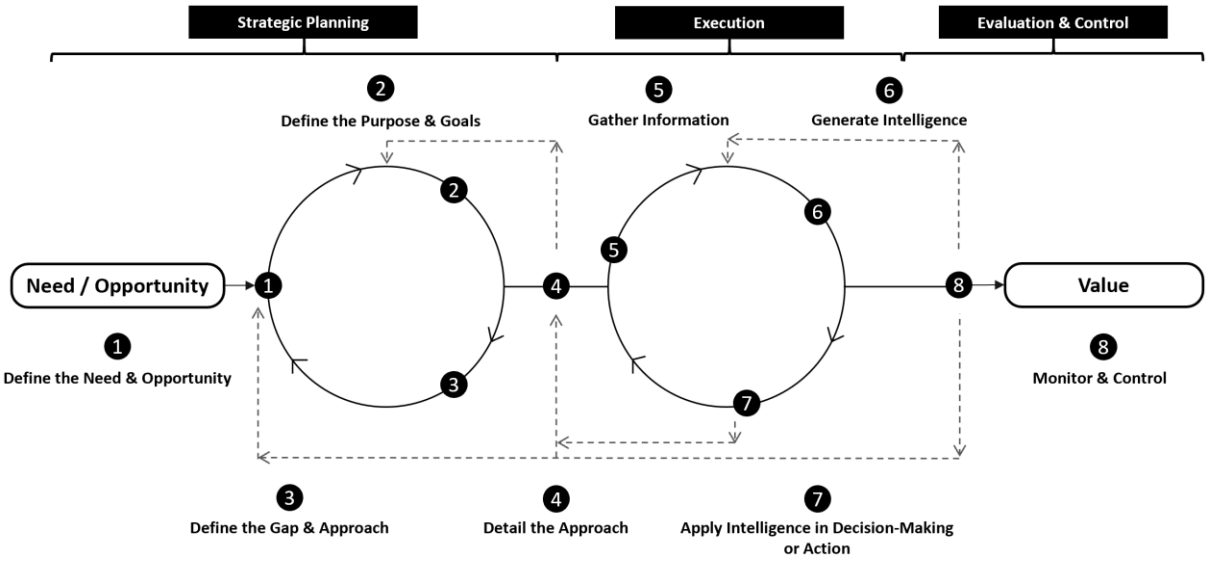


Figure 32: The Value Creation Chain - A Framework for an Iterative Strategic Management approach to Value Creation Processes across the Value Creation System Hierarchies

There are eight generic activities within the VCC. These are listed below, including a few guiding questions and actions for each:

1. **Define the Need & Opportunity**: What is the need/problem and corresponding opportunity to create and capture value? Why should this be addressed or exploited? Understand, identify and define the need and why there is an opportunity. Gain key stakeholder consensus;
2. **Define the Purpose & Goals**: Why start a project/initiative? What should the project/initiative achieve? Acknowledge the need/opportunity and set the value vision. 'Paint the future'. 'Set the scene'. Gain key stakeholder consensus;

3. **Define the Gap & Approach**: How will the value vision be achieved? Define the roadmap to the value vision and the framework for execution. Gain key stakeholder consensus on the gap to be bridged.
4. **Detail the Approach**: Exactly what do we need to do to make this a success? Who will do it, where, and by when? What criteria will be used to measure successful value creation? Develop the detailed execution plan.
5. **Gather Information**: What do we need to know? Where can we get the information or know-how, or how can we learn it? Gather the required info to support decisions and actions.
6. **Generate Intelligence**: What can we learn from all this info? Why this way? Think. Understand. Learn. Design. Build. Measure. Explore. Gain insights.
7. **Apply Intelligence in Decision-Making or Action**: How can we use this to create value or make progress toward the strategic goals? What should be done differently and how do we act? Define the next steps. Develop action plan. Make decisions and take action.
8. **Monitor & Control:** Are we executing everything according to plan? Do we need to adapt anything? What is the next step in the VCC Process? What can we measure? Have we successfully created value? What was the real impact in the end? Did we adapt, and how, and what was the effect? What did we learn from this process? Measure the impact of what was done or created and learn from the process.

Ultimately, the VCC functions to guide the activities and process of value creation efforts within the conceptual model discussed next. This applies to each individual layer of the value creation system hierarchy as each have processes (as directed by the applicable methods and tools) specific to the efforts within that layer.

7.4. The Conceptual Model

In Chapter 2 Figure 14 showed a 2D conceptualisation of strategic alignment, through the value creation system hierarchies of an organisation, while taking a lifecycle perspective. It was identified that the conceptualisation required a third dimension to represent the strategic management activities involved in dynamically creating, adapting, and managing the

capability elements throughout the value creation system of an organisation. Figure 33 shows this 3D conceptualisation, which forms the basis of the model of this study.

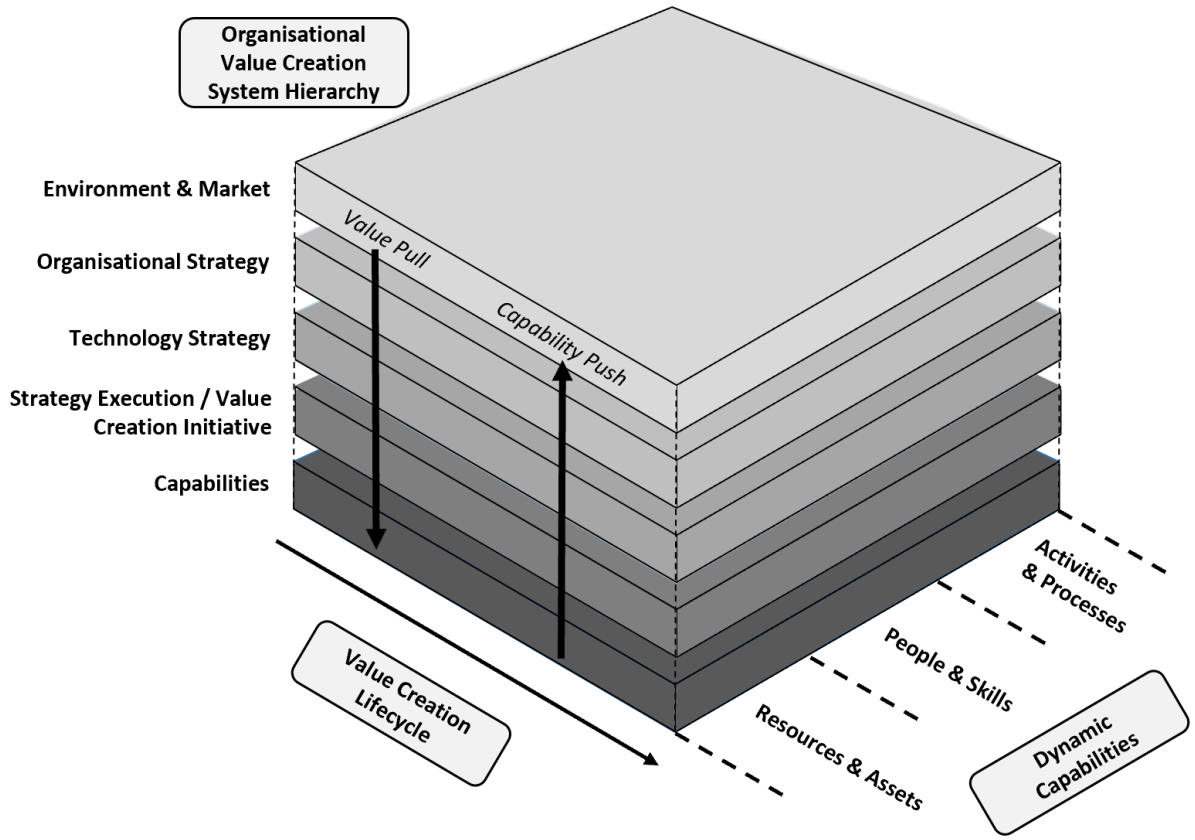


Figure 33: A Conceptual Model for the Strategic Management of Technology-enabled Value Creation Efforts

The 'Conceptual Model for the Strategic Management of Technology-enabled Capabilities' integrates the strategic alignment concepts from Figure 33 with the 'Roadmapping Framework for the SMTC from Figure 30 to support strategically aligned value creation in practice. The 'Dynamic Capabilities' dimension was expanded by including the Strategic Alignment Capacities (from Table 4), in relation to the Value Creation System Hierarchy (from Section 3.6.1), to conceptualise how strategic alignment is achieved from a system perspective. This model further supports and conforms to the Industry 4.0 System Architecture Framework shown in Figure 28, which represents a good basis for future 4IR System Architecture Frameworks.

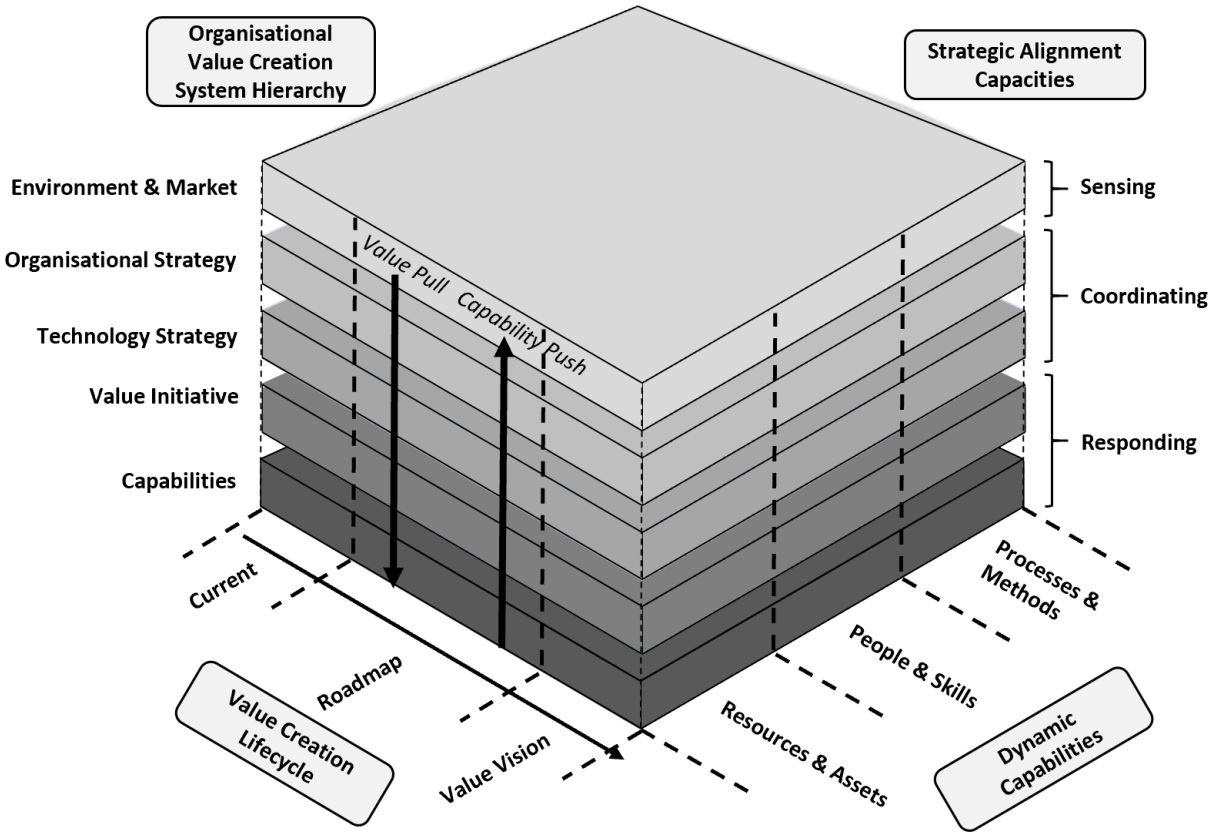


Figure 34: A Conceptual Model for the Strategic Management of Technology-enabled Capabilities: A Dynamic Capabilities approach to Strategically Aligned Value Creation within the Fourth Industrial Revolution

The resulting 3D model may be conceptualised as a Rubik's cube (divided along the indicated dotted lines), consisting of multiple blocks that each contain 3-dimentional information and that interface on these different dimensions with other adjacent blocks, where the information associated with each dimension is specific to the position of that block within the cube.

7.5. Chapter Conclusions

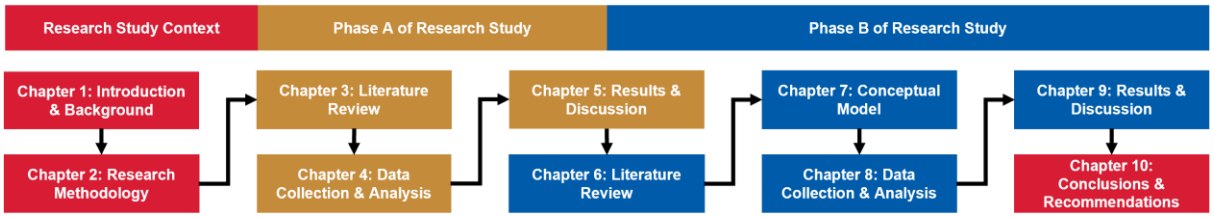
The presented conceptual model serves as the response to the second research question of Phase B. This model serves to provide context to the complex system surrounding the strategic management of technology-enabled capabilities, from a dynamic capabilities perspective on strategically aligned value creation. The model further corresponds to popular Industry 4.0 System Architecture Frameworks. The hierarchies are flexible and modular and can be

modified as necessary, such as expanding the main system hierarchies to include sub-layers (e.g. including corporate-, business- and functional strategies instead of the generic organisational strategy and listing the three capability elements on the capability layer to account for the necessary detail, etc.). Lastly, learning from the TMF, strategic alignment requires a balance between the value pull from the environment and market (e.g. to address a problem, need, or requirement or to exploit an opportunity) and the organisation's capability push (i.e. what value it can create and offered by leveraging existing capabilities).

8. Phase B: Data Collection and Analysis

What I've found in my research is that realism and self-honesty are the antidote to ego, hubris, and delusion – Ryan Holiday

8.1. Chapter Overview



Chapter 8 discusses the data collection and analysis of Phase B to support the results in the next chapter that would answers the research question:

- Are organisations that are more effective at strategic alignment, as conceptualised by the model, also more effective at value creation within dynamic environments?

8.2. Chapter Introduction

Following the literature review of Phase B and the development of the conceptual model to frame everything that has been covered within this study so far, some operational hypotheses were developed. These hypotheses are listed next, before the data collection and analysis methods are discussed. The outcomes of the reliability and validity tests that were performed prior to the analyses are also noted in this chapter.

8.3. Hypotheses

The research method in Phase B aimed to test the proposed conceptual model in Chapter 7, by answering research question 4 listed in Table 1, through the hypotheses (particularly H1) listed in Table 7. These hypotheses were developed by considering the elements impacting strategically aligned value creation as identified throughout the study (particularly from

section 3.6) and as conceptualised and framed in the conceptual model. The aim was to test correlations to value creation capacities across the different hierarchies of the model.

With the model's development stemming from a broad scientific research base, the validation focussed on the correlations between dynamic alignment capabilities and activities, their resulting strategic alignment capacities, and the effect on an organisations' ability to create value in dynamic environments (such as the 4IR and the COVID-19 global pandemic period).

Table 7: Hypotheses

No.	Hypothesis
H1	Organisations with higher Strategic Alignment Capacities, that are predicated on a dynamic capabilities approach, have higher Value Creation Capacities.
H2	Organisations with higher Sensing Capacities have a higher Coordination Capacities.
H3	Organisations with higher Coordination Capacities have a higher Responding Capacities.
H4	Organisations with higher Aligning Capacities have a higher Value Creation Capacities.
H5	Organisations that have higher sensing capacities for alignment changes within their value creation systems, and higher capacities for coordinating strategic responses to improve this alignment, have higher capacities for aligning their internal value creation efforts with their strategies.
H6	Organisations that are more effective at coordinating their value creation efforts (across teams, business units, and within their broader value streams), are more effective at aligning their internal value creation efforts to strategic objectives.
H7	Organisations that are more effective at reconfiguring all three capability elements (modifying existing and integrating new capabilities), have higher Aligning Capacities.
H8	Organisations that are more effective at reconfiguring all three capability elements (modifying existing and integrating new capabilities), have higher Value Creation Capacities.

8.4. Data Collection: Quantitative Surveys

A dynamic theory consideration was taken, in order to examine how various systems and their parts behave under the influence of dynamic forces that move it away from or towards equilibria (Gibbons, 1992). As such, the causal mechanism in this study involved the resulting impact from dynamic environments (Makadok, Burton & Barney, 2018), such as the COVID-19 pandemic and the 4IR landscape associated with dynamic and fast-paced business and technology trends.

Within this dynamic context, the phenomenon under consideration were drawn from large organisations across various industries. The level of analysis was on the business unit level (Makadok, Burton & Barney, 2018). This included the value creation focus of different business units in terms of their purpose within the larger organisational value creation system. This level of analysis provided insight into all layers of the value creation system, from the perspective of the business units, extending from the generic corporate strategy layer through to the capability layer of the individual business units.

This study adopted the perspective of Rumelt, Schendel & Teece (1991) in that the field of strategic management is not defined by any specific theoretical paradigm, but instead by its focus on a particular dependent variable, i.e. overall organisational performance, and the role of managers in shaping that performance. In the context of this study, overall organisational performance relates to the capacity to create value (as the primary dependent variable). The constructs and independent variables, measured for their correlation to an organisation's value creation capacity, included dynamic capabilities along with their enabling abilities and resulting strategic alignment capacities (Wetering, Mikalef & Pateli, 2017; Makadok, Burton & Barney, 2018).

To measure these constructs within various value creation systems an online quantitative survey questionnaire was developed with 42 questions. These questions asked respondents to rate the level of effectiveness of various dynamic capabilities' activities/processes (as per Table 4) within their organisation (business unit focus) on a Likert scale of 1 (not effective at all) to 7 (highly effective). The instructions requested that respondents consult other members

of their organisation where they may lack insight. Eighteen questions covered activities under the Sensing Capacity, twelve the Coordinating Capacity, eight the Responding Capacity, and four the Value Creation Capacity.

The survey was pretested through pilot surveys with a small select group of experts and non-response and common method bias actions were considered. To account for non-response biases on the questions, all questions were made compulsory. In order to control ex-ante for common method bias, the participation in (and submission of) responses was purely voluntary, and respondents were assured that collected data would remain anonymous and would be used for research purposes at an aggregate level only (Saunders, Lewis and Thornhill, 2009; Wetering, Mikalef & Pateli, 2017). The questionnaire design also dispersed related variables to account for common method bias in question sequence and formatting (MacKenzie & Podsakoff, 2012).

The final survey questionnaire was sent to key informants typically working in both the business and technology domains or where these domains interface. A non-probability sampling approach was followed. Key informants were initially contacted from the authors' network of experts (convenience sampling). Referrals were then requested to reach as many key informants as possible (snowball sampling) (Saunders, Lewis & Thornhill, 2009). Participants included senior managers (e.g. heads of R&D, innovation, new products, manufacturing, and operations), domain experts (enterprise architects, experienced consultants), directors (business, Industry 4.0, new technology, innovation, and digital enterprise leaders), and executives (Chief Digital/Technology Officers, and Digital or New Technology Vice Presidents). The matrix below indicates the spread of roles by industry/market.

Table 8: Survey respondents by designation and industry

	Mining & Mineral Resources	Professional Services	Consulting	Technology Products & Services	Processes & Chemicals	Media and Entertainment	Telecommunications	Manufacturing	EPCM	Logistics
Chief Digital/Technology Officer		x								
New Technology / Digital Vice President					x					
New Technology & Innovation Lead	xx	x	x		x	x				x
R&D Lead	x			x				x		
New Products Lead				x						
Manufacturing Lead										
Operations Lead	x		x				x		x	
Digital Enterprise Lead		x	x							
Business Development Director/Executive	xxx			x						
New Technology / Innovation Director										
Enterprise / Systems Architect	x					x				

All respondents were requested to participate in a voluntary interview after the submission of their responses. Six respondents agreed and were interviewed. The goal was to gain a better understanding to support the interpretation of the results. The interview questions focussed on how they interpreted and answered the questions from their perspective (through standard close-ended questions), as well as gaining a better understanding of the context of their environment and value creation systems (through open-ended questions exploring their circumstances in greater depth).

The duration of the cross-sectional data gathering process lasted approximately three months (July 2020 – September 2020, which was between three to six months after the lockdown period was initiated in South Africa in response to the pandemic). The pandemic limited access to and the responsiveness of potential research participants and it took some to get permission to engage further. Around fourty total suitable candidates were contacted from thirty different organisations and requested to participate in the research study.

A total of 25 valid responses were obtained which included 18 different organisations. The remaining 7 responses included different businesses units from the same organisations. These were all large firms as per the EU commission size-class recommendation (2003/361/EC) (European Commission, 2015), where 16 firms (making up 23 of the responses) had global operations and 2 had strong global networks while their operations were focussed on South Africa. The market segmentation of these firms included mining and mineral resources (32%), professional services (12%), consulting (12%), technology products and services (12%), processes and chemicals (8%), media and entertainment (8%), telecommunications (4%), manufacturing (4%), EPCM (4%), and logistics (4%).

See Appendix H for the responses obtained.

8.5. Quantitative Data Analysis

8.5.1. Reliability and Validity Tests

A factor analysis was performed (as shown in Appendix F) to ensure that the constructs consisted of single factors. SPSS (V26) was used to establish construct reliability and positive inter-correlation by determining the Cronbach's Alpha (α) values for both the dependent and independent constructs (see Table 9). All constructs had high α values above the threshold of 0.70 (Nunally and Bernstein, 1978; Mitchell, 1996), except for two, where one (V9) met the threshold of 0.6 (Griethuijsen et al., 2015; Taber, 2018), and the other (V51) had an α value of 0.28. The mean (μ) scores of the various sub-variables were used to score the constructed variables (in SPSS) shown in Table 9 for those α values that met the 0.6 threshold, while the Factor Score was used (in SPSS) to construct V51.

Table 9: Variables

No.	Variables & Groupings (X | Y = Alignment between X to Y)	Questions / Variables	μ	SD	α
V1	Creating Value: Realising Strategic Value Goals	Q5	4.60	1.12	
V2	Creating Value: Seizing New Opportunities	Q8	4.76	1.33	
V3	Creating Value: Innovation supporting future goals	Q9	4.84	1.43	

V4	Creating Value: Realising Project/Initiative Goals	Q23	4.60	1.41	
V5	Value Creation Capacity	V1 to V4	4.70	1.32	0.82
V6	Sensing Changes and Evaluating Implications/Disruptions: External Environment	Q1	5.16	1.18	
V7	Sensing Changes and Identifying New Opportunities: External Environment	Q2	5.20	1.15	
V8	Sensing New Opportunities that Align with Capabilities: External Environment | Capabilities	Q6	5.12	1.20	
V9	Sensing Capacity: External Changes and Implications	V6 to V8	5.16	1.18	0.60
V10	Sensing Alignment Changes: Organisational Strategy | External Environment	Q3	4.72	1.21	
V11	Sensing Alignment Changes: Technology Strategy | Organisational Strategy	Q10	4.44	1.58	
V12	Sensing Alignment Changes: Technology Strategy | External Environment	Q11	4.76	1.09	
V13	Sensing Capacity: Alignment Changes between Strategies & Environment	V10 to V12	4.64	1.29	0.82
V14	Sensing Alignment Changes: Value Offering | External Environment	Q16	5.12	1.05	
V15	Sensing Alignment Changes: Value Creation | Strategy Level (Organisational Strategy & Technology Strategy)	Q17	5.00	1.08	
V16	Sensing Alignment Changes: Value Creation | External Environment	Q18	5.00	0.91	
V17	Sensing Capacity: Alignment Changes in Value Creation to Strategy & Environment	V14 to V16	5.04	1.02	0.69
V18	Sensing Alignment Improvements: Capabilities | External Environment	Q25	4.48	1.36	

V19	Sensing Alignment Improvements: Capabilities | Value Creation (Current Strategic Goals)	Q26	4.52	1.00	
V20	Sensing Alignment Improvements: Capabilities | Strategy Level (Future Goals)	Q27	4.64	0.91	
V21	Sensing Alignment Improvements: Capabilities | External Environment (New Opportunities)	Q28	4.48	1.12	
V22	Sensing Capacity: Capability Alignment Improvements	V18 to V21	4.55	1.09	0.84
V23	Sensing Capacity: Alignment Changes in Value Creation System	V9, V13, V17, V22	4.74	1.13	0.80
V24	Assess Needs: Technology Resources | Value Creation (New Initiative)	Q33	5.12	0.97	
V25	Assess Needs: People and Skills | Value Creation (New Initiative)	Q34	5.00	1.26	
V26	Assess Needs: Processes and Methodologies | Value Creation (New Initiative)	Q35	4.88	1.17	
V27	Sensing Capacity: Capability Needs for New Value Creation Initiative	V24 to V26	5.00	1.13	0.86
V28	Learning: Supporting alignment Value Creation | Strategy level & Value Creation	Q24	4.76	1.27	
V29	Learning: Supporting alignment Value Creation | Capabilities	Q42	4.88	1.30	
V30	Learning Capacity	V28, V29	4.82	1.28	0.76
V31	Sensing Capacity	V9, V13, V17, V22, V27, V30	4.87	1.16	0.85
V32	Coordinating New Opportunity Response: Organisational Strategy | External Environment	Q7	4.44	1.56	
V33	Coordinating Alignment Response: Organisational Strategy | External Environment	Q4	4.72	1.57	
V34	Coordinating Alignment Response: Technology Strategy | Organisational Strategy	Q12	4.60	1.22	

V35	Coordinating Alignment Response: Technology Strategy | External Environment	Q13	4.04	1.31	
V36	Coordinating Capacity: Strategic Responses on Alignment	V32 to V35	4.45	1.41	0.86
V37	Coordinating enabling technology acquisition, implementation, utilisation: Technology Strategy | Value Creation & Capabilities	Q14	4.04	1.43	
V38	Coordinating new technology acquisition, implementation, utilisation: Technology Strategy | Value Creation & Capabilities	Q15	4.28	1.43	
V39	Coordinating Capacity: Technology-enabled Capabilities	V37, V38	4.16	1.43	0.84
V40	Acquiring TR: Capabilities | Value Creation (New Initiatives)	Q36	4.56	1.71	
V41	Acquiring PS: Capabilities | Value Creation (New Initiatives)	Q38	4.32	1.68	
V42	Acquiring PM: Capabilities | Value Creation (New Initiatives)	Q40	4.88	1.54	
V43	Acquiring Capacity: Technology-enabled Capabilities	V40 to V42	4.59	1.64	0.76
V44	Coordinate within value stream: Value Creation	Q19	4.60	1.26	
V45	Coordinate between silos/units: Value Creation	Q20	4.76	1.27	
V46	Coordinate between capabilities: Value Creation | Capabilities	Q21	4.00	1.32	
V47	Coordinating Capacity: Value Creation Efforts	V44 to V46	4.45	1.28	0.75
V48	Coordinating Capacity	V36, V39, V43, V47	4.44	1.44	0.86
V49	Responding to change: Aligning Value Creation | Strategy Level	Q22	4.76	1.20	
V50	Responding to change: Aligning Capabilities | Organisational Strategy (Future Objectives)	Q29	4.08	1.61	

V51	Aligning Capacity: Internal to Strategy Level	V49, V50	4.42	1.40	0.28
V52	Aligning Capacity	V36, V51	4.44	1.41	0.88
V53	Responding to change: Modifying Existing Technology Resources | Value Creation (Current Value Offering)	Q30	4.32	1.46	
V54	Responding to change: Modifying Existing People and Skills | Value Creation (Current Value Offering)	Q31	4.44	1.50	
V55	Responding to change: Modifying Existing Processes and Methodologies | Value Creation (Current Value Offering)	Q32	4.56	1.26	
V56	Modifying Capacity	V53 to V55	4.44	1.41	0.75
V57	Responding to change: Integrating New Technology Resources | Value Creation (New Initiative)	Q37	4.56	1.53	
V58	Responding to change: Integrating New People and Skills | Value Creation (New Initiative)	Q39	4.32	1.25	
V59	Responding to change: Integrating New Processes and Methodologies | Value Creation (New Initiative)	Q41	4.64	1.38	
V60	Integrating Capacity	V57 to V60	4.51	1.39	0.86
V61	Responding Capacity	V49, V50, V56, V60	4.46	1.40	0.86
V62	Strategic Alignment Capacity	V31, V48, V61	4.77	1.33	0.91

8.5.2. **Quantitative Analyses**

A Pearson correlation analysis (R) was calculated, which is an adequate assessment method to explore the correlation between dynamic capability dimensions and value creation outcomes on a Likert scale (Van de Wetering *et al.*, 2017). However, to account for potential non-linear relationships, Spearman's rank correlation coefficient (ρ) was also calculated for

the ranked data obtained. The two correlation analyses could then be compared when interpreting the data and the more conservative calculations were used. For both analyses two-tailed significance was tested and found to be below the 0.05 threshold for all instances. SPSS V26 was used for all analyses and the outcomes compared with calculation formulas in Microsoft Excel to detect and account for potential errors.

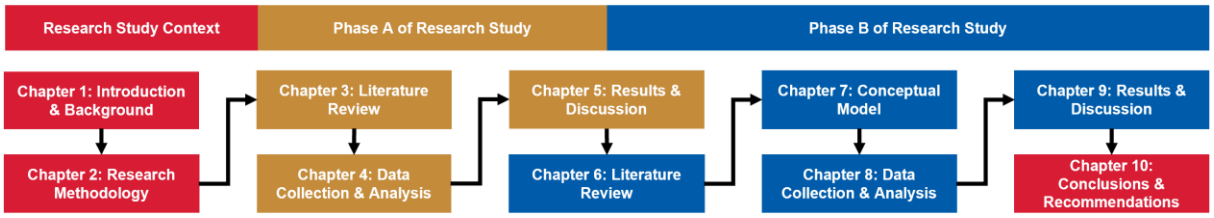
8.6. Chapter Conclusions

This chapter detailed the data collection and analysis method deployed toward testing the hypotheses aimed at drawing correlations between strategic alignment practices and abilities and the resulting value creation within organisations. The results of this quantitative method are presented and discussed in the next chapter.

9. Phase B: Results and Discussion

The mind which is most capable of receiving impressions is very often the least capable of drawing conclusions – Virginia Woolf

9.1. Chapter Overview



Chapter 8 contains the results of the quantitative data analyses in order to test the hypotheses within the framework of the presented conceptual model. This chapter uses the research design and method discussed in Chapter 2 to answers the research question:

- Are organisations that are more effective at strategic alignment, as conceptualised by the model, also more effective at value creation within dynamic environments?

9.2. Chapter Introduction

The outcomes of the hypotheses testing are presented in this chapter. These results are subsequently discussed in terms of the validation of the presented hypotheses (see Table 7).

9.3. Outcomes of the Hypotheses Testing

The correlation analyses in Table 10 show positive correlations between the independent and dependent variables (from Table 9), ranging between weak and very strong correlations, for each of the listed hypotheses (refer to Table 7). See Appendix G for the calculations resulting from the use of SPSS as well as Microsoft Excel.

Table 10: Correlation Analyses

Hypothesis No.	Dependent Variable	Independent Variable	Pearson's R (R)	Spearman's rho (ρ)
H1	V5	V62	0.75	0.74
H2	V48	V31	0.77	0.79
H3	V61	V48	0.86	0.85
H4	V5	V52	0.77	0.81
H5	V51	V23, V36	0.76	0.75
H6	V49	V47	0.39	0.50
H7	V52	V56, V60	0.63	0.59
H8	V5	V56, V60	0.60	0.49

9.4. Discussion of Findings

The findings from Table 10 are discussed in Table 11 in relation to each of the hypotheses in Table 7. H1 was the main hypothesis, while the other five hypotheses were attempts to discover trends that would assist in explaining the phenomena in question and further unpack the correlations between the constructs used to test H1.

Table 11: Discussion of Findings for each Hypothesis

No.	Discussion
H1	The dependent and independent constructs, for the main hypothesis, showed strong correlations. These consist respectively of five sub-variables representing Value Creation Capacity, while the remaining sub-variables culminate into the dynamic capabilities approach to strategically aligned value creation. This seems to indicate that the hypothesis is correct, i.e. the higher the Strategic Alignment Capacities of organisations are (meaning the more effective their dynamic capabilities are that constitute their dynamic alignment competencies as summarised in Table 4 and conceptualised in Figure 34), the higher their Value

	Creation Capacities are (meaning the more effective they are at creating and capturing value). This seems to give credence to the structure of the conceptual model that gives context to the relationship between strategic alignment (and its elements from a systems perspective on dynamic capabilities) and the value creation system of organisations (and the elements representing this system's function).
H2 & H3	Both hypotheses seem to be valid since a strong correlation was observed between higher Sensing Capacities and higher Coordination Capacities and in turn higher Responding Capacities. A possible trend is therefore observed where the higher the preceding strategic alignment capacity within an organisation is, the more likely it is that the succeeding capacity will be more effective. Increased awareness of dynamic changes and potential impact likely creates an increased sense of urgency on the strategy level. In turn, this tends to result in more formal and deliberate coordination efforts to induce a response. This support, buy-in and leadership from senior management drives execution on the lower levels of the Value Creation System to adapt to change, thereby supporting strategic alignment.
H4	A very strong correlation was observed between deliberate efforts to enact alignment within the Value Creation System itself and improved value creation outcomes. This seems to validate H4. The Aligning Capacity construct is a measure of the coordinated response to wilfully achieve and maintain alignment between the internal efforts of an organisation and its strategic intent.
H5	This hypothesis, which seems to be valid, focussed on sub-variables of the main capacities to further unpack correlations between strategic alignment factors within value creation systems. A strong correlation was observed between the higher levels of effectiveness to sense alignment changes within value creation systems, as well as to coordinate a strategic response on addressing these changes to maintain or improve alignment, and a higher capacity to successfully align internal value creation efforts to the strategies that set their value vision.

H6	A moderate correlation was observed for H6, which seems to partially prove the hypothesis. The effectiveness of organisations to coordinate across/between silos, business units, and its value stream was tested, and a moderate correlation was observed with increased aligning efforts within the value creation system itself. This likely indicates a trend that high levels of coordination are insufficient for aligning value creation efforts, unless alignment is an explicit goal of the coordination activity as shown in H5.
H7 & H8	These hypotheses both seem to be partially correct. A moderate correlation was observed between a dynamic capabilities approach (measured for the level of effectiveness to modify each capability element to align to changes) and an increased internal Aligning Capacity, while a poorer correlation was observed for an increased Value Creation Capacity. This supports the research that dynamic capabilities do, in fact, support and enable alignment. It also seems to indicate that those activities focussing only on modifying capabilities are insufficient in isolation to improve strategic alignment and/or value creation. Considering the observed high correlation between strategic alignment (and internal alignment efforts) and value creation outcomes, this seems to support the notion that the purpose of dynamic capabilities should be conceptualised as to enact strategic alignment. In turn, strategic alignment was shown to have a strong correlation with higher value creation outcomes.

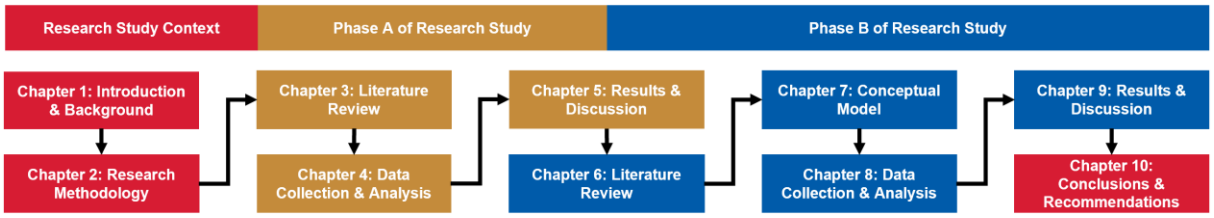
9.5. Chapter Conclusions

The main hypothesis was validated, by showcasing strong correlations ($\rho = 0.74$) between the defined independent and dependent constructs, as the response to research question 4. This indicates that organisations with higher Strategic Alignment Capacities that are predicated on a dynamic capabilities approach as conceptualised through the structure of the proposed model, have higher Value Creation Capacities. The conclusions drawn from these results are discussed in the next chapter in relation to the entire research study.

10. Conclusions and Recommendations

In literature and in life we ultimately pursue, not conclusions, but beginnings – Sam Tanenhaus

10.1. Chapter Overview



Chapter 10 summarises the conclusions and implications of this research study. It also covers the recommendations for further research and recommendations on application in practice.

10.2. Conclusions of the Study

This study defined 'value' as any measure of worth assigned to an outcome, such as reaching a goal, solving a problem, or addressing a need, that is beneficial to the affected or targeted stakeholders. It then stated that 'value creation' is the pursuit of realising value by addressing a need or achieving a goal, which involves a process of creating and ultimately capturing the sought value. Since humans use and interact with formal and informal organisations to obtain or enable the value they seek, through products and services, the purpose of an organisation was defined as the need to create, offer and in return capture value to ensure its continued existence.

Capabilities, which provide the ability to do something, were discussed as the means through which value is created. A systems view proposed that capabilities are an emergent trait from three primary interacting elements, namely resources and assets, people and their skills using these resources and assets, and the processes and activities that enable the interaction between these elements to allow action and decision-making.

A literature study, forming the research background, highlighted that the current business and technology environments in which organisations operate are becoming increasingly complex and dynamic. This makes it challenging for organisations to manage and adapt their capabilities to align with dynamically changing requirements. It was found that technology and innovation capabilities will play a particularly important role in these kinds of environments to create value, since new value creation approaches or outcomes are often needed to address dynamic requirements from internal and external changes.

Technology was also found to be the primary enabler of value creation initiatives. This led to the definition of technology-enabled capabilities (see Figure 12), which provided a different perspective on the popular Technology-People-Process framework through the systems lense of the organisational capabilities framework developed in this study (see Figure 10). Furthermore, it was identified that these challenges are expected to increase in future and in particular as the 4IR unfolds and plays a bigger role in the globalised and interconnected environment.

In order to articulate the nature of the major challenges to value creation within organisations, to define a clear problem statement to focus on, the following research question was asked (see Section 3.1):

- What are the major challenges that South African organisations face in their value creation efforts, enabled by emerging technologies, in the 4IR landscape?

Research Phase A, through an in-depth literature study followed by expert interviews, answered this research question and identified that the major challenge lies with the strategic management of dynamically adapting value creation systems in order to align with dynamic changes within the environment (see Section 5.4). This related to the difficulty of dynamically creating, adapting, and managing the underlying capabilities that enable an organisation's value creation system, in order to maintain strategic alignment throughout an organisation's value creation system hierarchies (see Section 3.6.1 for context). The identified challenge is

complex and integrated but correlated with the dynamic capabilities theory and perspective on strategic management and with research on strategic alignment.

Subsequently, the argument was made that the purpose of a dynamic capabilities approach to strategic management is to enable and support strategic alignment across an organisation's value creation system hierarchies, i.e. between (1) the external environment and the organisational strategy, (2) the organisational strategy and technology strategy, (3) the aligned strategies and strategy execution (i.e. operations or specific value creation initiatives), and (4) strategy execution and the enabling value creation capabilities. Therefore, the dynamic capabilities perspective on the strategic management of technology-enabled capabilities was shown to enable the adaptation of capabilities that serve to enact a strategic alignment process, thereby creating corporate agility.

It was found that the challenge of strategic alignment through dynamic capabilities was reported across industries, however, what constitutes dynamic capabilities and strategic alignment challenges per industry were noted to differ. An industry level analysis was not done to identify and quantify these differences. However, irrespective of the industry it was also found that these challenges are pronounced when the value creation initiatives involve emerging and/or disruptive technologies rather than more mature technologies. The identified reason for this stemmed from the increased complexity and dynamic nature associated with emerging technologies.

Lastly, another key finding indicated that South African companies focus more strongly on the continual expansion of the Third Industrial Revolution (i.e. computing power and digital technologies) and not on the new technology initiatives associated with the Fourth Industrial Revolution (i.e. consisting of the integration of digital, physical, and biological technology spheres) or even those technology initiatives associated with Industry 4.0 (i.e. the integration of the digital/cyber and physical technology spheres). This may be attributed to the large-scale pervasiveness of digital technologies in most emerging technology trends; or, it may be attributed to a lack of other technology focus areas in South Africa. Further analysis on this finding was not done.

With most of South Africa's industries and organisations still focussing on Digital initiatives and some examples of Industry 4.0 initiatives, this seems to indicate that the identified challenges may be exacerbated in future due to the increased complexity and dynamisism associated with the 4IR.

The conceptualisation of the link between dynamic capabilities and strategically aligned value creation efforts, throughout the organisational value creation system, was identified as a means toward creating a frame of reference from which this complex challenge may be approached. Research Phase B aimed to address this need by building on the preceding exploratory research phase, which developed improved insight into (and understanding of) the stated problem area. This phase took a deductive research approach that built on developed theory in order to develop and test operational hypotheses. This research phase was executed through a descriptive research design using quantitative methods to provide a valid representation of the observed phenomena.

However, a gap was identified in the literature on strategic alignment for the 4IR environment since the focus has remained on aligning business and IT (Digital technologies associated with the 3IR) for the last two decades. Furthermore, it was identified that the conceptualisation of the interconnectedness of value creation, strategic alignment, and dynamic capabilities would require a 3-dimensional model. Since both strategic management and strategic alignment are enterprise-wide functions, and since technology-enabled capabilities were defined from a systems view, this inevitably requires a systems perspective of the organisation when enacting these functions. Consequently, the following research question aimed to contextualise what such a model would require:

- What elements constitute a dynamic capabilities approach to strategic alignment?

The literature overview of Research Phase B focussed on the elements of a dynamic capabilities approach to the strategic management of technology-enabled value creation in order to create strategically aligned value within the 4IR. These included the fields of strategic-

, technology-, innovation-, knowledge-, and project management as the primary sources to frame conceptualisations and to draw tools from for a toolkit that could support execution in practice. With these elements identified, the following research question was asked:

- How can these elements be conceptualised to support the strategic management of technology-enabled capabilities?

In response, a model was proposed to conceptualise the strategic management of technology-enabled capabilities, from a dynamic capabilities perspective on strategically aligned value creation, within the 4IR context. This model (see Figure 34) drew on various frameworks developed and referenced throughout this study. These included, amongst others, the organisational capability framework (Figure 10), and in order to link the conceptual model to practice, a roadmapping framework. The latter formed a basis for this model to support the application of the model in industry, towards enabling corporate agility. Lastly, an Industry 4.0 System Architecture Framework was also presented and used to link the conceptual model to current 4IR-related technology system perspectives where conformity was illustrated.

This conceptualisation took a three-dimensional form, addressing the identified need to illustrate the interconnectedness of three different dimensions. One dimension represented the value creation system hierarchies of an organisation, across the lifecycle of a value creation effort (or roadmap) as the second dimension, while the third dimension represented the dynamic capabilities approach to maintain strategic alignment across the other two dimensions. This model, therefore, serves to provide context to the complex system surrounding the strategic management of technology-enabled capabilities, from a dynamic capabilities perspective on strategically aligned value creation.

Informed by the literature, findings from Research Phase A, and by the framework provided by the conceptual model, the following main hypothesis was formulated:

- Organisations with higher Strategic Alignment Capacities, that are predicated on a dynamic capabilities approach (as conceptualised within the proposed model), have higher Value Creation Capacities.

Research Phase B further sought to test this hypothesis. This part of the study involved a quantitative survey questionnaire to gather information on specific practices and perceived abilities in organisations, which relate to the creation and management of technology-enabled capabilities in support of creating strategically aligned value within dynamic environments. The guiding research question for this hypothesis testing part of the study was:

- Are organisations that are more effective at strategic alignment, as conceptualised by the model, also more effective at value creation within dynamic environments?

In response to the final research question, the model was tested where the dependent and independent constructs of the main hypothesis were shown to correlate positively and strongly. These consisted respectively of five sub-variables representing 'Value Creation Capacity', while the remaining sub-variables culminate into the dynamic capabilities approach to strategically aligned value creation. It was found that the higher the 'Strategic Alignment Capacities' of organisations are (i.e. the more effective their dynamic capabilities are that constitute their dynamic alignment competencies as summarised in Table 4 and conceptualised in Figure 34), the higher their Value Creation Capacities are (i.e. the more effective they are at creating and capturing value). This seemed to give credence to the structure of the conceptual model that gives context to the relationship between strategic alignment (and its elements from a systems perspective on dynamic capabilities) and the value creation system of organisations (and the elements representing this system's function).

In summary, organisations with higher Strategic Alignment Capacities that are predicated on a dynamic capabilities approach to the strategic management of technology-enabled capabilities (as conceptualised through the structure of the proposed model), have higher Value Creation Capacities within dynamic environments (such as the complex and dynamic environments of the 4IR and the COVID-19 pandemic).

10.3. Limitations of the Study

This research study relied on a relatively small number of respondents. This means that the data may be considered somewhat subjective in comparison to large number studies and as such the results are more indicative of trends than absolute conclusions. Furthermore, the data obtained stemmed from organisations that are primarily based in South Africa and as such the correlations drawn may be context dependent and again are more indicative of trends than absolute facts.

10.4. Implications for and/or Contributions to Theory and Practice

The implications and/or contributions to theory can be summarised as this study having:

- Proposed a new framework for conceptualising 'capabilities' from a systems perspective. This perspective was further applied to frame technology-enabled capabilities and organisational value creating capabilities in general;
- This provided a different perspective on the Technology-People-Process framework and possibly also provided insights as to why it is popular and effective in practice;
- Proposed a different perspective on dynamic capabilities and the role thereof in the strategic management of value creation efforts;
- Proposed a new definition of strategic alignment to address the gap between current focus areas in literature and the requirements of the 4IR environment;
- Proposed a different perspective on the relationship between dynamic capabilities and strategic alignment, and importantly on the common thread between the reported major challenges to value creation in South African industries;
- Proposed an improved way of conceptualising the interconnectedness of value creation efforts, the strategic management of dynamic capabilities, and strategic alignment throughout and organisation's value creation system hierarchies.

The implications and/or contributions to practice can be summarised as this study having:

- Proposed an improved conceptualisation of framing the key elements required to operate and create value within the current and increasingly complex and dynamic business and technology environments;
- Provided a means to structure strategic management activities and planning efforts in practice in a way that would support the development of strategic planning roadmaps that enable corporate agility;
- Provided toolkit development principles to accompany the application of the conceptual model in practice that would aid decision-making in a strategic planning workshop environment.

10.5. Recommendations on Further Research

The identified key research themes to build on this study in subsequent studies or research phases include:

- The connection between the technology-enabled capabilities framework and the technology-people-process framework to quantify if and why these frameworks provide a holistic approach to technology driven value creation initiatives.
- The degree to which South African industries are pursuing 4IR initiatives and technology capability development as compared to expanding 3IR technology initiatives and capabilities. It would be interesting to explore the pervasiveness of these Digital trends in various local industries as well as between differently sized organisations and compare these results to international trends, with other BRICS countries, and/or with developed countries.
- It was noted that the details of the reported major challenges differ by industry and that an industry analysis was not done. Interviewees stated that the industry level differences likely relate to the dominant culture and resistance to change (readiness levels to adopt emerging technologies) in the senior management of the larger organisations in the various industries. The major challenges, as reported, were however present across industries indicating that the identified main challenge is experienced across industries, although what constitutes the dynamic capabilities and strategic alignment challenges within an industry would be different. This breakdown

was not done within this study and would provide interesting detail for targeted problem solving within specific industries.

- The available sample for the quantitative analyses in Research Phase B was relatively small and therefore the results indicate trends and not necessarily exact correlations. It is recommended that the study be expanded upon or replicated for a larger sample size as well as for small and medium enterprises. The conceptual model as well as the value creation chain framework present opportunities for further research where it is recommended that these be applied, tested, validated and modified in practice.
- This study may also be replicated in other countries to gauge the correlation between Strategic Alignment Capacities and Value Creation Capacities of differently sized organisations within different industries. Being able to analyse such results between countries where different emerging technology trends (e.g. Digital, Industry 4.0, and 4IR trends) cause different levels of complexity and where the business environment is more and less dynamic would also provide interesting insights. The study could also be replicated for case studies of how different organisations adapted to the global pandemic to quantify the role of dynamic capabilities and strategic alignment abilities in effective value creation.
- Another burning question that was identified both in practice and through engagements with subject matter experts throughout this study, relates to how organisations can measure and monitor value creation efforts to inform investment and managerial decisions. Research is required on what value metrics (both tangible and intangible) can be assigned to value creation initiatives, or how they are to be defined, to measure and monitor the value being created through initiatives/projects both individually and as a collective. This relates particularly to measuring value creation outcomes from non-matured technologies, i.e. to evaluate investment decisions and inform managerial decisions regarding emerging technology applications for the enablement of new capabilities. How can organisations assess what emerging technology-enabled capabilities are providing, or would be able to provide, the sought value; or, what potential value may be realised from their application to create new capabilities? Are the collective value creation initiatives making sufficient progress towards the strategic goal(s) (e.g. operational, technological, or digital transformation

initiatives)? How can an initiative be assessed in isolation for its value (e.g. reducing costs, increasing efficiencies, improving safety, or reducing environmental impact etc.) or for its ability to enable/support other initiatives in their purpose within the collective effort towards the strategic goal(s)?

10.6. Recommendations on Application in Practice

Key principles and perspectives:

- Organisations (whether for profit or not for profit) exist to create value and only continue to exist if they can continue to create value. However, what is valued changes over time as needs evolve and change. In order to adapt an organisation's value creation system, to align the value created and offered to these changing needs, requires a dynamic capabilities perspective on the strategic management of an organisation's value creation efforts.
- It is important to understand that this 'dynamic capabilities perspective' refers to a managerial function, as the third dimension of the conceptual model. This function requires deliberate action from management to actively monitor changes in alignment, both internally and between the organisation and its external environment. This is represented by the organisation's Strategic Alignment Capacity and it encompasses those dynamic capabilities that span across the value creation hierarchies of a value creation system.
- Such dynamic capabilities, as highlighted throughout this study, consist of three key elements. The first is the necessary resources to enable the execution of what these capabilities are to be deployed for (these may include a wide range of resources ranging from financial resources to software tools used to aid action and decision making). The second includes the people with skills and knowledge that enable them to perform the required strategic management function. The third element consists of the processes and activities of the people using the resources to make decisions and take action (these stem from tacit knowledge and experience but also from explicit knowledge such as a structured execution methodology).
- In applying such dynamic capabilities toward creating dynamic alignment capacities, managers should take care to understand technology push versus market pull

approaches. Reference was made to research on value creation efforts that have failed or performed poorly when taking a 'technology push' (e.g. solution or product) approach and attempting to 'make it fit'. It is important to balance what is instead called 'value pull' (i.e. start with what value should be created, whether for the market or specific stakeholders) and technology-enabled 'capability push' (i.e. what capability will enable that value to be created and what does that capability consist of). Both perspectives are required, and a value creation initiative should be approached from both sides to ensure that the end goal remains clear, that it will add value, and that the means to reach it is practical and aligned with achieving the particular value goal. Furthermore, when considering what value creation a technology may enable, it is important to first understand what elements are required to turn the technology into a capability before assessing what value creation it may enable.

Key application considerations:

- **Assessment**: Organisations can measure the maturity of their Strategic Alignment Capacity and its constituting capacities as laid out within this study. The survey questions listed in the appendix can be used and added to for this maturity assessment on the effectiveness of various practices that constitute strategic alignment outcomes. Organisations are encouraged to remain objective in these assessments and to bear in mind that these capacities will change over time as their constituting dynamic capabilities change (whether voluntarily or involuntarily) and that periodic assessments may be warrented.
- **Gap Analysis**: From this assessment, organisations are encouraged to identify areas where the effectiveness of their dynamic alignment capacities are lowest and to consider how best to address those areas.
- **Improving Sensing Capacities**: Organisations that attempt to improve their sensing capacities can do so by implementing formal market-, business-, and technology intelligence capabilities. It is important to note that sensing capacities should focus both on external trends that may impact the organisation's value creation system in some significant manner, as well as on internal changes that may affect an organisation's capabilities and its alignment with the external environment. Formal

knowledge management practices may aid the latter, but these practices need to understand the strategic alignment context for which their sensing is to be deployed. This means that deliberate sensing of changes in alignment is required, particularly in highly dynamic environments. Direct customer or client feedback, such as surveys and open-ended interviews, is a useful tool to understand changes in value expectations. However, depending on the nature of the organisation, more tools to support specific sensing focus areas may be required (e.g. patent analysis in high-tech environments, sentiment analysis in social approval dependent environments such as social media or community driven environments, etc.)

- **Improving Coordinating Capacities**: Organisations that attempt to improve their coordinating capacities should periodically review the tools within their toolkit and the way these are applied in practice. The principles for toolkit development provided within this study can support the development of a toolkit to aid dynamic alignment practices. Structured and systematic tools and methods serve to guide the process element of dynamic capabilities, which underpin the required dynamic alignment capacity within the strategic management function of an organisation. Applying these tools and methods in structured workshops have been shown to improve the effectiveness of strategic planning. Within such strategic planning workshops, it is necessary to assess the impact of the alignment changes as highlighted by the sensing capacity and to devise a strategic response. The format of this response is best captured in a roadmap structure. As highlighted within this study, using a roadmapping framework greatly aids in creating a systemic structure that supports integrated planning, execution and monitoring and control activities. There are various types of roadmaps, one of which is the use of a swimlane diagram structure to plan strategic value creation initiatives across different time dimensions while accounting for interdependencies.
- **Improving Responding Capacities**: Organisations that attempt to improve their responding capacities should focus on their execution as well as evaluation and control capabilities. These capabilities are typically supported by project, R&D, or operations management practices and tools. It is important to note that highly dynamic environments may change the alignment requirements of an organisation's value

offering or capabilities adaptations while a previous initiative is still underway. Deploying agile principles and methods aids greatly in creating value in shorter phases as opposed to at the end of a long execution effort (such as with waterfall methods), while allowing continual adjustments to support dynamic alignment.

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Appendix A: Ethical Clearance

Conditional Approval: To Support Snowball Method of Interviews and Surveys

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

Reference number: EBIT/20/2020

Mr J Jacobs
Department: Engineering and Technology Mgt
University of Pretoria
Pretoria
0083

Dear Mr J Jacobs

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Conditional approval is granted.

This means that the research project entitled "Developing a Reference Model for the Strategic Management of Technology Enabled Value Creation: A Focus on Strategic Alignment through Strategic Capability Management in the Fourth Industrial Revolution" is approved under the strict conditions indicated below. If these conditions are not met, approval is withdrawn automatically.

Conditions for approval
Before any interview is to be conducted a permission letter should be first obtained. At the end of data collection period the applicant will need to provide these letters (upload on Ethics Work Center).
The informed consent form should be revised to also include a provision that participants may withdraw from the study at any point should they choose to do so.

This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Code of Ethics for Scholarly Activities of the University of Pretoria, or the Policy and Procedures for Responsible Research of the University of Pretoria. These documents are available on the website of the EBIT Ethics Committee.

If action is taken beyond the approved application, approval is withdrawn automatically.

According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of the EBIT Research Ethics Office.

The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof K.-Y. Chan
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

Appendix B: Formal Request to Participate in the Study

Graduate School of Technology Management (GSTM)
Pretoria 0002 South Africa
Eng 2, Floor 4, Office 4-24
Cell (071) 325 4992
November 2019

Subject: **PhD Research Study, titled: "A Model for the Strategic Management of Technology-enabled Capabilities: A Dynamic Capabilities Approach to Strategically Aligned Value Creation within the Fourth Industrial Revolution" – Request to participate in the study's data gathering.**

Dear Sir/Madam,

This letter serves as a formal invitation and request for the participation of select individuals in your organisation in my PhD research study, at the University of Pretoria's Graduate School of Technology Management.

Your organisation and its experts have been identified as valuable sources of information on the topic of creating organisational value through technology-enabled capabilities (technology, people, processes) and how to adapt to dynamic changes impacting your organisation.

The key objectives of the study include:

- To investigate the major challenges that organisations face in order to strategically manage technology-enabled value creation efforts in the dynamic (Fourth Industrial Revolution (FIR)) landscape.
- To develop and validate a model for the strategic management of technology-enabled value creation, that could provide context to the complex system surrounding the required technology-enabled capabilities and strategic alignment to address these major challenges.

This study consists of two research Phases, namely:

1. Interviews with experts to gain unique insights and clarity on the challenges faced in industry to create value in the FIR landscape.
2. Survey questionnaire to gather information on specific practices and perceived abilities in organisations, which relate to the creation and management of technology-enabled capabilities in support of creating strategically aligned value within dynamic environments.

Phase 1 of this study identified that the major challenges relate to maintaining alignment throughout the value creation system of organisations, while dynamic changes impact the organisation, as well as creating and managing the required technology-enabled capabilities (technology, people, processes) to enable the value creation efforts of the organisation (and to support the necessary alignment).

Phase 2 focusses on validating hypotheses developed around correlations between the various strategic capability management practices and abilities within organisations. Your participation in the survey to gather the required data, in order to test these hypotheses and validate the developed research model, will be invaluable to this research project.

University of Pretoria, Private Bag X20
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Researcher: jonatanjacobs@gmail.com
Cell +27 (0)71 325 4992
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Cell +27 (0)82 950 2726

University of Pretoria
Faculty of Engineering, Built Environment & IT
Department of Engineering and Technology Management
Graduate School of Technology Management
https://www.up.ac.za/graduate-school-of-technology-management

This letter serves to confirm that this study adheres to the strictest research ethics requirements of the University of Pretoria. In this regard, please take note of the following which you will consent to by approving this request:

- The information/data provided by participants will be strictly confidential and the organisation and individual participants will remain anonymous.
- The research participants are and will be requested to voluntarily participate in this research study, and to provide honest input and information.
- The interviews may be audio recorded, provided that the individual interviewee also grants permission for this by signing a form of consent.
- The information obtained from interviews and surveys will only be used for the purpose of this PhD study and will not be made available to anyone other than the researcher and the immediate supervisor.

The results of the research may be made available upon request and provision of the time of submission of the online surveys. No other identifiers are available to distinguish participants from the larger sample, so the time stamps will be required to respond to such requests. The analyses may show the results of your organisation or business unit or compare those results with the total research sample. Other analyses may be requested and discussed.

I look forward to your favourable response in approving this request and look forward to your participation in this study.

Approval is required in the form of a letter on your organisation's letterhead, signed by the appropriate member of senior management.

Yours faithfully

Mr Jónatan Jacobs

PhD Researcher

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Researcher: jonatanjacobs@gmail.com
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Appendix C: Individual Consent Forms

Note: Since this thesis will be in the public domain, the following is an example of the individual consent forms as submitted to the university's ethics committee, without personal or company information displayed.

UNIVERSITY OF PRETORIA

DEPARTMENT OF ENGINEERING AND TECHNOLOGY MANAGEMENT

INFORMED CONSENT FORM

(Form for informant's permission)
(Must be signed by each informant, and must be kept on record by the researcher for 5 years)

1 Title of research project:

..... A MODEL FOR THE STRATEGIC MANAGEMENT OF TECHNOLOGY-ENABLED CAPABILITIES: A DYNAMIC CAPABILITIES APPROACH TO STRATEGICALLY ALIGNED VALUE CREATION WITHIN THE FOURTH INDUSTRIAL REVOLUTION.....

2 I (the informant).... [redacted] ..... hereby voluntarily grant my permission for participation in the project as explained to me by

(researcher).....Jónatan Jacobs.....

3 The nature, objective, possible safety and health implications have been explained to me and I understand them.

4 I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication.

5 Before I provide any information which is directly linked to my company, the researcher should show me a letter of permission from my company.

6 I give my consent to be voice recorded without mentioning my name and contact details during the recording.

7 I give my permission to allow the researcher to publish the information I have provided during the interview, excluding the company's name.

8 Upon signature of this form, you will be provided with a copy.

Signed: [redacted] Date: 11 July 2020

Research Informant

Witness: [redacted] Date: 11 July 2020

Researcher: ..... Date: .....21 June 2020.....

1

Appendix D: Online Survey Overview and Instructions

University of Pretoria

SURVEY OR INTERVIEW QUESTIONNAIRE

(Phase 2 of Research Study)

TITLE:

A Model for the Strategic Management of Technology-enabled Capabilities: A Dynamic Capabilities Approach to Strategically Aligned Value Creation within the Fourth Industrial Revolution

An academic research study conducted by

Jónatan Jacobs

in partial fulfilment of the requirements for the degree

PHILOSOPHIAE DOCTOR (Technology and Innovation Management)

in the

DEPARTMENT OF ENGINEERING AND TECHNOLOGY MANAGEMENT,
GRADUATE SCHOOL OF TECHNOLOGY MANAGEMENT,
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY,
UNIVERSITY OF PRETORIA,
SOUTH AFRICA

Supervisor: Prof Martinus W. Pretorius

Date: June 2020

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Graduate School of Technology Management

Strategic Management of Technology-enabled Capabilities: Effectiveness Questionnaire

Survey Overview:

1. Survey Duration Estimate: 15 to 20 minutes
2. Survey Link: https://forms.gle/2axy2YemRJK6V47c7
3. Total Number of Questions: 42
4. Question Type: Multiple-Choice

Key Definitions:

1. Value: Value is any measure of worth assigned to an outcome, such as reaching a goal, addressing a need, or achieving desired project outcomes that are beneficial to the affected or targeted stakeholders.
2. Value Creation: The process of creating the sought value, such as increasing revenue, improving customer satisfaction, reducing cost, increasing efficiency, addressing stakeholder requirements, tapping into key trends, etc.
3. Value Offering: The products and/or services offered by the organisation that enable its continued existence.
4. New Value Creation Initiative: An initiative aimed at creating some form of new value for the organisation and/or specific stakeholders that will presumably affect the organisation positively (i.e. the outcomes will be valued).
5. Technology-enabled Capabilities: A capability that enables the value creation process, which is constituted by technology (resources/assets), people (and their skills), and the processes (and/or methodologies) that enable the former elements to be operationalised.

Survey Instructions:

1. You may complete and submit the survey online by using the link above.
2. For each question within the survey, please rate your organisation's (or your business unit's) level of effectiveness, on a scale of 1 to 7, for each of the respective abilities listed (With: 1 = Not effective at all; and with: 7 = Highly effective).
3. There are no duplicate questions so please consider the context and verbs used in each, e.g. evaluate versus coordinate, acquire versus implement, assess versus modify, strategy (business or technology) versus execution/operations.
4. Take your time and feel free to consult with other members of your organisation or business unit on questions where you might want additional insights.
5. If you prefer an interview instead then please respond to this email (jonatan.jacobs@up.ac.za) with your availability to discuss each of the questions during an online meeting. The researcher will then work with the participant through the questions by reading and clarifying each question before recoding the response of the participant.
6. Alternatively, if you have any uncertainty about any of the questions after you have gone through the survey, please respond to the email and indicate your availability for an online interview-type discussion about those specific questions. The researcher will then clarify these questions to enable optimal results to be obtained.

Perspective/Focus:

7. Please take a uniform perspective, as far as possible, for all questions, i.e. answering from the perspective of the total organisation, or a specific unit or function that you are most familiar with, for all questions.
8. The focus in on understanding the level of effectiveness for various abilities that relate to the management of technology-enabled capabilities (i.e. technology, people, processes) toward creating value for the organisation and/or stakeholders, as well as those that enable dynamic alignment while doing so.

Appendix E: Online Survey Questionnaire

Strategic Management of Technology-enabled Capabilities: Effectiveness Questionnaire

For each question, please rate your organisation's (or business unit's) level of effectiveness (With: 1 = Not effective at all; and with: 7 = Highly effective) for each of the respective abilities listed.

Total No. of Questions: 42

There are no duplicate questions so please consider the context and verbs used in each.

Take your time and feel free to consult with other members of your organisation or business unit on questions where you might want additional insights.

By filling in this questionnaire you consent that the researcher and his supervisor may use the information for academic research purposes. The information is strictly confidential and no publications will be made indicating the name of an individual nor organisation.

* Required

1. Please indicate what industry and line of service your job title/position focuses on (For example, media and entertainment - head of innovation; telecommunications - business development; mining - new technology lead; consulting - operational and technology transformations) *

2. 1) The ability to scan the external environment or market and evaluate changes or disruptions that may impact your organisation's ability to create or provide its current value offering (i.e. its product or service). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

3. 2) The ability to scan the environment or market and evaluate potential value creation opportunities for your organisation to pursue (e.g. new business opportunities, market gaps, new value offerings, customer frictions to solve, impactful trends, etc.). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

4. 3) The ability to evaluate whether your organisational (corporate or business) strategy accounts for the changes, within the external environment or market, that impact the organisation. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

5. 4) The ability to coordinate a rapid strategic response by adapting your organisation's (corporate or business) strategy, to account for changes in the market or environment that impacts your organisation's ability to create or provide its value offering (product or service). For example, shifting the organisation's strategic focus in a timely and effective manner to address the business implications from COVID-19. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

6. 5) The ability to create and realise the major strategic value outcomes/goals that your organisation wants (e.g. capturing new market opportunities, reducing costs, improving efficiencies, improving customer satisfaction, etc.), within time and budget, despite dynamic changes that impact your organisation. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

7. 6) The ability to select which new value creation initiatives (e.g. business opportunities, business goals, stakeholder requirements, new trends, etc.) to pursue, by considering their fit with your organisation's existing technology-enabled capabilities (i.e. the technology, people, and processes enabling such value creation). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

8. 7) The ability to coordinate a rapid strategic response by adapting your organisation's (corporate or business) strategic focus, to enable the pursuit of a new value creation initiative or opportunity. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

9. 8) The ability to seize new value creation opportunities and to create/realise the desired value for your organisation's stakeholders. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

10. 9) The ability to create new value for the organisation (i.e. innovation) that will support future business development goals (e.g. business expansion, improved competitiveness, increased customer retention or return, etc.). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

11. 10) The ability to evaluate whether your organisation's technology strategy (e.g. IT or Digital strategy) supports the organisation's current strategic goals and objectives. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

12. 11) The ability to evaluate whether your organisation's technology strategy accounts for the trends in the environment and market (e.g. technology, regulatory, competitor, and social trends). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

13. 12) The ability to coordinate a rapid strategic response by adapting your organisation's technology strategy and prioritised technology initiatives, to support and align with changing organisational strategy and goals. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

14. 13) The ability to coordinate a rapid strategic response to align your organisation's technology strategy with the environment, to account for major technological, social, geo-political, market or other relevant and impactful trends. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

15. 14) The ability to coordinate a strategic response focusing on the acquisition, implementation and utilisation of enabling technologies, within your organisation or business unit. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

16. 15) The ability to coordinate a strategic response focusing on the acquisition, implementation and utilisation of emerging technology trends, within your organisation or business unit, such as those associated with the Fourth Industrial Revolution or other Digital trends. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

17. 16) The ability to evaluate your organisation's existing value offering(s) to understand whether it is aligned with customer expectations. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

18. 17) The ability to evaluate whether your organisation's current operations and technology initiatives are still aligned with its new or shifting strategic goals. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

19. 18) The ability to evaluate your organisation's value creation process (execution of strategy or normal operations), to understand whether it is aligned with relevant dynamic trends (e.g. customer, shareholder, partner, or societal expectations; technology trends; regulatory trends; etc.) . *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

20. 19) The ability to coordinate within the value stream (with suppliers, partners, distributors, and/or customers) to synchronise (improve efficiencies of) or optimise (improve effectiveness of) your organisation's value creation efforts. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

21. 20) The ability to ensure that your organisation's strategy execution, or operational efforts, are synchronised with the efforts and work of other business or functional units within the organisation. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

22. 21) The ability to reduce redundant tasks or unnecessary rework by coordinating the utilisation of the optimal capabilities between units or teams within your organisation. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

23. 22) The ability to adapt your organisation's value creation process(es) (i.e. execution of strategy or normal operations to create value for the organisation), to reach shifting goals, in order to remain aligned with shifting expectations. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

24. 23) The ability to realise the major outcomes/goals from your value creation initiatives/projects, within time and budget, despite dynamic changes in strategic or business objectives or stakeholder requirements. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

25. 24) The ability to learn from the execution or operational process of creating value for your organisation's key stakeholders/customers and feeding that knowledge back into strategic planning and future execution. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

26. 25) The ability to evaluate whether your organisation's technology-enabled capabilities (technology resources, people, processes) need to be adapted, to account for changes in the market or environment that impact your organisation's ability to create or provide its value offering (i.e. product or service). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

27. 26) The ability to evaluate whether your organisation's current technology-enabled capabilities (technology resources, people, processes) enable effective value creation to execute the organisation's current strategy/ies. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

28. 27) The ability to evaluate which adjustments (if any) the technology-enabled capabilities will require to effectively enable the pursuit of the organisation's strategy/ies over various (now and future) strategic timeframes. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

29. 28) The ability to understand your organisation's existing technology-enabled capabilities and what new opportunities, or new value offerings, such capabilities might enable outside of the organisation's current focus. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

30. 29) The ability to modify/adapt your organisation's existing technology-enabled capabilities (technology resources, people, processes) to enable new value offerings or initiatives in line with its future strategic objectives. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

31. 30) The ability to modify the organisation's existing technology resources or assets (i.e. obtained and implemented new, or modified existing technologies), used to create or deliver its value offering (product or service) to its customers, to address dynamic changes (e.g. shifting requirements or goals). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

32. 31) The ability to modify the organisation's existing human resources (e.g. upskilling or new hires), to enable the use of key technologies, in order to create or deliver your organisation's value offering to its customers, to address dynamic changes. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

33. 32) The ability to modify to the organisation's existing processes or methodologies surrounding the use of its key technologies, in order to create or deliver its value offering to customers (e.g. implement a new project or innovation management method), to address dynamic changes. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

34. 33) The ability to assess the technology resources and assets required to enable (execute on) a new value creation initiative(s) (e.g. creating a new value offering, or adapting an existing offering to pursue a new opportunity or to address new expectations, pursuing a new business goal, etc.). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

35. 34) The ability to assess the people and skills required to use the enabling technology/ies to pursue the new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

36. 35) The ability to assess the processes and/or methodologies required to operationalise the technology-enabled capability, i.e. to coordinate the technology and human resources, that would realise the new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

37. 36) The ability to acquire the technology resources and assets required to enable a new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

38. 37) The ability to successfully implement, integrate, or reconfigure the acquired technology resources and assets required to enable a new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

39. 38) The ability to acquire the people and skills required to use the enabling technology/ies to pursue the new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

40. 39) The ability to successfully apply, integrate, or reconfigure the people and/or skills required to use the enabling technology/ies to pursue the new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

41. 40) The ability to acquire, identify or develop the processes and methodologies required to operationalise the technology-enabled capability that would realise the new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

42. 41) The ability to successfully implement, integrate, or reconfigure the processes and/or methodologies required to operationalise the technology-enabled capability that would realise the new value creation initiative(s). *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

43. 42) The ability to learn from the execution of a value creation initiative(s), for your organisation's key stakeholders, and feeding that knowledge back into capability development and management approaches. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not Effective at all	◯	◯	◯	◯	◯	◯	◯	Highly Effective

Appendix F: Online Survey Factor Analysis & Cronbach's Alpha

No.	Variables & Groupings	Questions or Variables	N	Mean	Std. Dev.	Cronbach's Alpha (SPSS)	Cronbach F1	Cronbach's Alpha	Factor Analysis (SPSS)	Significance Bartlett's Test (SPSS)
V1	Creating Value: Realising Strategic Value Goals	Q5	25	4.60	1.12					
V2	Creating Value: Seizing New Opportunities	Q8	25	4.76	1.33					
V3	Creating Value: Innovation supporting future goals	Q9	25	4.84	1.43					
V4	Creating Value: Realising Project/Initiative Goals	Q23	25	4.60	1.41					
V5	**Value Creation Capacity**	**V1 to V4 (Q5, Q8, Q9, Q23)**	**25**	**4.70**	**1.32**	**0.82**	**0.82**	**0.82**	**1 Factor**	**<0.05**
V6	Sensing Changes and Evaluating Implications/Disruptions: EE	Q1	25	5.16	1.18					
V7	Sensing Changes and Identifying New Opportunities: EE	Q2	25	5.20	1.15					
V8	Sensing New Opportunities that Align with Capabilities: EE | Cap	Q6	25	5.12	1.20					
V9	***Sensing Capacity: External Changes and Implications***	***V6 to V8***	***25***	***5.16***	***1.18***	***0.60***	***0.60***	***0.60***	**1 Factor**	**<0.05**
V10	Sensing Alignment Changes: OS | EE	Q3	25	4.72	1.21					
V11	Sensing Alignment Changes: TS | OS	Q10	25	4.44	1.58					
V12	Sensing Alignment Changes: TS | EE	Q11	25	4.76	1.09					
V13	***Sensing Capacity: Alignment Changes between Strategies & Environment***	***V10 to V12***	***25***	***4.64***	***1.29***	***0.82***	***0.82***	***0.82***	**1 Factor**	**<0.05**
V14	Sensing Alignment Changes: VO | EE	Q16	25	5.12	1.05					
V15	Sensing Alignment Changes: VC | Strategy Level (OS & TS)	Q17	25	5.00	1.08					
V16	Sensing Alignment Changes: VC | EE	Q18	25	5.00	0.91					
V17	***Sensing Capacity: Alignment Changes in VC to Strategy & Environment***	***V14 to V16***	***25***	***5.04***	***1.02***	***0.69***	***0.69***	***0.69***	**1 Factor**	**<0.05**
V18	Sensing Alignment Improvements: Cap | EE	Q25	25	4.48	1.36					
V19	Sensing Alignment Improvements: Cap | VC (Current Strategic Goals)	Q26	25	4.52	1.00					
V20	Sensing Alignment Improvements: Cap | Strategy Level (Future Goals)	Q27	25	4.64	0.91					
V21	Sensing Alignment Improvements: Cap |EE (New Opportunities)	Q28	25	4.48	1.12					
V22	***Sensing Capacity: Alignment Improvements w.r.t. Enabling Capabilities***	***V18 to V21***	***25***	***4.55***	***1.09***	***0.84***	***0.84***	***0.84***	**1 Factor**	**<0.05**
V23	***Sensing Capacity: Alignment Changes in VC System***	***V9, V13, V17, V22***	***25***	***4.74***	***1.13***	***0.80***	***0.88***	***0.88***	**1 Factor**	**<0.05**
V24	Assess Needs: TR | VC (New VC Initiative)	Q33	25	5.12	0.97					
V25	Assess Needs: PS | VC (New VC Initiative)	Q34	25	5.00	1.26					
V26	Assess Needs: PM | VC (New VC Initiative)	Q35	25	4.88	1.17					
V27	***Sensing Capacity: Capability Needs for New VC Initiative***	***V24 to V26***	***25***	***5.00***	***1.13***	***0.86***	***0.86***	***0.86***	**1 Factor**	**<0.05**
V28	Learning: Supporting alignment VC | Strategy level & VC	Q24	25	4.76	1.27					
V29	Learning: Supporting alignment VC | Cap	Q42	25	4.88	1.30					
V30	***Learning Capacity***	***V28, V29***	***25***	***4.82***	***1.28***	***0.76***	***0.76***	***0.76***	**1 Factor**	**<0.05**
V31	**Sensing Capacity**	**V9, V13, V17, V22, V27, V30 (Q1, Q2, Q3, Q6, Q10, Q11, Q16, Q17, Q18, Q24, Q25, Q26, Q27, Q28, Q33, Q34, Q35, Q42)**	**25**	**4.87**	**1.16**	**0.85**	**0.92**	**0.91**	**1 Factor**	**<0.05**
V32	Coordinating New Opportunity Response: OS | EE	Q7	25	4.44	1.56					
V33	Coordinating Alignment Response: OS | EE	Q4	25	4.72	1.57					
V34	Coordinating Alignment Response: TS | OS	Q12	25	4.60	1.22					
V35	Coordinating Alignment Response: TS | EE	Q13	25	4.04	1.31					
V36	***Coordinating Capacity: Strategic Responses on Alignment***	***V32 to V35***	***25***	***4.45***	***1.41***	***0.86***	***0.86***	***0.86***	**1 Factor**	**<0.05**
V37	Coordinating enabling technology acq., imp., util.: TS | VC & Cap	Q14	25	4.04	1.43					
V38	Coordinating new technology acq., imp., util.: TS | VC & Cap	Q15	25	4.28	1.43					
V39	***Coordinating Capacity: Technology-enabled Capabilities***	***V37, V38***	***25***	***4.16***	***1.43***	***0.84***	***0.84***	***0.84***	**1 Factor**	**<0.05**
V40	Acquiring TR: Cap | VC (New VC Initiatives)	Q36	25	4.56	1.71					
V41	Acquiring PS: Cap | VC (New VC Initiatives)	Q38	25	4.32	1.68					
V42	Acquiring PM: Cap | VC (New VC Initiatives)	Q40	25	4.88	1.54					
V43	***Acquiring Capacity: Technology-enabled Capabilities***	***V40 to V42***	***25***	***4.59***	***1.64***	***0.76***	***0.76***	***0.76***	**1 Factor**	**<0.05**
V44	Coordinate within value stream: VC	Q19	25	4.60	1.26					
V45	Coordinate between silos/units: VC	Q20	25	4.76	1.27					
V46	Coordinate between capabilities: VC | Cap	Q21	25	4.00	1.32					
V47	***Coordinating Capacity: VC Efforts***	***V44 to V46***	***25***	***4.45***	***1.28***	***0.75***	***0.75***	***0.75***	**1 Factor**	**<0.05**
V48	**Coordinating Capacity**	**V36, V39, V43, V47 (Q4, Q7, Q12, Q13, Q14, Q15, Q19, Q20, Q21, Q36, Q38, Q40)**	**25**	**4.44**	**1.44**	**0.86**	**0.91**	**0.91**	**1 Factor**	**<0.05**
V49	Responding to change: Aligning VC | Strategy Level	Q22	25	4.76	1.20					
V50	Responding to change: Aligning Cap | OS (Future Objectives)	Q29	25	4.08	1.61					
V51	***Aligning Capacity: Internal to Strategy Level***	***V49, V50***	***25***	***4.42***	***1.40***	***0.28***	***0.28***	***0.28***	**1 Factor**	
V52	***Aligning Capacity***	***V36, V51***	***25***	***4.44***	***1.41***	***0.88***	***0.87***	***0.87***	**1 Factor**	**<0.05**
V53	Responding to change: Modifying Existing TR | VC (Current VO)	Q30	25	4.32	1.46					
V54	Responding to change: Modifying Existing PS | VC (Current VO)	Q31	25	4.44	1.50					
V55	Responding to change: Modifying Existing PM | VC (Current VO)	Q32	25	4.56	1.26					
V56	***Modifying Capacity***	***V53 to V55***	***25***	***4.44***	***1.41***	***0.75***	***0.75***	***0.75***	**1 Factor**	**<0.05**
V57	Responding to change: Integrating New TR | VC (New VC Initiative)	Q37	25	4.56	1.53					
V58	Responding to change: Integrating New PS | VC (New VC Initiative)	Q39	25	4.32	1.25					
V59	Responding to change: Integrating New PM | VC (New VC Initiative)	Q41	25	4.64	1.38					
V60	***Integrating Capacity***	***V57 to V60***	***25***	***4.51***	***1.39***	***0.86***	***0.86***	***0.86***	**1 Factor**	**<0.05**
V61	**Responding Capacity**	**V49, V50, V56, V60 (Q22, Q29, Q30, Q31, Q32, Q37, Q39, Q41)**	**25**	**4.46**	**1.40**	**0.86**	**0.89**	**0.88**	**1 Factor**	**<0.05**
V62	**Strategic Alignment Capacity**	**V31, V48, V61**	**25**	**4.77**	**1.33**	**0.91**	**0.96**	**0.96**	**1 Factor**	**<0.05**
V13_V17	V13 & V17								1 Factor	<0.05
V23_V36	V23 & V36								1 Factor	<0.05
27_V43_V6	V27 & V43 & V60								1 Factor	<0.05
23_V27_V6	V23 & V27 &V61								1 Factor	<0.05
V56_V60	V56 & V60								1 Factor	<0.05

Appendix G: Online Survey Hypothesis Tests

TASM Paper	No.	Hypothesis / Proposition	Dependent Variable(s) (DVs)	Independent Variable(s) (IVs)	Questions (DVs)	Questions (IVs)	Pearson's (R) (SPSS)	Spearman's rho (ρ) (SPSS)	Sig (2-tailed)
H1	H1	Organisations with higher Strategic Alignment (Sensing, Coordinating and Responding) Capacities, that are predicated on a dynamic capabilities approach, have higher Value Creation Capacities.	V5	V62	Q5, Q8, Q9, Q23	Q1, Q2, Q3, Q6, Q10, Q11, Q16, Q17, Q18, Q24, Q25, Q26, Q27, Q28, Q33, Q34, Q35, Q42 Q4, Q7, Q12, Q13, Q14, Q15, Q19, Q20, Q21, Q36, Q38, Q40 Q22, Q29, Q30, Q31, Q32, Q37, Q39, Q41	0.75	0.74	<0.05
H4	H1a	Organisations with a higher Aligning Capacity have a higher Value Creation Capacity.	V5	V52	Q5, Q8, Q9, Q23	Q7, Q4, Q12, Q13 Q22, Q29	0.77	0.81	<0.05
H2	H2	Organisations with a higher Sensing Capacity have a higher Coordination Capacity.	V48	V31	Q4, Q7, Q12, Q13, Q14, Q15, Q19, Q20, Q21, Q36, Q38, Q40	Q1, Q2, Q3, Q6, Q10, Q11, Q16, Q17, Q18, Q24, Q25, Q26, Q27, Q28, Q33, Q34, Q35, Q42	0.77	0.79	<0.05
	H2a	Organisations that are more effective at sensing misalignment between their value creation efforts and strategies and their external environments, are more effective at coordinating their value creation efforts.	V47	V17	Q19, Q20, Q21	Q16, Q17, Q18	0.70	0.67	<0.05
	H2b	Organisations that are more effective at sensing external changes and evaluating implications and opportunities, are more effective at coordinating a strategic response aiming at maintaining or improving alignment with their external environments.	V36	V9	Q4, Q7, Q12, Q13	Q1, Q2, Q6	0.55	0.47	<0.05
	H2c	Organisations that are more effective at sensing and evaluating whether their technology-enabled capabilities align with dynamic changes in the external environment and support the effective execution of value creation initiatives in line with the organisation's current and future strategic goals, are more effective at realising their major value creation outcomes/goals.	V1	V22	Q5	Q25, Q26, Q27, Q28	0.51	0.47	<0.05
	H2d	Organisations that are more effective at sensing and evaluating changes in alignment between their strategies and value creation efforts and the environment, are more effective at coordinating a strategic response to improve alignment with their external environments	V36	V13 V17	Q4, Q7, Q12, Q13	Q3, Q10, Q11, Q16, Q17, Q18	0.62	0.65	<0.05
H3	H3	Organisations with a higher Coordination Capacity have a higher Responding Capacity.	V61	V48	Q22, Q29, Q30, Q31, Q32, Q37, Q39, Q41	Q4, Q7, Q12, Q13, Q14, Q15, Q19, Q20, Q21, Q36, Q38, Q40	0.86	0.85	<0.05
H6	H3a	Organisations that are more effective at coordinating their value creation efforts across teams, business units, and within their broader value streams), are more effective at aligning their internal value creation efforts to strategic objectives.	V49	V47	Q22	Q19, Q20, Q21	0.39	0.50	0.05/<0.05
	H3b	Organisations that are more effective at coordinating a strategic response that focusses on acquiring, implementing and utilising enabling and new technologies, have a higher responding capacity to modify existing and integrate new capabilities.	V61	V39	Q22, Q29, Q30, Q31, Q32, Q37, Q39, Q41	Q14, Q15	0.68	0.65	<0.05
	H3c	Organisations that are more effective at coordinating a strategic response that focusses on acquiring, implementing and utilising enabling technologies are more effective at modifying their technology-enabled capabilities.	V56	V37	Q30, Q31, Q32	Q14	0.69	0.70	<0.05
	H3d	Organisations that are more effective at coordinating a strategic response that focusses on acquiring, implementing and utilising new/emerging technologies are more effective at reconfiguring (integrating new) their technology-enabled capabilities.	V60	V38	Q37, Q39, Q41	Q15	0.30	0.20	0.15/0.32
H5	H4	Organisations that have a higher sensing capacity for alignment changes within their value creation systems, and that have a higher capacity for coordinating strategic responses to improve their alignment, have a higher capacity for aligning their internal efforts with their strategies.	V51	V23 V36	Q22, Q29	Q1, Q2, Q6, Q3, Q10, Q11, Q16, Q17, Q18, Q25, Q26, Q27, Q28 Q4, Q7, Q12, Q13	0.76	0.75	<0.05
	H5	Organisations that are more effective at assessing, acquiring and integrating new technology-enabled capabilities, have a higher value creation capacity.	V5	V27 V43 V60	Q5, Q8, Q9, Q23	Q33, Q34, Q35 Q36, Q38, Q40 Q37, Q39, Q41	0.49	0.46	<0.05
	H5a	Organisations that are more effective at assessing, acquiring and integrating new technology-enabled capabilities, are more effective at realising their major value creation outcomes/goals.	V1	V27 V43 V60	Q5	Q33, Q34, Q35 Q36, Q38, Q40 Q37, Q39, Q41	0.59	0.64	<0.05
	H5b	Organisations that are more effective at assessing, acquiring and integrating new technology-enabled capabilities, are more effective at creating value from new value creation initiatives and opportunities.	V2	V27 V43 V60	Q8	Q33, Q34, Q35 Q36, Q38, Q40 Q37, Q39, Q41	0.39	0.36	0.05/0.08
	H5c	Organisations that are more effective at assessing, acquiring and integrating new technology-enabled capabilities, are more effective at creating value that support their future strategic goals.	V3	V27 V43 V60	Q9	Q33, Q34, Q35 Q36, Q38, Q40 Q37, Q39, Q41	0.28	0.23	0.17/0.27
	H5d	Organisations that are more effective at assessing, acquiring and integrating new technology-enabled capabilities, are more effective at realising the major outcomes/goals of their value creation initiatives or projects.	V4	V27 V43 V60	Q23	Q33, Q34, Q35 Q36, Q38, Q40 Q37, Q39, Q41	0.37	0.39	0.07/0.05
	H6	Organisations that are more effective at reconfiguring all three capability elements (modifying existing and integrating new capabilities), have a higher value creation capacity.	V5	V56 V60	Q5, Q8, Q9, Q23	Q30, Q31, Q32 Q37, Q39, Q41	0.60	0.49	<0.05
	H6a	Organisations that are more effective at reconfiguring all three capability elements (modifying existing and integrating new capabilities), have a higher aligning capacity.	V52	V56 V60	Q4, Q7, Q12, Q13 Q22, Q29	Q30, Q31, Q32 Q37, Q39, Q41	0.63	0.59	<0.05
	H6b	Organisations that are more effective at reconfiguring all three capability elements (modifying existing and integrating new capabilities), are more effective at maintaining strategic alignment between their technology-enabled capability reconfiguration and their organisation's strategy/ies.	V50	V56 V60	Q29	Q30, Q31, Q32 Q37, Q39, Q41	0.69	0.66	<0.05
	H6c	Organisations that are more effective at aligning their capabilities to their future strategic goal requirements, are more effective at creating new value for the organisation that support its future goals.	V3	V50	Q9	Q29	0.44	0.44	<0.05
	H7	Organisations that have a high learning capacity, are more effective at realising the major outcomes/goals of their value creation initiatives or projects.	V4	V30	Q23	Q24, Q42	0.52	0.50	<0.05
	H7a	Organisations that are more effective at learning from their value creation efforts and feeding that knowledge back into strategic planning, have a higher Coordinating Capacity.	V48	V28	Q4, Q7, Q12, Q13, Q14, Q15, Q19, Q20, Q21, Q36, Q38, Q40	Q24	0.69	0.69	<0.05
	H7b	Organisations that are more effective at learning from their value creation efforts and feeding that knowledge back into their capability management approaches, have a higher Responding Capacity.	V61	V29	Q22, Q29, Q30, Q31, Q32, Q37, Q39, Q41	Q42	0.43	0.47	<0.05
	Hx	Organisations that have a higher sensing capacity for changes within their value creation systems, a higher sensing capacity for the capabilities needed to enable a new value creation initiative to improve their strategic alignment, and a higher responding capacity to enable this alignment, also have a higher value creation capacity.	V5	V23 V27 V61	Q5, Q8, Q9, Q23	Q1, Q2, Q6, Q3, Q10, Q11, Q16, Q17, Q18, Q25, Q26, Q27, Q28 Q33, Q34, Q35 Q22, Q29, Q30, Q31, Q32, Q37, Q39, Q41			
	Hxa	Organisations that are more effective at sensing alignment changes within their value creation system, assessing the needs of the technology-enabled capabilities to enable a new value creation initiative to improve strategic alignment and modifying their existing technology-enabled capabilities, have a higher value creation capacity.	V5	V23 V27 V56	Q5, Q8, Q9, Q23	Q1, Q2, Q6, Q3, Q10, Q11, Q16, Q17, Q18, Q25, Q26, Q27, Q28 Q33, Q34, Q35 Q30, Q31, Q32			
	Hxb	Organisations that are more effective at sensing alignment changes within their value creation system, assessing the needs of the technology-enabled capabilities to enable a new value creation initiative to improve strategic alignment and integrating new technology-enabled capabilities, have a higher value creation capacity.	V5	V23 V27 V60	Q5, Q8, Q9, Q23	Q1, Q2, Q6, Q3, Q10, Q11, Q16, Q17, Q18, Q25, Q26, Q27, Q28 Q33, Q34, Q35 Q37, Q39, Q41			
		.00-.19 "very weak"							
		.20-.39 "weak"							
		.40-.59 "moderate"							
		.60-.79 "strong"							
		.80-1.0 "very strong"							

Appendix H: Online Survey Response Data

		Dynamic Capacities and the Constituent Abilities:	Sensing (18)	Coordinating (12)	Responding (8)	Value Creation (4)											
		Value Creation System Hierarchy Level:	**Environment & Market**		**Organisational Strategy**							**Technology Strategy**					
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
			The ability to **scan** the external **environment** or market and **evaluate** changes or disruptions that may **impact** your organisation's ability to create or provide its current value offering.	The ability to **scan** the **environment** or market and **evaluate** potential value creation **opportunities** for your organisation to pursue.	The ability to **evaluate** whether your **organisational strategy** accounts for the changes, within the external **environment** or market, that **impact** the organisation.	The ability to **coordinate** a rapid strategic response by adapting your **organisation's strategy**, to account for changes in the market or environment that **impacts** your organisation's ability to create or provide its **value offering**.	The ability to create and **realise** the major strategic **value** outcomes/goals that your organisation wants, within time and budget, **despite** dynamic changes that **impact** your organisation.	The ability to **select** which new **value creation initiatives** to pursue, by considering their **fit** with your organisation's existing technology-enabled **capabilities**.	The ability to **coordinate** a rapid strategic response by **adapting** your **organisation's strategic focus**, to enable the pursuit of a **new value creation initiative** or opportunity.	The ability to **seize** new value creation **opportunities** and **create/realise** the desired **value** for your organisation's stakeholders.	The ability to **create new value** for the organisation (i.e. innovation) that will support future **business development** goals.	The ability to **evaluate** whether your organisation's **technology strategy** supports the **organisation's** current **strategic goals** and objectives.	The ability to **evaluate** whether your organisation's **technology strategy** accounts for the trends in the **environment** and market.	The ability to **coordinate** a rapid strategic response by adapting your organisation's **technology strategy** and **prioritised technology initiatives**, to support and **align** with changing **organisational strategy** and goals.	The ability to **coordinate** a rapid strategic response to **align** your organisation's **technology strategy** with the **environment**, to account for major technological, social, geo-political, market or other relevant and impactful trends.	The ability to **coordinate** a strategic response focusing on the **acquisition, implementation and utilisation** of **enabling technologies**, within your organisation or business unit.	The ability to **coordinate** a strategic response focusing on the **acquisition, implementation and utilisation** of **emerging technology trends**, within your organisation or business unit, such as those associated with the FIR
Respondent	**Timestamp**	Please indicate what **industry** and **line of service** your job title/position focuses on. (For example, telecommunications - business development, mining - new technology, consulting - operational and technology transformations.)	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**
R1	2020/07/13 3:22:26 PM GMT+2	Telecommunications - Network Operations	6	6	5	7	6	7	7	6	6	7	6	7	7	6	6
R2	2020/07/20 2:55:04 PM GMT+2	Consulting - Industry agnostic management consulting focussir	6	5	4	2	4	4	2	4	3	4	4	3	3	3	3
R3	2020/07/20 5:57:12 PM GMT+2	Professional Services (Assurance) - Operational and Digital Tra	5	5	5	6	4	6	5	5	5	5	6	3	3	4	3
R4	2020/07/21 12:01:56 PM GMT+2	Financial Services (Risk Assurance) - Digital Trust	6	6	5	6	6	6	7	6	6	5	4	5	5	5	5
R5	2020/07/21 3:34:10 PM GMT+2	Mining - Technology (Head of T&I)	7	6	7	5	5	6	5	6	5	5	6	5	5	6	5
R6	2020/07/22 10:13:21 AM GMT+2	Professional services - Enterprise Change and Digital Transform	6	5	5	5	4	5	5	6	5	5	5	6	5	5	6
R7	2020/07/22 10:45:33 AM GMT+2	Mining - GM R&D & Technical Services Coal Mining	6	6	3	6	5	6	6	7	6	4	4	4	4	5	4
R8	2020/07/22 3:07:39 PM GMT+2	Mining - Business Development and new technology	5	6	4	3	4	5	3	4	5	2	3	4	3	2	2
R9	2020/07/22 3:34:06 PM GMT+2	Mining - Health and Safety through Innovation	6	6	5	4	4	6	5	5	5	3	4	4	3	4	4
R10	2020/07/22 4:26:28 PM GMT+2	Mining technology services - General manager mine planning s	5	5	5	6	5	5	5	5	5	6	6	6	5	6	6
R11	2020/07/23 9:37:52 AM GMT+2	Mining - Resource and Business Development	7	6	5	3	2	4	3	5	6	2	5	5	5	2	3
R12	2020/07/29 11:59:43 AM GMT+2	Consulting - Operational and technology transformations	6	7	5	5	5	3	2	3	4	4	5	4	1	2	2
R13	2020/07/29 1:26:22 PM GMT+2	Head of new technology	5	6	6	6	5	6	5	6	7	5	5	6	5	6	5
R14	2020/07/30 2:19:39 PM GMT+2	Mining - Head of Technology and Innovation	4	6	6	5	6	6	6	6	5	6	6	6	6	5	4
R15	2020/08/04 11:52:44 AM GMT+2	Mining Product Supplier - Product Specialist Cyclones	6	5	4	6	4	4	4	3	5	5	5	5	5	3	4
R16	2020/08/05 2:27:26 PM GMT+2	Head of Engineering: Realisation of products by R&D, qualifica	3	6	2	5	2	6	3	2	1	2	3	3	3	3	5
R17	2020/08/07 1:30:20 PM GMT+2	Chemical & Mining - VP Digital	6	6	6	3	5	5	4	3	5	7	7	5	3	3	3
R18	2020/08/12 3:01:46 PM GMT+2	Consulting - New Technology & Industry 4.0	3	3	5	2	5	6	6	5	6	2	4	6	5	4	6
R19	2020/08/17 11:14:00 AM GMT+2	Electrical (Maintenance of Equipment)	3	3	2	1	3	2	1	2	4	4	4	2	2	1	2
R20	2020/08/22 7:36:37 AM GMT+2	Mining - business improvement	6	5	4	6	6	6	6	6	6	6	5	5	4	5	4
R21	2020/08/29 8:35:42 AM GMT+2	Mining - Business Development	5	6	6	6	6	6	5	5	7	7	6	5	4	4	7
R22	2020/09/04 11:34:30 AM GMT+2	Mineral Processing/Manufacturing - Technology manager	4	5	5	4	5	5	4	5	4	3	3	4	3	5	6
R23	2020/09/10 1:53:25 PM GMT+2	Mining - Principal Architect, Enterprise Architecture and Minin	4	3	4	6	4	5	4	5	2	5	5	4	4	3	3
R24	2020/09/18 12:51:34 PM GMT+2	Senior Specialist Innovation	4	4	6	5	5	5	5	5	5	4	4	5	4	5	5
R25	2020/09/28 10:54:44 AM GMT+2	Senior Manager: Software and Data engineering - Media and E	5	3	4	5	5	3	3	4	3	3	4	3	4	4	4
		Median	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
		Mode	**6**	**6**	**5**	**6**	**5**	**6**	**5**	**5**	**5**	**5**	**4**	**5**	**5**	**5**	**4**
		Highest Value	**7**	**7**	**7**	**7**	**6**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**7**
MAX	**MIN**	**Lowest Value**	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**
5.20	**4.00**	**Mean**	**5.16**	**5.20**	**4.72**	**4.72**	**4.60**	**5.12**	**4.44**	**4.76**	**4.84**	**4.44**	**4.76**	**4.60**	**4.04**	**4.04**	**4.28**
1.71	**0.91**	**Standard Deviation**	**1.18**	**1.15**	**1.21**	**1.57**	**1.12**	**1.20**	**1.56**	**1.33**	**1.43**	**1.58**	**1.09**	**1.22**	**1.31**	**1.43**	**1.43**
		Cronbach's Alpha	**0.960493738**														

Value Creation / Strategy Execution / Operations								
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
The ability to **evaluate** your organisation's existing **value offering**(s) to understand whether it is aligned with **customer expectations**.	The ability to **evaluate** whether your organisation's current **operations and technology initiatives** are still **aligned** with its new or shifting **strategic goals**.	The ability to **evaluate** your organisation's **value creation process** (execution of strategy or normal operations), to understand whether it is **aligned** with dynamic **trends** (e.g. key stakeholder expectations)	The ability to **coordinate** within the **value stream** (with suppliers, partners, distributors, and/or customers) to **synchronise** (improve efficiencies of) or **optimise** (improve effectiveness of) your organisation's **value creation** efforts.	The ability to **ensure** that your organisation's **strategy execution**, or **operational efforts**, are **synchronised** with the efforts and work of other business or functional units **within** the **organisation**.	The ability to reduce redundant tasks or unnecessary rework by **coordinating** the utilisation of the optimal **capabilities** between units or teams **within** your **organisation**.	The ability to **adapt** your organisation's **value creation process(es)** (i.e. execution of strategy or normal operations to create value for the organisation), to reach shifting goals, in order to remain **aligned** with shifting **expectations**.	The ability to **realise** the major outcomes/goals from your **value** creation initiatives/projects, within time and budget, **despite dynamic changes** in strategic or business objectives or stakeholder requirements.	The ability to **learn** from the execution or operational process of **creating value** for your organisation's key stakeholders/customers and feeding that knowledge back into **strategic planning and future execution**.
Q16	**Q17**	**Q18**	**Q19**	**Q20**	**Q21**	**Q22**	**Q23**	**Q24**
6	6	6	5	5	5	6	5	6
4	3	4	3	6	4	2	3	3
6	6	5	6	3	3	5	3	5
5	5	6	4	5	4	5	6	5
7	7	6	7	7	5	6	6	7
4	6	5	4	5	5	5	4	4
6	5	3	5	4	3	3	4	5
6	3	5	4	3	4	5	5	3
5	4	5	4	5	3	4	5	5
6	4	5	5	5	4	5	5	5
4	6	4	3	3	2	7	5	3
5	4	6	6	6	3	5	5	4
5	6	6	6	5	6	6	6	5
6	6	5	6	5	4	5	5	5
4	5	4	5	5	4	4	5	4
6	5	5	5	3	2	5	2	5
6	6	6	4	6	5	3	5	6
5	6	6	5	5	6	5	7	7
4	4	4	2	2	2	3	1	3
5	5	6	6	6	5	6	5	5
6	5	5	5	6	4	5	5	6
6	5	5	4	5	6	5	3	5
3	3	3	2	3	2	3	3	2
5	5	5	4	6	6	6	6	6
3	5	5	5	5	3	5	6	5
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
6	**5**	**5**	**5**	**5**	**4**	**5**	**5**	**5**
7	**7**	**6**	**7**	**7**	**6**	**7**	**7**	**7**
3	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**
5.12	**5.00**	**5.00**	**4.60**	**4.76**	**4.00**	**4.76**	**4.60**	**4.76**
1.05	**1.08**	**0.91**	**1.26**	**1.27**	**1.32**	**1.20**	**1.41**	**1.27**

Value Creation Capabilities																	
25	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
The ability to **evaluate** whether your organisation's technology-enabled **capabilities** need to be **adapted**, to account for changes in the market or **environment** that **impact** your organisation's ability to create or provide its **value offering**.	The ability to **evaluate** whether your organisation's current technology-enabled **capabilities** (technology resources, people, processes) enable effective **value creation** to execute the **organisation's** current **strategy**/ies.	The ability to **evaluate** which **adjustments** (if any) the technology-enabled **capabilities** will require to effectively enable the pursuit of the **organisation's strategy**/ies over various strategic **timeframes**.	The ability to **understand** your organisation's existing technology-enabled **capabilities** and what **new opportunities**, or **new value offerings**, such capabilities might enable outside of the organisation's current focus.	The ability to **modify/adapt** your organisation's existing technology-enabled **capabilities** to enable **new value offerings** or **initiatives** in line with its **future strategic objectives**.	The ability to **modify** the organisation's existing **technology resources** or assets, used to create or deliver its **value offering**, to address dynamic changes.	The ability to **modify** your organisation's existing **human resources** (e.g. upskilling), to enable the use of key technologies, in order to create or deliver its **value offering**, to address dynamic changes.	The ability to **modify** your organisation's existing **processes** or methodologies surrounding the use of its key technologies, in order to create or deliver its **value offering**, to address dynamic changes.	The ability to **assess** the **technology resources** and assets required to enable (execute on) a **new value creation** initiative(s).	The ability to **assess** the **people and/or skills** required to use the enabling technology/ies to pursue the **new value creation** initiative(s).	The ability to **assess** the **processes** and/or methodologies required to operationalise the technology-enabled capability, i.e. to coordinate the technology and human resources, that would realise the **new value creation** initiative(s).	The ability to **acquire** the **technology resources** and assets required to enable a **new value creation** initiative(s).	The ability to successfully **implement, integrate, or reconfigure** the acquired **technology resources** and assets required to enable a **new value creation** initiative(s).	The ability to **acquire** the **people and skills** required to use the enabling technology/ies to pursue the **new value creation** initiative(s).	The ability to successfully **apply, integrate, or reconfigure the people and/or skills** required to use the enabling technology/ies to pursue the **new value creation** initiative(s).	The ability to **acquire**, **identify or develop** the **processes** and methodologies required to **operationalise** the technology-enabled **capability** that would realise the **new value creation** initiative(s).	The ability to successfully **implement, integrate, or reconfigure** the **processes** and/or methodologies required to **operationalise** the technology-enabled **capability** that would realise the **new value creation** initiative(s).	The ability to **learn** from the execution of a **value creation** initiative(s), for your organisation's key stakeholders, and feeding that knowledge back into **capability development and management** approaches.
Q25	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**	**Q41**	**Q42**
6	6	6	6	6	6	5	6	6	6	6	7	6	7	5	7	5	5
5	6	5	5	3	3	2	3	5	4	6	4	6	4	4	7	7	7
5	5	5	4	3	3	5	4	5	5	6	4	4	5	4	4	4	3
5	4	4	5	5	5	4	5	6	4	4	6	3	6	4	2	3	4
6	6	6	6	5	6	6	5	6	7	6	7	5	5	5	6	6	6
4	4	4	4	5	4	4	4	4	4	4	3	4	4	4	4	4	5
5	4	5	5	6	5	6	5	5	4	4	6	5	6	5	5	5	5
3	4	3	4	2	2	3	5	3	3	3	2	2	2	2	2	2	3
4	4	4	3	5	6	4	6	5	3	3	5	4	5	5	5	6	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
3	5	3	1	2	6	3	5	5	3	3	4	5	3	4	6	3	3
2	4	4	4	1	2	5	5	5	7	5	6	4	6	6	4	4	4
7	5	6	6	5	6	5	6	6	5	6	6	7	6	5	6	6	6
4	4	5	4	5	5	4	5	5	5	5	6	6	4	5	6	5	7
5	5	5	4	6	5	5	4	3	3	3	4	4	3	4	4	4	4
3	2	5	5	2	4	1	3	6	6	6	1	3	1	3	6	5	5
6	6	6	5	3	3	6	5	5	6	6	3	6	2	6	5	6	6
5	4	4	3	2	2	6	2	6	7	5	2	1	1	2	5	5	7
3	4	5	5	2	2	2	2	5	5	5	2	2	3	2	2	2	3
5	4	4	5	5	4	5	5	6	6	6	5	6	5	5	6	5	5
6	6	5	5	6	5	5	5	6	6	6	6	6	5	5	5	5	6
4	4	5	5	4	4	6	6	5	5	5	5	4	6	5	6	5	5
2	3	4	3	3	3	2	2	3	5	3	3	4	3	2	2	2	3
6	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6
3	4	3	5	5	6	6	5	6	5	5	6	6	5	5	6	6	5
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
5	**4**	**5**	**5**	**5**	**6**	**5**	**5**	**5**	**5**	**6**	**6**	**6**	**5**	**5**	**6**	**5**	**5**
7	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**7**	**6**	**7**	**7**	**7**	**6**	**7**	**7**	**7**
2	**2**	**3**	**1**	**1**	**2**	**1**	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**3**
4.48	**4.52**	**4.64**	**4.48**	**4.08**	**4.32**	**4.44**	**4.56**	**5.12**	**5.00**	**4.88**	**4.56**	**4.56**	**4.32**	**4.32**	**4.88**	**4.64**	**4.88**
1.36	**1.00**	**0.91**	**1.12**	**1.61**	**1.46**	**1.50**	**1.26**	**0.97**	**1.26**	**1.17**	**1.71**	**1.53**	**1.68**	**1.25**	**1.54**	**1.38**	**1.30**