The impact of a disruptive technology implementation on a selection of a project management style in the South African ICT sector

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DECLARATION

I, _____Rohendrie Pillay ____, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Rohendrie Pillay

Signed at …… ……

On the ……31st…….. day of ……March…… 2019…..

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Through God all things are possible. I Thank you God for giving me this opportunity to study and for his wisdom and understanding that carried me through the times I felt I needed to quit.

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Abstract

In this technological era, organisations are expected to be innovative in delivery of projects in a more aggressive timeframe to remain competitive (Bughin, Chui, & Manyika, 2013). It must be considered that in the past year, approximately 80% of organisations implemented disruptive technologies (DT) to increase revenue and maintain a competitive advantage, however globally, only 26.7% of projects were delivered successfully (Accenture, 2018). Disruptive technologies are increasing the long-term competitiveness of a company however it is often associated with volatility, uncertainty, complexity and ambiguity (Danneels, 2004). Disruptive technologies are implemented through projects however there is a gap of how this technology influences a PMM selection (Pajares, Poza, Villafañez, & López-Paredes, 2017). The purpose of this study was to investigate what influences disruptive technologies project management style selection and how this impacts the competencies that are relevant.

The study focused on a Multi-national Information and Communication Technology organisation in South Africa (SA), whereby, two subsidiaries participated in the case study that concentrated on three disruptive technologies such as Internet of Things, Cloud Computing and Robotic Processing Automation. Literature has revealed that both traditional and agile methodologies have been popular, yet has been unproven to successfully implement disruptive technology (Pajares et al., 2017). On the other hand, the hybrid approach even though it's at its infancy has been shown to manage expectations in delivering a more successful project (Grushka-Cockayne, 2015)
The study also addresses the need for PM's to have the appropriate competency in relation to the selected PMM to successfully implement projects.

In recent research, the application of Project Contingency Theories (PCT) has been recommended as an effective approach to manage project management complexities (Sauser, Reilly, & Shenhar, 2009). The PCT frameworks applied in this study are the Henderson and Clark's Innovation Framework, and Shenhar and Dvir's NTCP Diamond Framework, providing a more comprehensive understanding of classifying projects to determine the appropriate PMM fit (Sauser et al., 2009).

Based on the exploratory study, a qualitative approach, employing the interpretivism research paradigm was executed (Creswell & Creswell, 2017). A pilot study was conducted before executing the twelve face to face interviews to ensure reliability and validity. Data collected from the interviews and observations were analysed through grounded theory (coding) to understand the relationship between the variables in the research model (Kolb, 2012). The model was successful in explaining the impact of disruptive technology on selection of a PMM and gives project decision maker's insight into how to classify projects correctly.

The findings derived that this study supports the conceptual model by acknowledging that classification of disruptive technologies based on innovation, novelty, technology, complexity and pace does have an impact on the selection of the appropriate PMM selection. This further highlights that the appropriate project management competency needs to be associated to ensure successful implementations.
This study can potentially add value to other industries within South Africa and the greater Sub-Saharan countries.

Nomenclature/Definition

Cloud Computing: Delivery of a hosted service over the internet. Instead of buying a physical machine, a virtual machine is provided.

Disruptive Technology: A Disruptive technology is known for shifting an existing technology, forcing organisations to transform their current way of working or an introduction of a new product which creates a new industry.

Internet of Things: Is a network of physical devices such as; home appliance, vehicles that contain embedded software, sensors, and connectivity that allows data to be exchanged.

Robotic Processing Automation: Refers to a technology that allows organisations to configure a computer software, to imitate and integrate the actions of a human interacting within digital systems to execute a core business process.

Abbreviations

APM	Agile Project Management
CC	Cloud Computing
DT	Disruptive Technology
ICT	Information and Communication Technology
IoT	Internet of Things
PMBOK®	Project Management Body of Knowledge
PMCD	Project Management Competency Development
PMI	Project Management Institute
PM	Project Manager
PMM	Project Management Methodology
PMP	Project Management Professional
RPA	Robotic Processing Automation

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1 Introduction

1.1 Background

In this technological era, organisations are expected to be innovative in delivery of successful projects in a more aggressive timeframe to remain competitive (Bughin et al., 2013). Research has indicated that South African (SA) organisations have become more project-based to guarantee successful implementation of new products (Muganda & Pillay, 2013). It must be considered that in the past year, approximately 80% of organisations implemented disruptive technologies (DT) to increase revenue and maintain a competitive advantage, however globally, only 26.7% of projects were delivered successfully (Accenture, 2018). Nonetheless, the organisations that had success in the implementations, implied that this was due to successful execution through project management (Accenture, 2018; Carl Marnewick, Erasmus, & Nazeer, 2018). The development of DT introduces complex new services, products and business models (Dutta, Geiger, & Lanvin, 2015). The complexities represented are lack of technology standards, inter-operability of technology, cybersecurity breaches and lack of appropriate skills and competencies (Zanni, Rios, & Sampanthar, 2018)..

ICT organisations, in the attempt to remain competitive, are focusing on the implementation of DT for increased efficiencies and productivity (Li, Westbrook, Callen, & Georgiou, 2012; Nhlapo, 2018). Bughin et al., (2013) studies highlighted that the collective economic impact of DT has been forecasted globally, between $10 trillion to $20 trillion annually by 2025. For this reason, SA ICT organisations need to be positioned to successfully implement DT to ensure future development. Prior research postulated DT characteristics as being, volatile, uncertain, complex and ambiguous (VUCA) (Danneels, 2004). In the context of this study, DT encompasses products such as, the Internet of Things (IoT), Cloud Computing (CC) and Robotic Processing Automation (RPA).

Many authors have advocated that due to the added complexities that DT introduces, organisations question if project managers recognize the need to select the appropriate project management styles to implement a DT (Medjo, 2016; Muganda & Pillay, 2013; Pajares et al., 2017; Sauser et al., 2009). In the context of this study, methodologies, styles and approaches related to project management will be used interchangeably.(PMBOK,

2013; Špundak, 2014). Shenhar indicated that projects can be implemented using either traditional or agile PMM but the notion of one size fits all is a myth.

Many scholars argue that traditional methodologies are known for its structured linear process and has been in practised longer than the agile method (Grushka-Cockayne, 2015). Schwaber (2004) highlighted that agile's emphases is on short development cycles as requirements evolve, allowing continuous changes and adaptions throughout the project life cycle (Edivandro C. Conforto, 2016). Shenhar (1998) saw the limitations of traditional and agile styles, therefore introduced a hybrid style which he advocated could focus on milestones, prototype and flexibility. The importance of project management styles and competencies relative to the success of projects is well documented in the literature. However there has been a lack of research on DT and project management methodology (PMM) selection (Auth, Dürk, & Jokisch, 2018; Pajares et al., 2017)

Sauser et al., (2009) conducted a study to determine why projects fail using NASA's Mars Climate Orbiter (MCO) loss as a case study to determine if the route cause could be attributed to the incorrect technical or managerial approaches. The study focused on applying the project management contingency theories to assess the fit between the project management style and the project classification. The two contingency theories included Shenhar and Dvir's (NTCP) Diamond Framework and Henderson and Clark's Innovation Framework (Sauser et al., 2009). Henderson and Clark's framework focused on the categorisation of innovation whilst the Diamond Framewok explored the selection of project management styles based on the variables of DT (Pajares et al., 2017; A. Shenhar & Dvir, 2007). Geoghegan & Duelwicz (2004) also argued that respective PMM's requires the appropriate PM competencies to successfully execute a project, therefore the two contingency theories were applied to the study.

A qualitative research methodology was implemented due to the exploratory study based on the case study conducted. The subjective and interpretivism paradigm was the most relevant approach selected to allow for observations and interpretations. Grounded theory allowed themes to be derived via coding. In view of the lack of research on the impact of DT on project management style selection, the outcomes of this qualitative study will add to the body of knowledge to allow more research to be done to validate this empirical study. SA organisations will have the insight on the impact of selecting the correct project

management style to ensure project success. Further to this, the findings will empower organisations, to implement DT successfully, ensuring a higher market share of the forecasted economic impact of these technologies. Being cognisant that other industries are becoming more technology focused and honing into creating their own competitive edge, the significance of the study becomes larger than the ICT sector.

1.2 Problem Statement

The Market Intelligence Provider, International Data Corporation (IDC), have expressed that organisations are embracing DT, therefore the Information Technology (IT) spend in SA of $26,6 Billion in 2016, will increase by 2.6 percent year on year (IDC, 2015). Organisations are aiming to leverage the full potential of DT remain competitive (Berman, 2012). Due to the nature of unpredictability and complexity of DT very few organisations are prepared to lead and manage the impact of these solutions (Regis, 2017). Product life cycles are getting shorter, forcing an earlier go to market strategy (Latzer, 2009; Suikki, Tromstedt, & Haapasalo, 2006). Considering the complexities and rapid deployment required to deliver DT, project management has become the focal point.

Seeing that project management has matured at such a rapid pace in the last decade, giving rise to new standards and methodologies, the obvious conclusion is that most projects have been successful (H. Wells, 2012). Yet literature by Sheffield & Lemetayer (2013), and Marnewick & Labuschagne (2013), have pointed out that there has been an increase in the failure rate of projects in the ICT industry, due to selection of the incorrect project management style. Organisations have not understood the relevance of selecting the appropriate project management styles, resulting in the increased failure rate of projects (A. J. Shenhar, 1993).

For this reason, understanding the impact of DT on project management style selection requires a detailed exploratory exercise. The problem statement is that even though project management supports the implementation of DT, the importance of the selection of the appropriate project management style in relation to the classification of DT has not been established.

1.3 Research Objectives

The primary research objective is to apply a project contingency theory in the ICT sector in SA to meet the following objectives:

1. To determine what influences disruptive technologies project management style selection
2. To examine the influence of disruptive technology on project management competencies

1.4 Research Question

The following research questions aims to add to the Project Management Body of Knowledge:

1. How disruptive technology implementations influences the outcome of a project management style selection in the ICT sector?
2. What is the influence of DT on project management competencies required to deliver projects in this technological era?

1.5 Significance of the study

ICT is focused on delivering innovative technologies that offers an organisation a competitive advantage within that specific industry (Windell, 2008). Muganda & Pillay (2013) pointed out that the ultimate reason to addressing the research questions in a SA context, is that SA can play a significant role in management of innovation and technology advancements resulting in economic gains for the country. Furthermore, due to SA being the economic leader in the sub-Saharan Africa, SA can set the precedence on how best to manage complex projects to get the desired business value (Joseph, Erasmus, & Marnewick, 2014; Muganda & Pillay, 2013)

1.6 Limitations of the study

The Project contingency theories were applied in the engineering sector and not the ICT, therefore, the analysis in using this framework may not return the expected results. The time limit of this study doesn't allow for in-depth research and additional interviews. A selection

of more experienced resources could have been consulted to ensure more validity and trustworthiness. Some participants chose not to participate as their experience level didn't meet the criteria. The potential of biasness of the researcher while reporting the observations and analysis existed.

Although all respondents worked on ICT projects, a few were not able to fully articulate the relevance of choosing the correct project management style. The case study was based on two organisations and could have included more subsidiaries. Limiting this study to the ICT industry did not allow for cross validation to be done to generalise the framework.

1.7 Delimitation of the Study

The Study has been ring fenced to the following:

1. ICT Sector in SA based on a System Integrator and an Internet Service Provider,
2. Portfolio Managers, Project Managers and Scrum Masters,

1.8 Assumption

The research attempts to generalise the experiences of all professionals within the ICT sector. The study assumes experiences and practise will be consistent across gender and demographics within SA.

It will be assumed that all respondents have adequate experience in the ICT sector to contribute to the study. Furthermore, all respondents will be able to accurately answer questions based on DT and project management styles and competencies.

1.9 Conclusion

DT projects are increasing, and the risk associated with project failure is increasing due to the complexities introduced by the technology. Businesses are focusing on more prolific approaches to manage projects successfully. As most projects are managed by Project Managers, the focus is on selecting the appropriate PMM to gain better project success results within the ICT sector. This study seeks to augment project management in the South African ICT environment by decipher what influences the selection of disruptive

technologies project management styles and how this impacts project management competencies.

Chapter 2 will provide a comprehensive literature review of the study in line with the research objectives.

2 Literature Review

2.1 Introduction

Chapter 2 will explore the significant sections constructed by the research questions from a theoretical viewpoint. The first section examines DT and the trend of the ICT sector in context of the study. The second section examines the Project Contingency Theories that are applied to the study. The subsequent section focuses on project management methodologies and competencies that are appropriate for successful implementation which is core to the study.

2.2 The Complexities of Disruptive Technology

In February 2016, Professor Klaus Schwab, the chairman of the World Economic Forum (WEF), highlighted that the impact of the Fourth Industrial Revolution (FIR), is driving the socio-economic and technical changes, directly influencing how we live, work and relate to one another (Schwab, 2016). The FIR is advanced by DT, such as the IoT, RPA and Cloud Computing, resulting in a mammoth number of projects being initiated.

Christensen, in his book Innovators Dilemma, changed DT to disruptive innovation, to not confine the theory to a specific industry. Therefore, for the purposes of this study, DT and innovation will be used interchangeably (Christensen, 1997). The in-depth report by the PMI attests that organisations that are not prepared for the this technology revolution, which is being propelled forward by DT, will be impacted negatively (Project Management Institute, 2018a). Consistent with prior research, DT are characterised by being a more superior technology and has the capability of displacing existing technologies (Fan & Suh, 2014; Obal, 2013). Christensen (1997) insinuated that a DT is often a minimal viable product with limited functionalities however the technology is enhanced over time to take over the mainstream technology (Christensen, 1997; Thomond, Herzberg, & Lettice, 2003). Obal (2013) claimed that DT implementations manage products and companies which are volatile, uncertain, complex and ambiguous (VUCA). This is evident of the ICT products however it is also noticed that people are over allocated to projects which results in unnecessary spend (Chung and Kim, 2016; J. Wells, 2012).

DT introduce radical changes which require diverse competencies for implementation (Fan & Suh, 2014). Obal (2013) added that DT transforms user behaviour and innovates new product development, giving organisations a competitive edge. Nevertheless, prior examinations of DT implementations has revealed that if the appropriate project management style is not selected, the new technology has a negative impact on the ROI. (Windell, 2008).

2.3 IoT, CC and RPA

ICT advancements have set the foundations for IoT implementations to succeed (Li Da Xu, 2018). For the purposes of this study, the research model will be applied on the three disruptive technologies defined in Table 1.

Internet of Things	Cloud Computing	Robotic Processing Automation
IoT is related to a diverse digital ecosystem that connects physical objects, embedded with sensors communicating by the means of the internet (Kiel, Arnold, Collisi, & Voigt, 2016).	CC introduces the delivery of computing services such as networking, servers, databases, and storage and data analytics over the Internet, resulting in faster innovation and flexible resources. Organisations only pay for the services that are used, which ultimately lowers operating costs and assists with scaling the business as the organisation evolves (JoSEP et al., 2010).	Although RPA implies physical robots performing human tasks, in this case, it is a software-based solution. RPA's role within an organisation is to configure the software for business processes to be completed by human who collaborate with many systems (Willcocks, Lacity, & Craig, 2015).
IoT uses devices such as Radio Frequency Identification (RFID) and Global Positioning System (GPS) to get an all-inclusive view of the movement of goods from the supplier to the sale. Businesses can analyse the data in real time to enhance their supply and inventory management process.	CC is one the most disruptive technologies, changing how ICT is accessed and used. Yet, many organisations are risk averse on moving to a full cloud solution, opting for a hybrid cloud solution due to the security, data integration and vendor management issues (Ross & Blumenstein, 2013). The shortage of ICT skills related to innovating and managing the cloud environment is forcing organisations to train existing ICT workers.	Although RPA implies physical robots performing human tasks, in this case, it is a software-based solution. RPA's role within an organisation is to configure the software for business processes to be completed by human who collaborate with many systems (Willcocks et al., 2015)
IoT plays a significant role by generating customer insights through video surveillance cameras, social media and mobile devices, allowing better prediction on customer behaviour (Manu, 2016).	Data security is a core concern during the management of CC therefore increasing the risks that can potentially arise during implementations. Furthermore, the scarcity of skilled resources to assist with the implementation is a growing concern as the demand for CC increases within organisations (JoSEP et al., 2010)	IT departments spend ~ 30-70 percent of their business as usual (BAU) on maintain legacy systems which have limitations integrating with other innovative systems. Executives are focused on keeping the architecture, infrastructure and technology platform streamlined and secure to ensure focus on business performance by digitising the organisation. RPA is introduced to increase productivity and reducing human errors, ultimately impacting the bottom line and turnover of workers positively without changing the legacy systems(Aguirre & Rodriguez, 2017)
Organisations implementing IoT need to ensure robust, secure, end user products and effective cloud solutions are produced. Whilst this solution changes the landscape for retailers, the requirement to protect customers against data and legal issues is prevalent (Chieochan, SaoKaew, & Boonchieng, 2017). For this reason, the General Data Protection (GDPR) was introduced to ensure compliance (Chaudhuri, 2016).	The complexities and the change management required to ease the transition of stakeholders to changing how CC supports the business. However, it is has been acknowledged that strong project management competencies are important for this paradigm shift (Ross & Blumenstein, 2013)	RPA has its disadvantages that require skilled resources and investment to be made at the onset of the initiative. Even though RPA is an interim solution, and whilst the front end is effective, the back end, machine to machine integration, is still inferior. From a social context, even though RPA is supposed to assist humans, the paranoia exists that humans will lose their jobs (Willcocks et al., 2015). Overall RPA solutions need to be secure, therefore access control such as multifactor authentication must be put in place for both humans and robots (Brugali & Fayad, 2002).

Table 1. Case Study - Disruptive Technologies

2.4 ICT in South Africa

Looking at the past and future ICT spends; the data reveals that spending is increasing even though projects are failing year on year. The forecast for SA ICT spending totalled approximately US$14.59 billion and US$18.18 billion in 2014 and 2017 respectively (Joseph et al., 2014). Marnewick, Labuschagne, Eloff, Steyn & Tobin (2013) revealed that 29% of projects were challenged in 2013 and 12 % failed in SA. This implies that the project spend does not get the appropriate ROI, resulting in the inability to facilitate future revenue and economic growth that is required in SA (C Marnewick, Labuschagne, Eloff, Steyn, & Tobin, 2013). IDC have projected that due to organisations embracing digital transformational, the IT spend globally of US$26,6 Billion in 2016 will increase by 2.6 percent year on year (IDC, 2015).

In Medjo's (2015) study, she exposed the lack of the appropriate ICT skills and skills development in SA. Mpumi Nhlapo, the Head of Demand Management at T-Systems, indicated that the talent pool needs to consist of the appropriate skills required to transform external businesses and ICT companies that are impacted by DT (Nhlapo, 2018).

2.5 Research Model - Project Contingency Theory

The contingency theory developed ~ 50 years ago proposed that there is no distinct way to manage an organisation (Çakır, 2012). Furthermore, it is based on the notion that a collaboration of specific components of a managerial organisation and applicable contingencies will improve an organisation's performance. Project contingency theories (PCT) have been used to study project management practices (Howell, Windahl, & Seidel, 2010; Sauser et al., 2009). Shenhar and Dvir (2007) maintained that PCT was derived from the contingency theory and was built upon innovation.

Henderson and Clark's Innovation framework was extended to identify the limitation in analysing products. For this reason the current innovation model of incremental and radical components, was divided into technological knowledge required to develop new products with two new dimensions. These dimensions focuses on knowledge of the components and the linkage between them identified as architectural knowledge (Sauser et al., 2009).

Recent studies have shown academics applying PCT to project management, stating that 'one size fits all' is not ideal. This has been evident in the disciplines such as innovation, product development and engineering (Sauser et al., 2009). Shenhar and Divir (2007) has evolved PCT using the four contingency factors; Novelty, Technology, Complexity and Pace (NTCP). In addition, Henderson's and Clarks framework applied with Diamond Framework suggests that these two theories provides insight into selecting the appropriate PMM (Sauser et al., 2009).

On the other hand, Van Donk & Molloy (2007) argued that organisational design theory (ODT) plays a significant role in the success of projects. Von Don and Molloy studied Mintzberg's contribution which defines the logical set of contingencies that is associated to the respective design parameters indicated in Figure 1.

Mintzberg's design parameters within project management

Group	Design parameter	Explanation/definition	Project management relevance
Design of positions	Job specialization	The amount of tasks to be executed and the amount of control over that work	Hardly discussed in PM, but addresses amount of task and control over task e.g. specialist's job
	Behaviour formalization	Regulating the behaviour of individuals by formalization of job, work-flow or rules	Used in PM as formalising behaviour is often evident but alternatives hardly considered
	Training and indoctrination	Training is the process by which job related skills and knowledge are taught, while indoctrination is the process by which organizational norms are acquired	Within PM on-the-job training is regarded as the best way to become a Project leader, which is a hardly researched claim
Design of superstructure	Unit grouping	Establishing of the formal lines of authority by combining people into units and departments	Unit grouping is relevant, but in PM an implicit result of the work breakdown structure
	Unit size	The span of control (distinguishing between a narrow and a wide span)	Similar as previous, org. design would favour small groups under uncertainty as in projects
Design of lateral linkages	Planning and control systems	The specification of the desired output and the assessment if the desired outputs or standards have been achieved	Within PM performance planning is preferred whereas in many cases action planning would be preferable
	Liaison devices	Positions by-passing the normal vertical channels to establish contacts between two units to coordinate the work of these units	By-passing vertical channels of communication is hardly visible in PM literature and probably only informally used in practice
Design of decision-making systems	Vertical decentralization	The power to make decisions down the chain of authority	PM advocates clear lines of authority but mainly within the vertical line, far less to the decision making
	Horizontal decentralization	Refers in general to the extent to which non managers control decision processes	scope needed for highly knowledgeable specialists

Figure 1. Mintzberg's Design Theory - Van Donk & Molloy (2007)

The core contingencies focus on age and size, complexity of the technical system, environment and power. This highlights that projects operate in diverse conditions and requires specific choices in relation to the design parameters which results in many project configurations (Van Donk & Molloy, 2008). Further research theorised by Cakir (2012) focused on a structural CT, which concentrated on the impact of the environment, size and strategy of the organisation, including the technology to increase project performance.

Despite, ODT and structural CT being well studied and proposes that organisations in different environments display different characteristics, resulting in managing by an organisation and not by projects (Çakır, 2012; Van Donk & Molloy, 2008).

On the other hand, PCT allows management to adapt based on the project type. This theory was applied in the engineering sector revealing that the collaboration of Henderson and Clark's framework and the Diamond framework is appropriate for identifying the appropriate PMM fit based on the technology.
Figure 2.highlights the PCT frameworks and further emphasizes that classification of the innovation before assessing the product and task in the related environment is fundamental in applying this framework appropriately to get the most accurate results.

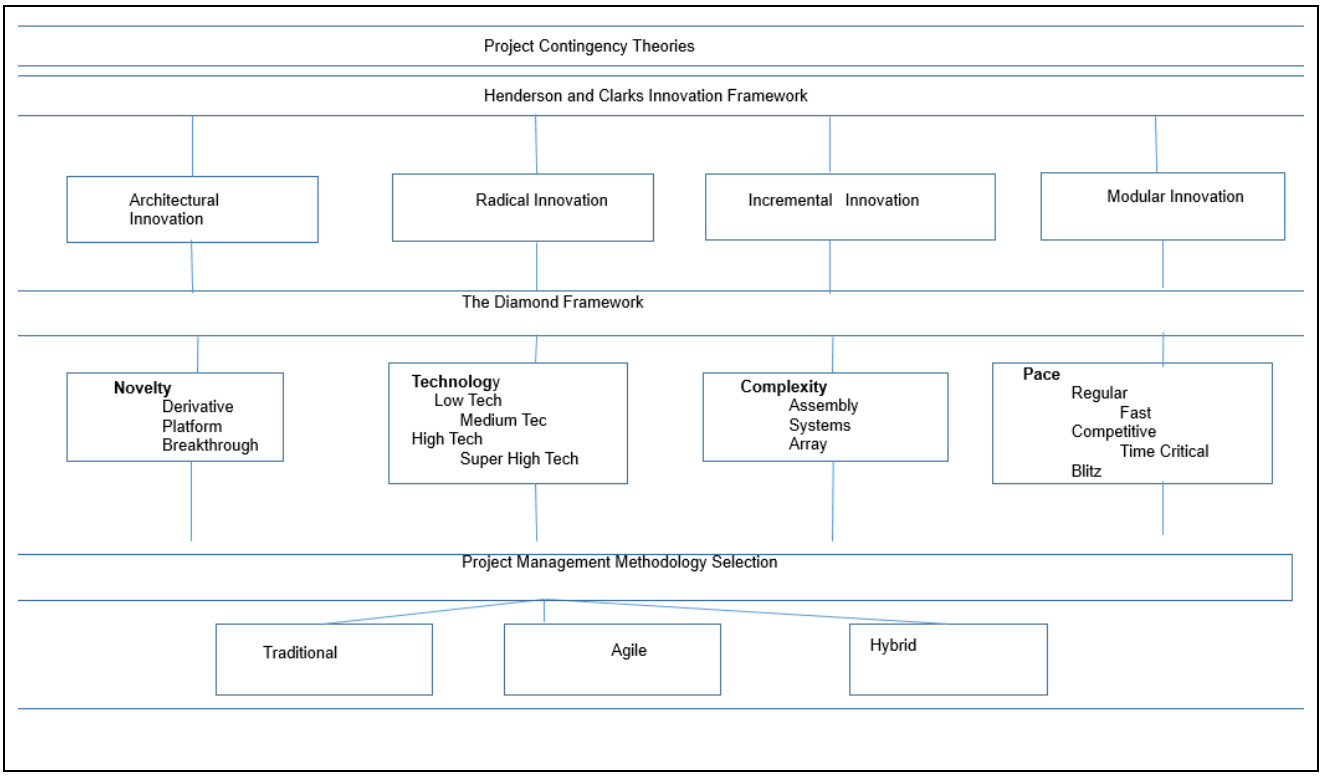

Figure 2. Project Contingency Theories

2.5.1 Henderson and Clarks Innovation Framework

Henderson and Clark's innovation framework centres on products that entails core technology components and its appropriate architecture. Based on the type of technological

change, the consequences to the organisation will differ. The fundamental distinction is the diverse ranges of technology changes which have significant organisational impacts on different project management. A noticeable difference is the relationship between the components and the architecture, which is directly related to the impact of innovation on these two integrated knowledge components. The framework expands innovation as radical, incremental, modular and architectural innovation, depicted in Figure 3 and Table 2. (Henderson & Clark, 1990; Sauser et al., 2009).

While there exists other forms on innovation such as architectural innovation, business model innovation, which in its individual capacity has its own characteristics, Henderson's and Clarks Framework, takes into consideration four components giving a more holistic perspective into classifying innovation (Danneels, 2004).

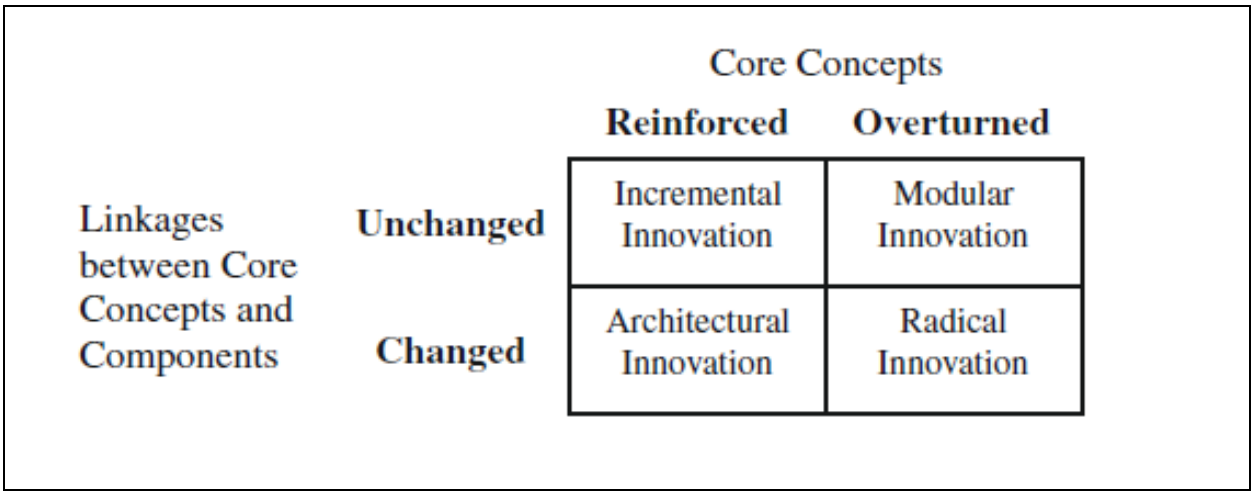

Figure 3. Framework to define innovation. Adapted from "Contingency Theory" by A. Shenhar, R. Reilly and B. Sauser (2009)

Architectural	Radical	Incremental	Modular
Architectural innovation constitutes the reconfiguration of the incumbent system to link together existing components in a fundamental new approach This change is triggered by a component-internal or external to the organisation (Henderson & Clark, 1990; Thomond et al., 2003)	Radical innovation establishes a new prime design with new set of cored design concepts embodied in components that are linked together in a new architecture (Henderson & Clark, 1990).	Incremental innovation presents minimal changes to the incumbent product. It exploits the potential of the established design, and often strengthens of established firms (Henderson & Clark, 1990)	Modular innovation in impacts a project's Knowledge of core concepts, ultimately impacting the projects technical evolution, organisational experience and technical knowledge as they relate to component knowledge. This has minimum impact on the architecture (Sauser et al., 2009)

Table 2. Henderson and Clark's Innovation Framework

The Henderson and Clark framework demonstrates the emergence of new technology, understanding the linkage of modules and systems is important to the overall success of the project (Henderson & Clark, 1990). Nevertheless, this framework focused on categorisation of innovations that imposed by an organisation, compared to the Diamond Framework which focused on the classification of a project type relating to a PMM.

2.5.2 Diamond Framework (NTCP Framework)

The NTCP framework, assesses the environment, product and task; and proposes that a project management style is adopted based on the characteristics of the project (Sauser et al., 2009; A. Shenhar, 2015). Technology projects vary in size and complexity, therefore the need for the classification of a project (A. Shenhar, 2015). Shenhar implies that organisations need be cognisant that not all projects are the same, and will need be analysed using the NTCP framework to ascertain the appropriate PMM required (Pajares et

al., 2017; A. Shenhar, 2015). Shenhar (2012), pursuit a framework to classify projects was based on while there are differences within innovation, in project management innovation is not selected to differentiate projects. Shenhar evolved this model from 1996, from a two dimension model which initially focussed on scope and technology, into the four dimension model to ensure more accurate classifications considering the evolvement of technology (A. J. Shenhar, 1998). Nevertheless, this framework does not consider social aspects within VUCA projects (Patanakul, Shenhar, & Milosevic, 2012). However, Pajares et al., (2017) supported the use of the Diamond Framework to highlight the complexities within DT, and advocates that this framework is the most viable to evaluate a project classifications.

Shenhar (2015) postulated that the Diamond Framework can be used to understand a project classification by categorising a specific project type through the levels of the four dimensions highlighted in Figure 4. Based on the project type, the relevant project management style can be selected. In spite of the benefits of this framework assisting with the project classification, the limitation is it doesn't focus on competency required to manage using the respective PMM.

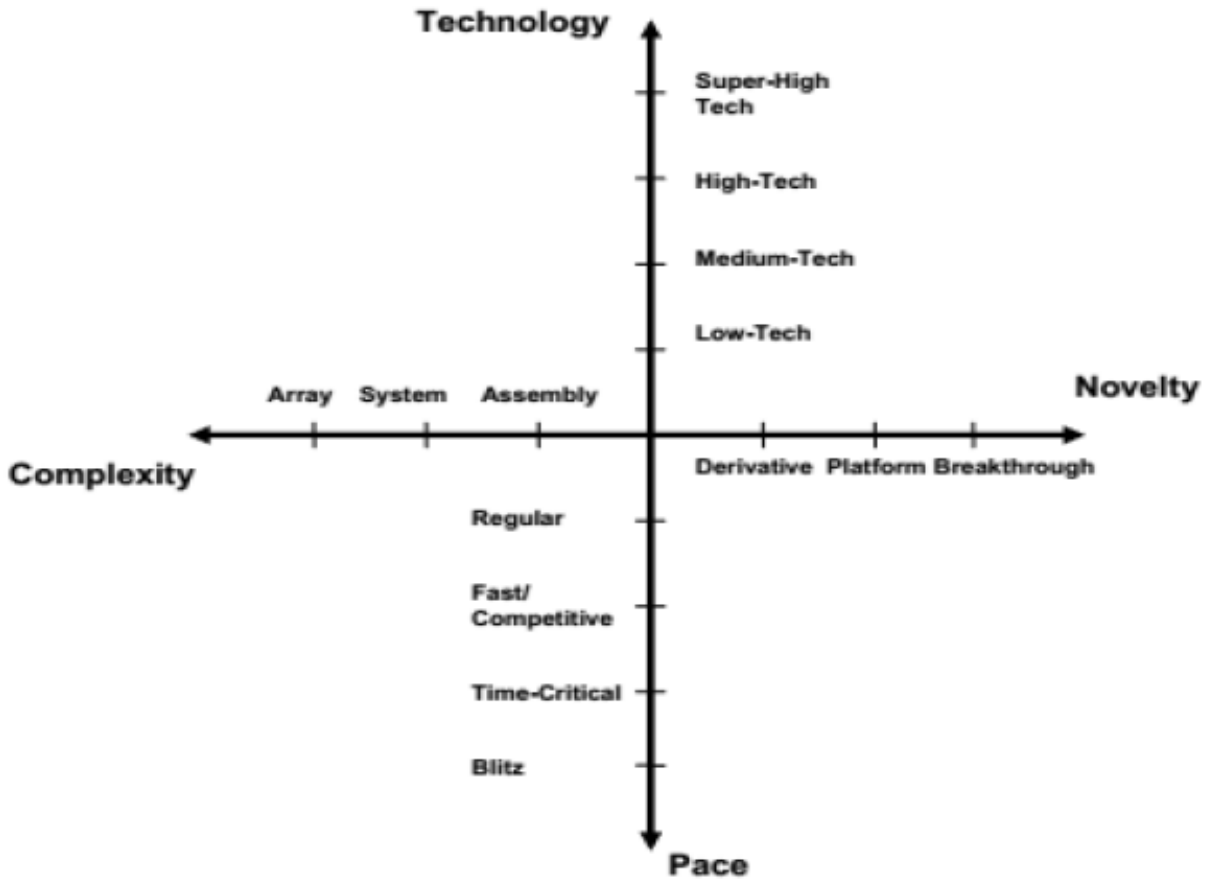

Figure 4. The Diamond Framework. Adapted from "Reinventing Project Management" by A. Shenhar, D. Dvir, 2007.

The constructs of the Diamond Framework detailed in the next section can guide organisations to distinguish, classify and select a project management style to manage complex projects.

2.5.2.1 Novelty

Novelty represents the innovation in the market and how new the product is to the market and customers, ultimately measuring the benefit and use of this type of product (Vasconcellos & de Oliveira Moraes, 2014). This construct comprises of three levels of projects; derivative, platform and break-through. Derivative is based on improving existing products and services. Platform emphases is on developing new versions of existing products and services for existing customers, while breakthrough is related to creating new products or services that customs have never been privy to before (Sauser et al., 2009; A.

Shenhar & Dvir, 2007). Table 3. depicts the constructs of novelty indicating the various levels based on the accuracy of market data and the maturity of the product guiding the decision to make on the project management style.

Managerial aspect	Level of product novelty		
	Derivative (De)	Platform (Pl)	Breakthrough (Br)
Market data	• Accurate market data exists from previous products and market research	• Extensive market research and careful analysis of previous generations, competitors, and market trends	Unreliable market data; market needs unclear, • no experience with similar products; • customer base not defined
Product definition	• Clear understanding of required cost, features, functionality, etc.	• Invest extensively in product definition, • involve potential customers in process	• Product definition based on intuition and trial and error; • fast prototyping to obtain market feedback
Requirements freeze	• Early freeze of product requirements, usually before or immediately after project launch	• Freeze requirements later, usually at mid-project	• Very late freeze of requirements, often after prototype feedback
Marketing	• Emphasise product advantage in comparison to previous model; • focus on existing as well as new customers	• Create product image. • Emphasize product advantages; • differentiate from competitors	• Create customer attention through new and innovative marketing techniques; • educate customers about potential of product; • hidden customer needs; • create industry standard

Table 3. The Diamond Framework – Novelty - Adapted from ”Reinventing Project Management” by A. Shenhar, D. Dvir, 2007

2.5.2.2 Technology

The technology construct is dependent on the number of new technologies required in the realisation of the product. Technology uncertainty is measured by the four levels depicted in Table 4. Based on evaluation, how the project must be managed and what applicable technical skills must be assigned to the project will be determined (A. Shenhar & Dvir, 2007).

Level of technological uncertainty				
	Low Tech	Medium Tech	High Tech	Super High Tech
Definitions	Uses only existing, well-established, and mature technologies	Uses only existing, well-established, and mature technologies	Uses many new. recently developed. existing technologies	Key project technologies do not exist at the time of project initiation

Table 4. The Diamond Framework – Technology - Adapted from "Reinventing Project Management" by A. Shenhar, D. Dvir, 2007

Project uncertainty is a measurement of a mix of new and mature technology. Newness of a product determines how the issues merge, and ultimately deciding the level of technological uncertainty (Sauser et al., 2009; Vasconcellos & de Oliveira Moraes, 2014). Low-tech projects correlate to a no technological risk but require extreme efficiency and effectiveness to achieve sufficient ROI. The risk of failure increases when the level of technical complexity increases. Super high-tech projects are susceptible to delays, budget overrun and potential risk of product failure. Low-tech products requirements must be stopped early in the process. In the case of a high-tech project, there is a need for the requirements to remain open for a longer period to take advantage of knowledge gained during the project (A. J. Shenhar, 1993, 1998). Based on the mix of technologies, the project team will be selected (A. Shenhar & Dvir, 2007).

The constructs of Technology used to measure uncertainty is highlighted in Table 5.

Variable	Level of technological uncertainty			
	Low-Tech	Medium-Tech	High-Tech	Super-High-Tech
Development, testing, and prototypes	• No development; • no testing	• Limited development; • some testing	• Considerable development and testing; • prototypes usually used	• Need to develop key technologies during project effort; • intermediate small-scale prototype
Design cycles and design freeze	• Only one cycle • design freeze before start of project execution	• One to two cycles; • early design freeze	• At least two or three cycles; • design freeze usually at midpoint during second or third quarter	• Typically, three cycles after the final technologies have been selected; • late design freeze

Project reviews	• Formal progress and status reviews	• Formal progress and status reviews; • some technical reviews	• Technical reviews with experts in addition to formal progress	• Extensive peer reviews by technical expert teams critical to success
Management style and attitude	• Firm style; • sticking to the initial plan	• Less firm style; • readiness to accept some changes	• More flexible style; • many changes are expected	• Highly flexible style; • living with continuous change; • "looking for trouble"
Communication and interaction	• Mostly formal communication; • scheduled meetings	• More frequent communication; • some informal interaction	• Frequent communication through multiple channels; • informal interaction	• Many communication • channels; • informal interaction
Project manager and project team	• Manager with good administrative skills	• Manager with some technical skills; • considerable proportion of academicians	• Manager with good technical skills; • Many professionals on project team	• Project manager with exceptional technical skills; • highly skilled professionals

Table 5. The Diamond Framework – Level of Technology uncertainty - Adapted from "Reinventing Project Management" by A. Shenhar, D. Dvir, 2007

2.5.2.3 Complexity

Project complexity has a direct effect on the way a project is managed, and, in the context of this model, it is segmented into three levels; assembly, systems and array projects that include product design. Assembly relates to the lowest degree of complexity and is related to materials, components, subsystems and process of assembly. It focuses on building a straight forward product. System measures provides information on the complication of manufacturing the product. Complex software is categorised as system and is often outsourced due to the medium to high risk nature. Low complexity is often associated with products with a simple arrangement of sub-systems. High complexity is associated to a

product with complex sub-systems (Vasconcellos & de Oliveira Moraes, 2014). The Array consists of coordination of a number of systems and is managed bureaucratically, therefore, stakeholders influence these projects due to high risk (Sauser et al., 2009; A. Shenhar & Dvir, 2007).

2.5.2.4 Pace

Projects are usually under pressure to be delivered before the realistic date as the urgency is driven by the customer. This directly impacts management of the project team, administration and the intensiveness of management involvement during the project execution. The pace measurement stipulates the urgency of time in relation to the success of the project (Sauser et al., 2009; Vasconcellos & de Oliveira Moraes, 2014). Due to competitive pressures, projects need to be pushed to market much quicker or potentially risk deterioration of competitive advantage due to project failure. The constructs to understand the different levels of the urgency on a project is highlighted in Table 6. Decision making, autonomy of teams, flexibility and speed of the project is based on the pace (Pajares et al., 2017; A. Shenhar, 2015).

	Regular	Fast Competitive	Time-Critical	Blitz
Definitions	Time not critical to organisational success	Project completion on time is important for company's competitive advantage and/or the organisation's leadership position	Meeting time goal is critical for project success; any delay means project failure	Crisis projects; utmost urgency; project should be completed as soon as possible

Table 6. The Diamond Framework –Pace. Adapted from "Reinventing Project Management," by A. Shenhar, D. Dvir, 2007

The Innovation framework allows the project team to analyse a project based on the innovations construct, providing an outcome, which is a predecessor to applying the Diamond Framework (Sauser et al., 2009). Christensen tested that the Diamond Framework is applied on the outcome of the innovation framework. Based on the analysis, DT is classified as a breakthrough project due to the complexity and uncertainty as depicted in Figure 5. (Christensen, Raynor, & McDonald, 2015; A. Shenhar & Dvir, 2007).

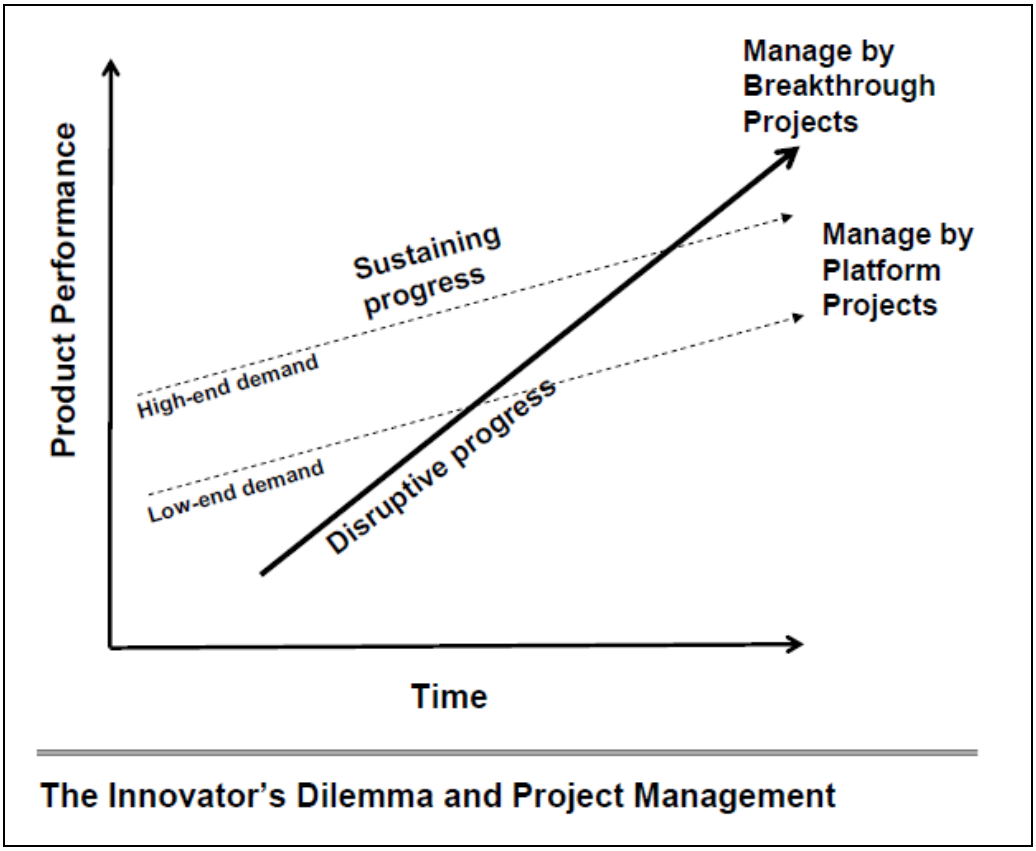

Figure 5. Disruptive innovation and Project management. Adapted from "Reinventing Project Management," by A. Shenhar, D. Dvir, 2007

The Diamond Framework is a graphic illustration (diamond shape), classified according to novelty, technology, complexity and pace levels. The objective of the model is to prioritise the measures of success and to determine the project management methodology based on the project dimensions. The framework can assist project managers to analyse risks and issues allowing to proactively manage projects (A. Shenhar, 2015).

2.6 Project Management Methodologies

The Project Management Body of Knowledge (PMBOK®) states that project management methodologies are a combination of interconnected practises, methods and processes that guides the planning, development, controlling and delivery aspects of a project. Organisations have been required to adopt project management to remain competitive (Medjo, 2016). For this reason, project managers need to ensure they acquire the appropriate skills to deliver projects successfully (Joseph et al., 2014). Research has indicated that ICT organisations are not only focusing on traditional methodologies, but is

including agile methodologies to manage the complexity and chaos introduced by innovation (Othman, Zain, & Hamdan, 2010). Wells (2012) added that selecting PMM facilitates easier decision making in complex projects.

Project Management Body of Knowledge (PMBOK®) renowned for its traditional PMM, consists of five core processes (initiating, planning, executing, controlling and closing) that constitutes of 47 processes. Further to this, the PMBOK demonstrates ten knowledge areas (scope, time, cost, quality, integration, human resources, procurement, risk, communication, and project stakeholder management) (Rose, 2013). Although waterfall is seen to be the most deployed PMM, many forms of agile is gaining traction by most modern project managers (Dingsøyr, Nerur, Balijepally, & Moe, 2012; Dybå, Dingsøyr, & Moe, 2014; Vijayasarathy & Turk, 2008). This approach focuses on self-managing teams rather than direct supervision and standardisations. Agile PM consists of four principles; redundancy, autonomous teams , minimum critical specification, and feedback and learning (Dybå et al., 2014). Researches have emphasised that while using the correct methodology is key success factor, without the correct tools and competencies of the PM will result in a failure.

DT forces project management competencies to advance as routine project management tasks are being automated. This results in employees having the time and flexibility to focus on more strategic and leadership functions within the project, ultimately changing the competencies required of a project manager to support complex implementations (Bughin et al., 2013; Project Management Institute, 2018a).

Kerzner (2014) insinuated that methodologies do not manage projects, people do. For this reason, the organisational culture needs to support the selection of a PMM. The benefits of implementing a PMM is associated with releasing a product much faster and earlier to the market, through a well-managed scope and risk management process, to achieve greater customer satisfaction and quicker decision making. (Terlizzi, de Souza Meirelles, & de Moraes, 2016) argue that change management is an important agent in accepting a change in a PMM

2.6.1 Traditional Project Management

Traditional project management principles go back to 1950's and has been described as procedures and methods that should be applied to all projects in a standard way. The

assumption made on projects that use the traditional approach is that the projects are linear and simple (H. Wells, 2012). The main goal of this approach, is obtaining project efficiency by following a detailed project plan to meet the triple constraint of cost, resources, and time measurements (Špundak, 2014).

The Waterfall methodology depicted in Table 7. has gained traction and is popular in all industries, especially for DT as they are software development, that follow a sequential development model (Balaji & Murugaiyan, 2012).

Phase	Description
Requirements	Customers need are identified and refined to be used as an input into the design and implementation (Petersen, Wohlin, & Baca, 2009). These requirements are checked for validation with the stakeholders and business strategy The number of requirements selected are based on the number of team members (Chieochan et al., 2017).
Systems Design	The system design is completed based on the requirements gathered. The system architecture inclusive of the hardware and software is documented. The software code is formulated in this phase to be written in the implementation phase (Petersen et al., 2009)
Implementation	Using the data from the previous phase, the development commences in small units. Each unit is tested for its functionality before integration (Petersen et al., 2009)
Integration and Testing	Integration testing is completed to test measurements quality and functional tests against performance against software, hardware and customer requirements (Chieochan et al., 2017)
Deployment	Developed unites are integrated with the system after testing of each unit. Before deployment, the requirements are checked with the customer (Petersen et al., 2009) Product is made available to the customer and market (Chieochan et al., 2017)
Maintenance	This process involves post deployment, should the customer have issues, a process is put in place to manage expectations in resolving the issues. Enhancements results due to the defects raised during the use of the system. Support of the system is available based on the service level agreements (Chieochan et al., 2017; Petersen et al., 2009)

Table 7. Waterfall Methodology

Each activity is scheduled for a specific period based on prior experience and needs to be completed before moving to the next event. This process ensures that requirements are clearly understood before starting to build the next component (Stackowiak, Licht, Mantha, & Nagode, 2015). Whilst Balaji & Murugaiyan (2012), advocates that this process guarantees quality, defects are established later in the cycle as the testing team can only start testing after the development has been complete. Further to this, Stakowiak et al.; (2015) points out that this causes a delay in the project, and, should further changes be required at this stage; the project team will not consider the change without following a change control process. Due to the innovative and disruptive characteristics of technology products, customers are driven by the market, hence require changes on their products whilst in the development phase (Stackowiak et al., 2015). This suggests that this methodology limits innovative implementations.

2.6.2 Agile Project Management

Due to the complexities and high failure rates in projects, practitioners have been investigating more innovate and iterative project management approaches. APM was first accepted by majority of project managers in 2011 due to technology innovations implementations (Sarkar & Locatelli, 2018). Research has proven that agile has been selected more often than traditional approaches, as it tends to deliver a minimal viable product timeously (Dybå et al., 2014). Agile accentuates continuous design and improvement, flexible scope, embracing uncertainty and customer interaction. The Agile Manifesto focuses on finding better ways to implement software by valuing individuals and interactions over processes and tools. Dyba et al., (2014) noted that other relatable agile business principles are product adaptation, adjustment of people and process, continuous innovation and shortened delivery times. The APM facilitates flexibility and stability through uncertainty whilst managing quicker feedback loops with stakeholders (Sarkar & Locatelli, 2018; Špundak, 2014).

There are different methodologies within the Agile body such as Extreme Programming, Scrum, Feature Driven Development and Agile Modelling (Pajares et al., 2017). Scaled Agile

Framework (SAFe) was introduced in 2013 and relies on the Agile Manifesto principles (Laanti, 2014).

2.6.3 Hybrid Project Management

One of the principal explanations of failed projects is due to the incorrect selection of project management methodologies (Cooper, 2016; H. Wells, 2012). In most organisations the methodology is selected at a strategic and executive level instead of the project level (Quist, 2015; Špundak, 2014). While traditional project management methodologies argue that they can deliver large projects successfully, the agile methodology states that complex products can be delivered much quicker and effectively. Spundak (2014) argued that a project must follow a specific methodology end to end, instead of looking at the components that can influence the selection of the correct approach. Both methodologies have advantages and disadvantages, therefore it is not always easy to justify which methodology is better and question remains if a single methodology must be followed end to end (Quist, 2015; Špundak, 2014). Due to the complexity and uncertainty of the technological changes transpiring, organisations want to ensure rapid deployment but also want the structured delivery. For this reason, Conforto (2012) recommended merging agile and traditional methodologies to get the best of both processes. Walters & Holling (1990) introduced the Adaptive Project Management methodology based on the premise on learn by doing.

Stalhane and Hannsen studied the International Organisation of Standardisation (ISO), revealing that even though the ISO 9001 only includes the waterfall methodology, many organisations who practise agile, need to be ISO certified (Stålhane & Hanssen, 2008). The core reason some organisations do not accept agile is the perceived notion that agile does not produce documents that ISO requires. Quist (2015) pointed out that one of the benefits of merging the two methodologies is to combine the strengths of agile and waterfall of each ISO process.

Adaptive PM is an iterative and incremental method intended to manage initiatives where there are more unknowns than known, requiring numerous changes in order to find a solution that delivers the highest value (Wysocki, 2010). APM is a combination of traditional and agile processes resulting in a hybrid approach highlighted in Table 8. Authors postulated that this approach requires a mind-set shift which is customer driven, creating a shared

partnership with shared responsibility (Cooper, 2016; Edivandro C. Conforto, 2016; Hayata & Han, 2011).

Approach	Traditional project management	Adaptive project management
Project goal	Getting the job done on time, on budget, and within requirements	Getting business results, meeting multiple criteria
Project plan	A collection of activities that are executed as planned to meet the triple constraint	An organisation and a process to achieve the expected goals and business results
Planning	Plan once at project initiation	Plan at outset and re-plan when needed
Managerial approach	Rigid, focused on initial plan	Flexible, changing, adaptive
Project work	Predictable, certain, linear, simple	Unpredictable, uncertain, nonlinear, complex
Environment effect	Minimal, detached after the project is launched	Affects the project throughout its execution
Project control	Identify deviations from plan, and put things back on track	Identify changes in the environment, and adjust the plans accordingly
Distinction	All projects are the same	Projects differ
Management style	One size fits all	Adaptive approach; one size does not fit all

Table 8. Traditional and Adaptive Project Management - Adapted from “Reinventing Project Management,” by A. Shenhar, D. Dvir, 2007

Shenhar and Dvir indicated that a project selection shouldn’t be deciphered based on one dimension, but one needs to take into the NTCP framework (Sauser et al., 2009; A. Shenhar

& Dvir, 2007). Grushka-Cockayne (2015) considered the work done by Shenhar and Dvir to formulate a project selection framework that focuses on a hybrid methodology.

Literature distinguishes between traditional, agile or a combination of both, leads to a greater chance of project success however the full measurement of the impact of PMM's on project success is yet to be fully quantified. Spundak (2014) argued that when organisations select the incorrect project management methodology, the project efficiency will be impacted. Wysocki examined the complexity of projects, clarifying that based on the criteria of the project, the appropriate PMM should be selected (Hayata & Han, 2011; Wysocki, 2010).

2.7 Project Management Competencies

Numerous academics express that using a the correct methodology is not the only criteria that leads to successful projects but the combination of the competency of using the PMM and the ability to adapt it to meet the project requirements (Takey & de Carvalho, 2015)

Based on the respective PMM available for selection, PM's need to manage their competencies, to successfully facilitate the increasing level of complexity and uncertainty in project environments (Project Management Institute, 2018a).

The definition of competency is a performance capability required by workers in a specific industry and is used to describe a person's capability. The characteristics of competencies may be attitudinal, cognitive and psychological, which does not imply perfection but performance (Furniss, Curzon, & Blandford, 2018). Personal attributes will also be considered in understanding the competencies required by project managers which is depicted in Figure 6. (Wiangnak & Lekcharoen, 2014). The 5th edition of PMBOK records Knowledge as the application of appropriate processes, skills, tools, techniques and knowledge in project management (Rose, 2013). The Project Manager Competency Development (PMCD) is detailed in the respective ten Knowledge Processes depicted in Table 9.Further to this, Figure 6. Highlights the PM's personal competencies including hard and soft skills.

Scope Management	limiting and controlling the work included and excluded in the scope, ensuring exclusions are documented and communicated (Varajão, 2018)
Time Management	ensuring the timely completion of the project(Cha, Newman, & Winch, 2018; Varajão, 2018)
Cost Management	ensuring planning, estimating, and controlling of all resource costs enabling the project to be completed within the approved budget (Cha et al., 2018).
Quality	ensuring project results are correlated with the needs for which the project was executed using required quality assurance tools (Cha et al., 2018; Varajão, 2018)
Integration management	controls all aspects through project documents (Cha et al., 2018; Varajão, 2018)
Human resources	ensures organisation and management of the project team including training (Cha et al., 2018; Varajão, 2018)

Procurement management:	ensure products and services are acquired including contract management and negotiation.
Risk Management	Identifying, analysing, and properly responding to project risks
Communication	Collaboration of people impacted on the project, ideas, and information throughout the project life cycle in a timely manner (K. H. Rose, 2013)
Stakeholder management	communicating and collaboration with stakeholders throughout the project lifecycle to ensure expectations are met (Varajão, 2018)

Table 9. PMBOK Knowledge Processes

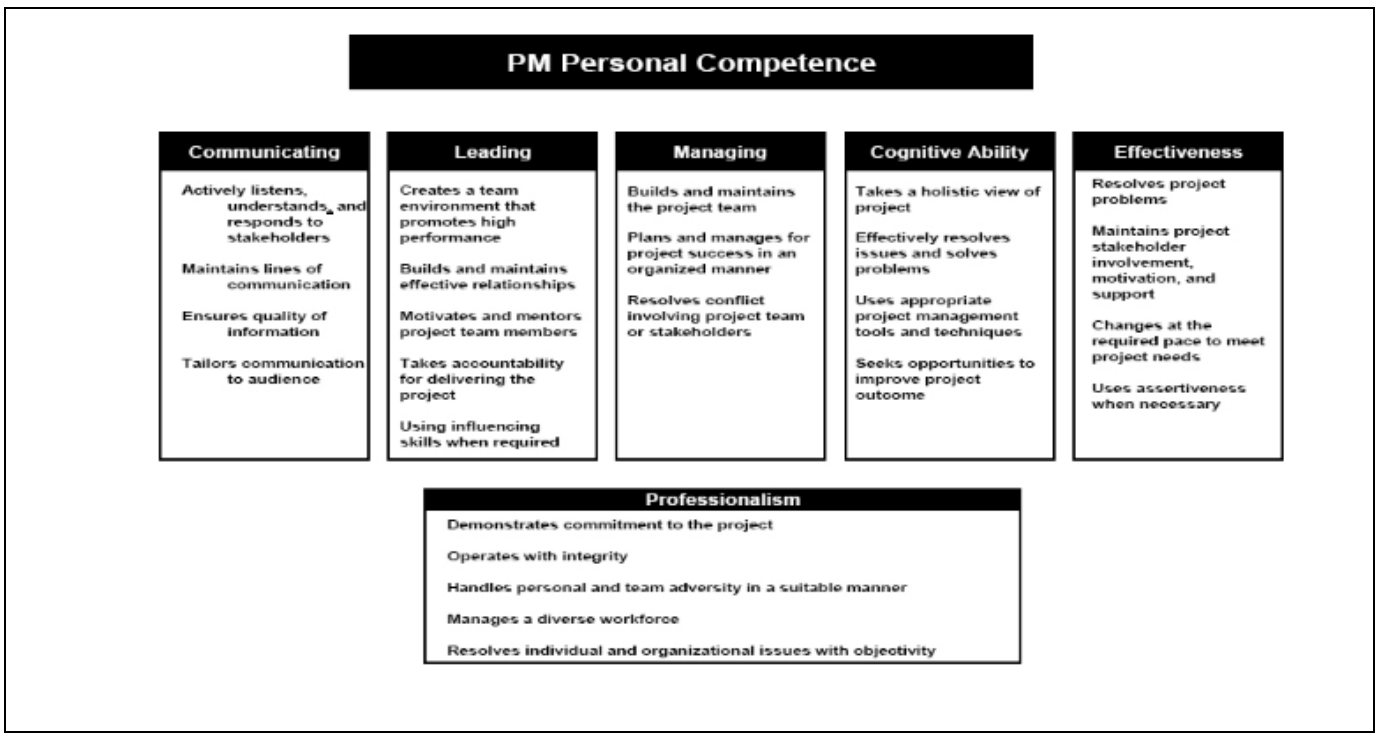

Figure 6. Personal Competencies

Due to the VUCA aspects of disruptive projects globally, researches have recently focused on the strategic aspects of project management to help improve organisational performance, as the notion that meeting the triple constraint doesn't guarantee project success. (Patanakul et al., 2012; A. Shenhar, 2015). Patankul et al. (2012) draws a comparison between strategy in product and project management as they see the organisations strategy driving the product development strategy. The one view of project strategy is the project perspective, position, and guidelines on what to do and how to do it, to achieve the highest competitive advantage and to gain the best value from the project outcome (Patanakul et al., 2012; A. Shenhar, 2015). Shenhar added that traditional project management focused on the planning and execution and not on the people who ultimately deliver a project. For that reason the project manager needs to adopt strategic and leadership skills to manage the vision of the organisation through uncertainty and complexity (A. Shenhar, 2015).

Research revealed that organisations for years have aimed to implement organisational and strategic change using senior managers as the change managers (McElroy, 1996).Similarly, Although the PMBOK® cites change management, it does not highlight the criticality in its role in the success of project implementations. Project manager's fail in project delivery due to their lack of effort in change management activities (Hammoud, 2008). Ballesteros and Chavarria postulated that project managers need to implement change management to engage and collaborate with the respective impacted people (Ballesteros & Chavarria, 2016). Kerzner pointed out that complex projects require intense change management experience (Kerzner & Kerzner, 2017).

2.8 Research Gap and Conclusion

The fundamental role of a PMM is to increase the success rate of project delivery and ensure consistency and sustainability of the project across the impacted spectrum (Kerzner & Kerzner, 2017).

There is a vast amount of literature on traditional and agile project management however very limited on the hybrid styles and project competencies required to execute this PMM.. Due to the complexities of disruptive technology, there is a possibility of using a hybrid approach. Yet, Organisations have been only been given the options to select agile or traditional and have not considered the hybrid approach. Compelling a single methodology

in an organisation is not ideal. Literature has shown that there is immense effort spent on PMM's and competencies individually, however not in context of DT. Research to date has insinuated that traditional and agile methodologies are still relevant, however, cannot be used exclusively to manage VUCA projects. Christensen (1997) allude to ICT being challenged due to DT, therefore new competencies are required to manage the complexities and uniqueness introduced. Selection of the incorrect project management styles and associated competencies results in the practise of project management not being as innovative and effective, to deliver new products in a much shorter pace (Pajares et al., 2017; A. Shenhar & Dvir, 2007). Executing the framework to classify the project appropriately leads to how the project will be managed. The greater the area of the diamond, the greater the degree of risk, highlighting the appropriate PMM.

The next chapter will outline the research methodology that will be used to conduct the empirical study.

3 Research Methodology

3.1 Purpose and Research Design

Research design can be understood as the blueprint of a research that highlights how the study needs to be executed. It collaborates all parts of the study to address the research questions (Creswell & Creswell, 2017). Silverman (2016) denotes that the research design phase can be seen as actualising logic through a set of defined procedures to optimise the validity of data for that research problem. It helps draw conclusion based on a set of questions. Hence, this chapter offers the research context, philosophy, and methods used to address the research questions and related objectives in Chapter 1.

Qualitative research provides many options to conduct this research with the proper rigour and validity. This research will follow a case study approach which allows the researcher to analyse simple and complex situations (Baxter & Jack, 2008). The initial step to determining the method of research was to formulate and clarify ,leading to structured and unstructured approach (Burnard, Gill, Stewart, Treasure, & Chadwick, 2008). Structured focused on quantitative and unstructured was qualitative. Qualitative research supports the semi-structured and unstructured interviews (Burnard et al., 2008).

Research philosophy focuses on the way the researcher views the environment and the ability to develop and acquire new knowledge (Corbin, Strauss, & Strauss, 2014). According to Creswell (2017) the researcher needs to consider the research strategy and methodology based on the nature of the research. For this reason the, paradigm is constructed into Methodology, Ontology and Epistemology. It represents the researchers view of reality (Flick, 2014).

3.2 Ontology

Ontology places emphasis on the nature of reality which allows questions to be raised about the number of assumptions made by the researcher (Järvensivu & Törnroos, 2010). Bahari discussed two concepts of ontology, subjectivism and objectivism, which followed ideas of positivist positons and interpretive tradition respectively. Positivism considers proving and disproving hypotheses by hard facts while interpretive is based on the lived experience of

the researcher and relationship that the researcher has with that phenomena that constituted it (Bahari, 2010).

The researches focused on the understanding and exploration of project management behaviour of DT implementation, therefore, the subjective perspective better fits the relevance of the study. This was supported by the literature review in a practice that was analysed against the perceptions of both case study sample respondents selected. The observations and opinions of the professionals are key in providing reliable and trustworthy responses to the research objectives and questions.

3.3 Epistemology

What constitutes acceptable knowledge in a field of study is the core question epistemology seeks to answer (Bahari, 2010). Epistemological considers four positions; positivism, realism, pragmatism and interpretivism. The researcher selected the interpretivism methodology as the ontology position selected was subjectivism. Interpretivism aims to understand what occurs in a specified environment (Ryan, 2018). The research aims to present transparency to understand the interpretations, interactions and perceptions that happens when a DT is being implemented.

3.4 Case Study

The case Organisation consists of many subsidiaries globally, with twenty-eight thousand knowledge workers that delivers system integrated, innovative and world class internet solutions, whilst practising multi-discipline traditional and PMM's to deliver innovations. The case study consists of Subsidiary 1 (S1) and the Head Office (HO). The organisation sets itself as a differentiator within the market with price, organisational culture and driving innovativeness, creating an ideal case study. The organisation's primary goal is to integrate and enhance business through digital innovations through the adoption of technology.

The research model was applied on the three innovative DT projects highlighted in Table 10. Through observations, intricacies on PMM's relative to DT were identified. The respective subsidiaries within the organisation have different operating models and systems to facilitate their profit generation, aiming to deliver a cross brand go to market strategy.

Organisational Units	Project A CRM Automation	Project B Robotic Process Automation	Project C Internet of Things - Connected Retail
Organisation	Subsidiary 1	Head Office	Head Office
Organisational Management Style	Steering Committee	Agile Release Train	Agile Release Train
Project Methodology	Traditional Project Management	Scaled Agile Framework	Scaled Agile Framework
Team dynamic and size	Dedicated teams consisting of 12 — 15 team members	Dedicated Teams Consisting of 3- 9 members	Not dedicated -Consisting of 3- 9 members
Leadership Style	Combination of Transactional and Transformational Leadership	Servant Leadership	Servant Leadership
Product Delivery	Core functionalities delivered in holistically, additional functionalities for automation added incrementally to the platform	Minimal viable product was delivered in a space of 6 months. Additional functionalities are being added for Finance and Human Resources departments	Minimal viable product delivered in 6 months'
Project Management System	Sciforma and Jira	AgileCraft	Jira and AgileCraft

Table 10. Case Study Projects

The organisation's focus is to deliver a 2% cost reduction and increase in gross margins and revenue respectively by 2020, through focus on innovation by implementing the projects in Table 11. The secondary resources was an output from the organisations PM tool AgileCraft, Jira and Sciforma. The interviews were conducted in a safe and comfortable environment, focusing on Project-A, implemented by S1, and Project-B and Project-C, currently being implemented by HO.

3.5 Data Collection

Data was collected from twelve face to face semi-structured interviews. Secondary data consisted of documents of the two case study organisations. Zaidah (2007) alluded to case studies becoming a norm as a research tool used by scholars, as the researcher gets intricate value out of the interviews. In this case a collective case study was completed where the researcher examined projects. The detailed accounts produced by qualitative case studies through real life data assist with rationalising complexities of real life (Le Roy, 2008)

The researcher attended project meetings of the three projects and observed daily activities of the team members for approximately 6 months to a year. A defined timeframe for the interviews ranged from 30 minutes to 1h10 minutes. The semi-structured interview allowed for a more flexible approach, which meant that the researcher could change the order of the questions to allow a better dialogue. Questions were posed in a non-leading but clearly worded manner to achieve the most reliable data (Kallio, Pietilä, Johnson, & Kangasniemi, 2016). The aim of the interview was to ensure that the respondent's personal view, spontaneity and in-depth reflections were conveyed. To ensure that a more descriptive answer was given, the researcher posed *what* questions. Often follow up questions were asked to understand and to get more information on the study to provide more accurate insights (Louise Barriball & While, 1994).

92% of the interviews were recorded and very few hand-written notes were taken. Approximately five of the interviews were personally transcribed by the researcher to get a better understanding.

3.6 Samples and Participants

Bernard (2012) stated that sampling is selecting a group of people that represents the whole population to conduct a study (Bernard & Bernard, 2012). The sample of this study consisted of project managers, scrum masters, business analysts, portfolio managers, strategic consultants and executives across the two ICT organisations. The sample consists of both male and females

from different age groups and races to ensure that diversity is factored into the research. Due to the context of the research, age was a key factor to get a perspective of the current thinking of ICT resources.

One respondent advised that she lacked project management experience, but had personal experience of the younger generation and could have provided insights into the workforce of the future, but decided to not participate. The age category of the respondents are 25 to 56 years old, with a minimum of 5 years to 32 years of experience in the technology sector.

3.7 Research Instruments

The research instruments that were used for the study were interviews based on 'what and how' questions, therefore it has been suggested this is best completed through a qualitative approach (Peters, Adam, Alonge, Agyepong, & Tran, 2013). Based on the research model, the interview questions were analysed across other literature thoroughly, to ensure validity and reliability of the questions. If a Respondent was not clear in their answers, the researcher clarified and probed for more feedback. Scholars noted that probing assists when research is not clear, but the researcher needs to be mindful, especially in a small study such as this one, that the research does not reach data saturation too quickly (Wargo, 2013). Data saturation refers to the point when there is adequate information to replicate the study. The importance of not reaching data saturation too early, will result in a high possibility of validity and the research not being compromised (Taylor, Bogdan, & DeVault, 2015).

3.8 Data Analysis

The data was screened for completeness and examined through the lens of ground theory (Kolb, 2012).The researcher was able to develop a general abstract theory of process, action, and interaction, grounded in the views of respondents in the study. The Grounded theory proposes that meaning emerges inductively from the data collected and analysed (Kolb, 2012). The researcher collected, sorted and analysed data iteratively from the interviews conducted. Grounded theory techniques like coding were used, where every word was examined for commonality, through which predominant themes were derived based on the research model. The researcher was able to develop concepts from the data by identifying most commonly used words. The advantage of this process is that the research starts with raw data. However, through

comparing the data regularly, a valid theory emerged while considering the literature. This process does require a substantial amount of the researcher's time (Corbin et al., 2014).

For the grounder theory to be viable, the three approaches are consulted in the research: noncommittal, integrative, comparative and transcendent. Noncommittal or preliminary literature review is vital in the conception of a substantive theory while remaining open to emergence (Kolb, 2012). This method allowed for flexibility to pursue emergent lines of investigation (Corbin et al., 2014). This theory enables the researcher to evolve a theory from practice through discussions with the respondents. Prior DT and project management research was conducted using the grounded theory method. For this reason, this approach was most valid to understand the complexity and uncertainty (Chieh, Dan, & Hin, 2007; Joo, 2011).

3.9 Validity and Reliability

Validity is a major concern in research methodologies as the researchers need to have an explanation for the information provided in the study and to acknowledge internal and external validity (Kolb, 2012). Internal validity focuses on the accuracy of the data by incorporating the checks and triangulation processes. Corbin et al., (2014) stressed that validity and reliability need an accurate representation of the results of the research. Kolb (2012) suggested that establishing trustworthiness and understanding limitations of the study is critical in developing integrity. The researcher considered internal and external validity (Kolb, 2012). For this reason, the researcher only considers data that is relevant to the study. Table 11. highlights the validity checks.

Triangulation was used to ensure that the research is credible. To ensure further validity and reliability of the interview questions, a pilot test was conducted for feedback and input into the questions. This ensured that the researcher was not biased in the way the questions were posed, and any ambiguity was resolved before the interview was conducted. Further to this, recordings and transcribed interviews were reviewed at the same time to ensure that the researcher was interpreting the data accurately and in an unbiased manner (Rodham, Fox, & Doran, 2015). The researcher is seen as the research instrument in the qualitative research methodology and can

influence the findings and interpretations intentionally or unintentionally.

Validity Criteria	Theory	Researcher's focus on validity check
Credibility	This is the first criteria in establishing trustworthiness. Linking of researches findings with the observations of the case study (Corbin et al., 2014)	The researcher collected and analysed data by validating assumptions with the respondents after the interview
Confirmability	Confirmability is the comparable concern to objectivity. Data should be traced to the source (Shenton, 2004)	The researcher provides background on her PM exposure. The research respondents were given code ID's (P1, P2 etc.)
Dependability	Enhancement of dependability is done through the audit report (Bashir, Afzal, & Azeem, 2008)	The Researcher ensured consistency through validation of all data together at different intervals. Triangulation was also implemented
Transferability	Transferability takes care of the external validity by providing background data to give context to the study for credible comparisons to be done (Corbin et al., 2014)	Validation of the questions before the research started. Researched checked with a few respondents on their view of the findings

Table 11. Validity checks

3.10 Limitations

The time constraint prohibited the researcher to select a larger sample to carry out the study. Research has indicated that the small sample size is a limitation to generalisation and external validity findings. Qualitative methods requires more time to complete interviews. (Creswell & Creswell, 2017).

Grounded theory may not be the most appropriate method based on the research problem Therefore, credibility and how the data needs to be managed has been highlighted. Even though the data was analysed after each interview, biasness could have been prevalent due to the researcher being exposed to projects (Kolb, 2012).

3.11 Ethical Considerations

Due to the nature of qualitative method, more caution to ethics prevailed as interviews can be intrusive (Roberts, 2015). The researcher facilitated online research therefore procedural and process ethics was considered. Continuous evaluation of ethics was practised throughout the research (Creswell & Creswell, 2017). Organisational permission was and respondent's approval was granted before execution of interviews. Before the interview commenced the researcher explained the purpose of the interview and requested the consent form to be signed but respondents had the option to decline participation. Respondent's anonymity has been maintained throughout the research report.

3.12 Conclusion

In summary, the qualitative methodology together with the interpretivist paradigm was selected as it was suitable for the exploratory nature of the objectives. Two organisations were considered for the case study for observation, applying the grounded theory to analyse the data. The data was derived from unstructured interviews and observations which has been presented in a structured format.

Chapter 4, focuses on the Data Analysis and Findings of the applied research model.

4 Data Analysis and Research Findings

4.1 Introduction

Based on Marshall and Rossman's studies in 1999, it is apparent that data analysis is a process of bringing order, structure and organisation to the data collected in order to draw meaning and to present realistic conclusions from the data (Bengtsson, 2016).The analysis of this study analysing the literature against the insights of the respondents who have been working in the technology environment with a collective experience of 236 years. This is significant as respondents were able to provide insights based on challenges and opportunities experienced.

In this case the researcher examined the interviews based on how many of the same responses were given on a specific category. However, this process could be bias and could have resulted in the incorrect theme development (Spencer, Ritchie, & O'Connor, 2003). Based on the grounded theory approach, thematic content analysis theory was implemented to analyse transcripts to identify themes based on the research model. Using coding, the researcher identified the highest frequency of words that determined the predominant themes.

4.2 Description of Respondents

Table 12. represents the profile of the respondents who participated in the study. The job title and the number of years in the ICT sector of each respondent highlights the experience that was visible in the interviews. Each respondent was assigned a code as approval was not given to socialise the names to ensure confidentiality.

Respondent	Age	Role	Number of Years in ICT	Number of years at the organisation
P1	48	Transformational Executive	25	12
P2	42	Portfolio Manager	20	7
P3	45	Senior Business Analyst	20	5
P4	38	Product Development Executive	16	6
P5	32	Scrum Master/Project Manager	4	1
P6	25	Project Manager	6	6
P7	55	Solutions Executive	28	11
P8	50	Business Consultant/Analyst	30	6
P9	40	Strategic Consultant	18	6
P10	57	Programme Manager	22	14
P11	61	Programme Manager	39	12
P12	35	Project Manager/Scrum Master	13	3

Table 12. Respondents Profile

4.3 Preparation of Data

Five audio recordings from the interviews with the participants were transcribed by the researcher to ensure correct interpretation of the data. Due to the time constraint, a transcriber was used for the remainder of the transcripts. The analysis was completed by listening to recording whilst reviewing the transcript. Coding was completed as the transcripts were reviewed approximately four times. The coding accuracy is estimated to be around 80% due to the manual process. Furthermore, the data collected was segmented according to the three phases of the interview to allow for focused qualitative analysis as per the research objectives.

4.4 Analysis of Interviews

Based on the research model, key themes were established through the coding process by determining the sub-themes based on the highest word frequency as illustrated in Table 13. Scholars highlighted that when researchers perform a qualitative analysis, the intention is to methodically transform large data sets into organised and summarised key outcomes (Erlingsson & Brysiewicz, 2017). For this reason, the researcher segmented the questions into appropriately whilst coding to ensure the categorisation of the themes were valid and reliable. Considering the research objective on understanding the influence of DT on PMM's, three fundamental themes were identified through the analysis.

- Theme 1 considers the awareness of a DT
- Theme 2 reflects on Project Management Styles and Practises
- Theme 3 focuses on project management competencies

Theme 1 Awareness of Disruptive Technology	1. What is your understanding of a disruptive technology? 2. Are you aware of any disruptive technology that is being implemented in your company, such as RPA, IoT and Cloud Computing? 3. Are these factors (Novelty, Complexity, Technology and Pace - Diamond Framework) considered when evaluating a disruptive technology?
Theme 2 Project Management Styles and Practices	1. How many project management styles/methodologies does your company practise? 2. What project management style is currently being used to implement disruptive technology projects 3. What factors are considered when choosing a project management style for a new innovative product? 4. What approach do you use to assign or agree on a project management methodology to be used for a project? 5. Drawing from past projects, do you think a project management style can make the difference between a project's success and failure? 6. What is the impact on the business value on selecting the incorrect project management style?
Theme 3 Project Management Competencies	1. What do you believe are the reasons for a disruptive technology implementation failing? 2. Are there any disruptive technologies that assist your project management practise to allow you to focus on other project management competencies? 3. What competencies does a project manager require to implement a disruptive technology in your company?

Table 13. Themes

4.4.1 Impact of DT

The purpose of this section was to determine the respondent's view of the impact of DT. The second part focused on the significance of the classification of a DT using the research

model. The results and the manual coding of the transcript have been displayed in Table 14. Demonstrating the most predominant sub-themes.

Sub-Theme	Participant Code	Frequency
Security in the Fourth Industrial Revolution	P1, P3, P4, P7, P10, P11	23
Internet of Things	P1, P2, P3, P4, P5, P6, P7, P10	11
Robotic Processing Automation	P1, P2, P9, P12	6
Productivity	P1, P2, P3, P4, P5, P6, P7, P8, P9 P10, P12	32

Table 14. Theme 1 – Impact of DT

All respondents were familiar with the understanding of the construct of a DT within the ICT sector, associating it to a new technology replacing an existing technology, changing the way a product is developed and marketed. Respondents, argued that this changes how business operates through digitisation and cloud solutions. For this reason, respondents felt that they are stimulated to be move innovative However, (P7. Personal communication, December 13, 2018) suggested that DT are not treated differently to other projects and should be classified in the same way to get the benefits of a PMM.

The participants from HO are more aware of the impact of DT, than the participants from the S1 (P4, personal communication, December 12, 2018) highlighted that S1 is responsible for the connectivity and security infrastructure that the DT are implemented on, but is not aligned with the HO's digital transformational strategy which leads to inconsistencies in delivering a unified solution to the customer.

From the observations, the DT being introduced within the organisation is to increase productivity and customer satisfaction. (P2 personal communication, December 12th, 2008), stated that robotic processing automation, which alleviates pressure on employees by focusing on automating manual intensive financial transactions, is currently being disruptive within the organisation. While (P8, personal communication, December 14, 2018) confirmed that the new CRM is being built to automate as many of the business processes to ensure employees focus on more complex responsibilities. (P7, 2018) mentioned that the business

owner must involve the executive committee to get the buy-in and investment and to communicate the impact of the DT on improved quality and reduced costs.

(P2, 2018), confirmed that due to the procrastination of the business case generation and approval to secure funding for the IoT innovation, the retail partner lost confidence in the organisation to deliver this DT that would have led to both organisation leading in the market.

4.4.2 Security in the Fourth Industrial Revolution

(P7, 2018), highlighted that additional security investigations is being included, as automation is focused core functions of the business, connecting many personal and business devices. The security and privacy requirements need to be robust for customers to trust the solution. Security needs to be considered over the innovativeness of the product to ensure adoption and sustainability. Robust firewall and intrusion prevention devices need to be implemented to ensure secure services, therefore the project manager needs to have product knowledge to ensure the solution is secure (P2, 2018)..

Although RPA can reduce security challenges, data security becomes a concern as the possibility of hacking or employees accessing data not meant for them. HO has implemented (P10.personal communication, December 14, 2018) corroborated that approximately 2 years ago, some of the customers on cloud solutions were affected by Denial of Service(DOS) with the attempt to shut down all security controls put in place. Even though the organisation reacted promptly, there was reputational damage. Due to the lack of boundaries within the organisations network of a DT implementation, the intent to segregate the intrusion has been convoluted. (P6, personal communication, December 12, 2018) claimed that there is no control over IoT devices, and allowing these types of devices to be implemented across the network will increase the risk of cyberattack. For this reason, (P2, 2018) argued that HO needs to guard their reputation by ensuring secure and robust solutions are put in place.

4.4.3 Improving Productivity

Disruptive technology that is implemented within the organisation is increasing customer and employee satisfaction as productivity is being improved through automation of time-consuming and mundane tasks (P10, 2018). HO and S1, are using DT to improve their

products and service development by reducing costs to enable a competitive edge. (P1 personal communication, December 10, 2018) advised that there are technical limitations in the payroll system for paying out bonuses and RPA is being used to overcome the limitations without incurring exorbitant costs and the need for manual intervention to complete the bonus process.

S1 implemented a CRM tool that allows customers to procure services via an online platform, including automating business processes. (P8, 2018) pointed out that large organisations need to provide differentiating services to ensure all segments can receive a personalised service, whereas previously this was convoluted. Due to the system being an in-house, cloud-based solution, license and hardware costs were reduced allowing the budget to be allocated to automation.

4.4.4 Classification of a DT

The PCT framework gave insight into the classification complexity of the DT. The constructs are highlighted in Table 15.

Sub-Theme	Participant Code	Frequency
Classification of Innovation	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	25
Level of newness of the product	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	12
Level of technology uncertainty	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	36
System Complexity	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	24
Project urgency	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	21

Table 15. Classification of DT

4.5 Project A - Cloud Computing - CRM

S1 respondents highlighted that the in-house developed CRM system, was released within 15 months from initiation, a month after the license for the current tool expired. The main reason for selecting an in-house-built CRM was due to increased license costs and lack of user friendliness of the incumbent tool. Table 16. depicts the outcome of the application of the research model on Project A.

Disruptive Technology Components	Case Study Observation
Classification of Innovation	Radical Innovation
Novelty	This was not an off the shelf product however was being built based on the business rules of the current CRM system which had many limitations
Technology	The current processes were relatively well understood however the development was written in a new language by a single resource Within three months into the project, RPA was introduced increasing the level of uncertainty.
Complexity	The CRM system was integrated with the billing, change management, support services, engineering and customer master systems to ensure that the organisation could meet the quote to support processes. The data management and integration requirements were highly complicated (P10. Personal communication, December 14, 2018).
Pace	The two significant success criteria were to ensure that the new CRM was implemented before the licence's expiration date of the incumbent CRM. The Automation of processes needed to be implemented in order to retrench employees to reduce the operational costs (P6, 2018).

Table 16. Customised CRM

4.6 Project B – Robotic processing automation

Robotic Processing Automation was implemented for the accounts receivable and payments solutions to ensure data accuracy. This allowed employees to focus on more challenging tasks creating productivity within the finance division. Automating mundane tasks allowed employees to focus on more important projects, reducing staff turnover. Human Resource functionality was introduced to ensure leave was monitored, ensuring that sick leave and

study leave notifications were uploaded correctly. Table 17. depicts the outcome of the application of the research model on Project B.

Disruptive Technology Components	Case Study Observation
Classification of Innovation	Radical Innovation
Novelty	RPA has been operational in the organisation for approximately 11 months hence it is relatively new. Outsourced resources were employed to setup the infrastructure and code
Technology	Even though the setting up of the technology has limited challenges except for chip management and security issues. However, the change management is more predominant uncertainty experienced by employees.
Complexity	Number of processes and systems involved in the automation is significant. The processes that need to be automated are of high risk therefore, the level of uncertainty and change in the process does impact the success of the automation. Bonus Processes and Annual salary increase is being automated due to the limitations of the incumbent payroll system
Pace	(P2. Personal communication, December 12, 2018) insinuated that minor changes upstream or downstream on the user interface can lead to significant bot reconfiguration which delays putting the release into production. The reliance on external systems can create unnecessary delays, as often work needs to be done on other systems to ensure the RPA system can continue its processing. Currently the RPA team have been waiting for six months for new tables for the vendor sub-ledger folders to be made available. (P9. Personal communication, December 14, 2018). System limitations of other peripheral systems leads to quick fixes that needs to be done by the RPA system.

Table 17. Robotic Processing Automation

4.7 Project C – IoT– Connected Retail

IoT is revolutionising the retail industry globally, therefore SA businesses are excited to have this solution implemented to drive a more intimate customer experience and leaner supply management processes. For this reason, HO started the IoT connected retail project, however, did not follow the governance process to secure funding. Although this product will ensure the organisation is a differentiator in the market, the investment committee has not

been able to secure the funding due to the vagueness in the business case and the complexities of the solution that was not well thought through. Table 18. Depicts the outcome of the application of the research model on Project C

Disruptive Technology Components	Case Study Observation
Classification of Innovation	Radical Innovation
Novelty	IoT connected retail has not yet been implemented by the organisation, however understanding the inception phase is important to the process of the implementing the disruptive technology. (P7, 2018) Indicated that the process started out eight months ago to complete the business case however identifying all commodity volumes (ACV) across the territories needs to be well defined before the investment can be committed on. The organisation and the internal project team do not have enough experience in implementation.
Technology	Although the solution is a combination of multiple existing services, the combination of the operations leads to uncertainty on how this will be implemented and managed. The scope of what skills are required is well understood however finding people with the correct skills and the right culture is scarce. (P2, 2018) revealed that the current connectivity solution will suffice for the number of devices, however the uncertainty of the connectivity architecture required to sustain the demand is yet to be determined. The likelihood that the hardware devices that will be installed can become obsolete within a few years whilst the IoT solution will last longer than the devices is high.
Complexity	The dependency on value streams to ensure a robust and feasible IoT solution is implemented is incredibly significant to the organisation. Internet connectivity, security, data protection and increased energy demands needs to be considered. Legacy systems could impact the integration with the new technology.
Pace	(P7, 2018) claimed that strategically IoT is one of the most important tools that they can use to improve customer experience. A large retail customer has been in contact with the organisation to start the implementation however due to the lack of committed numbers on the ACV, the project has not commenced. Benefits of IoT in the retail space has been aggressively socialized in the last five years. The current risk is that there are competitors who are able to deliver this solution and should one of the other retailers get the solution implemented first, the incumbent customer will be in a compromising position

Table 18. IoT – Connected Retail

4.8 Project Management Styles

The section was to determine the number of project management styles in practise and if a preferred methodology was selected for a disruptive technology.

All respondents agreed that both organisations practiced agile and traditional project management methodologies, whether the one was preferred over the other is yet to be determined. (P7, 2018) initially was not convinced that in order to implement a DT successfully, that a project management style was significant. However as more clarity was given through the interview, he concluded that not selecting the correct project management style at the onset of a project could delay the implementation. (P2, 2018), insinuated that not all projects fit a specific project management style. This is supported by Shenhar who theorised one size does not fit all (Patanakul et al., 2012; A. J. Shenhar, 1998). Table 19. Depicts the sub-themes that were derived through the frequency of words uses.

Sub-Theme	Participant Code	Frequency
Agile Project management	P1, P2, P3, P4, P5, P6, P7, P8, P9 P10, P11, P12	47
Waterfall/Traditional	P1, P2, P3, P4, P5, P6, P7, P8, P9 P10, P11, P12	44
Hybrid Project Management	P2, P5, P6, P7, P8, P9 P10, P12	20
Business value of a PMM	P1, P2, P3, P4, P5, P6, P7, P8 P10, P11, P12	12

Table 19. Theme 2 – Project Management Styles

4.8.1 Agile Project Management

Both case study organisation practised agile, however following two different methods, S1 focused on Scrum while HO implementing using SAFe, but none to its optimal level. The findings in Table 20. and Table 21. gives an overview of the respondent's view of agile.

Impact of Agile	Findings
Limitations in Traditional	(P4, personal communication, December 12, 2018) indicated that aligning to the agile methodology within the last six months has increased motivation and productivity within their product development team. Nevertheless, selecting to use the agile methodology was not due to being more innovative and productive, it was related to the short-comings of the traditional approach.
	(P10, 2018) indicated that if the agile approach was used to implement the CRM system, the team would have been in a better position to mitigate their risks much earlier and would have been able to go live much earlier, allowing the organisation not to go into contract for license costs for another two months. In addition, introducing the new requirements for robotic process automation earlier in the process would have been lucrative for the organisation.
Product Development	In product development, before projects are approved, extensive documentation to prove feasibility has resulted in unnecessary documentation and delays to the project initiation. However, in the agile framework, (P4, 2018) advised that starting on development as soon as possible is highly recommended.
	On the other hand, (P8, 2018) pointed out that executives require accurate costs and documentation before the project continues. However, the IoT project continued without the lean business case being approved which resulted in the project being put on hold one month after kick-off.
	(P10, 2018) highlighted that Product Managers risk getting attached a product due to the time and effort invested in the development of the product. This product attachment results in Product Managers being reluctant to change their product, even though the changes are based on customer and market feedback. Product management and organisations have found value in agile which allows for the minimal viable product to be built, encouraging customers to drive product changes. This results in product managers being more innovative.
	(P12, personal interview, December 14) highlighted that in previous projects, the development and testing cycles didn't deliver value quick enough to businesses, but through the agile framework the development and testing is almost concurrent.

Table 20. Agile Project Management

Impact of Agile	Findings
Limitations in the Commercial Model	(P11, 2018) attested that customers are uncomfortable with not knowing the cost and the timeline of the implementation starts, making it difficult to manage expectations.
	(P12, 2018) concluded that customers have not yet evolved to accepting a minimum viable product, but rather expect the full solution to be delivered. Furthermore, (P7, 2018) advocated that Head Office's commercial model for DT has not yet been built to allow the organisation to sell a minimal viable product to the customer.
Adoption of Agile	(P2, 2018), emphasised that Head Office has implemented the SAFe methodology over the last year. The key roles to drive the projects are the Scrum master, Product Owner and Manager. The organisation is driving this new methodology to ensure the minimal viable products are taken to market in a shorter period.
	(P2, 2018) added that this approach was selected due to limitations with both scrum and traditional project management. Yet, (P8, 2018) referred to training not being completed by key roles, therefore the full value of the methodology has resulted in work not being completed as planned.
	(P8,2018) referred to training not being completed by the key roles, therefore the full value of the methodology has resulted in work not be completed as planned
	(P12, personal communication, December 14, 2018) implied that through the adoption of ceremonies, it is evident that the executives are not ready to accept a new methodology as they are still confined to the normal ways of working as it is more structured and includes documentation.
	(P2, 2018) confirmed that only strategic projects are implemented using SAFe, permitting the rest of the organisation to use scrum or traditional styles. Moreover, SAFe supports software development projects and not organisational change (Knaster & Leffingwell,2018)
	(P6, personal communication, December 12, 2018) confirmed that for this reason, some project teams do not see the value in completing all ceremonies. Then again, other teams on the project have had great value in using the methodology as teams were more focused and motivated, facilitating early delivery dates through self-managed teams (P5, personal communication, December 12, 2018).
	(P2, 2018) mentioned that the other challenge is that most teams have Business as Usual (BAU) and project work. Although team members have requested to take into consideration their BAU work when committing to project task, this does not always work out seamlessly. However, (P12, 2018) acknowledged that their large cross-functional teams responsible for delivering the business goals are more effective and motivated through this new methodology.
	(P4, 2018) implied that the SAFe journey has begun for Head Office, and due to the benefits of this framework being exposed through another DT being implement between Subsidiary 1 and Head Office, the decision has been made for Subsidiary 1 to start being SAFe aligned.

Table 21. Agile Project Management

4.8.2 Traditional Project Management

Both organisations have been practicing traditional project management for many years and sees value in using a specific methodology in implementing DT. (P10, 2018) explained that "*even though the process is linear for traditional project management there is a misconception that projects cannot be delivered incrementally* ". A process called progressive elaboration, allows the project to evolve as new information becomes available". However, a concern was shared by (P2, 2018) that DT is so volatile that it could introduce significant changes, impacting the cost of the project even though the contract is signed based on the initial scoping. For this reason, skilled technical resources that includes the project manager needs to be involved in such projects to be able to scope and manage expectations accordingly. (P5, 2018) mentioned that as a result of huge software and hardware investments, once these requirements have been agreed on, the scope cannot be changed without understanding the full impact on budget, time and quality of the project.

(P9, 2018) implied that DT often requires the business models to be changed to ensure customers can be managed accordingly. DT often represent complexity and requires quick implementation, but with the waterfall approach, changes need to go through a change management board before being approved for implementation. The customer is regularly required to sign change variation orders, leading to frustration and loss in confidence in the project team.

On the other hand, (P11, 2018), cited that "*most customers and subsidiaries prefer using traditional project management methodologies, therefore do not accept projects being rolled out using agile* ". (P 3, 2018) advised that project managers make sure documentation is complete at each stage due to the governance procedures. Even though the documentation is extensive, it is a structured process highlighting the full impact of the change to the customer. In this way, the organisation is not implementing significant changes resulting in the outcome of the initiative varying from the initial agreed scope. This allows for the project to be more accurately implemented and controlled. Having dedicated phases within the life-cycle gives the project team confidence that when the product is ready for release it will have very minimal bugs or defects. Overall, respondents insinuated that even though customers and executives expect the traditional approach to be followed, the process is being streamlined significantly from a governance perspective.

4.8.3 Hybrid Project Management

(P7, 2018) stated that even though the organisation is implementing their strategic projects through the SAFe methodology, the waterfall process still exists. There isn't a purist methodology within the organisation for strategic projects. Most of the respondents pointed out that the introduction and acceptance of agile was at the expense of the benefits of waterfall. (P8, 2018) acknowledged that starting the project with detail planning and executing in increments is an ideal approach that is prevalent with some projects within the organisation. (P2, 2018) states that this methodology exists within the organisation but has not been formalised.

(P1, 2018) agreed that while this approach may seem appropriate, "*the organisation's investment into a project management system supporting a hybrid methodology will not be feasible*". Further to this a hybrid solution is not an industry standard, therefore a project management tool to cater for this solution doesn't exist.

4.8.4 Business Value in Selecting the Correct Project Management Methodology

(P6, 2018) postulated that selecting a PMM before implementing a project allows the correct questions to be asked to determine if the project is aligned to the strategy. Having the entire team speak the same language and be on the same page around the delivery mechanism of a project helps progress the project more effectively. (P11, 2018) mentioned that, "*methodologies allow only respective processes to be followed instead of completing unnecessary activities.*

"Whilst waterfall methodologies focus on the governance and planning in detail, Agile is more flexible and accommodating, however both methodologies increases project performance" (P2, 2018).

By selecting a methodology, consistency amongst the team is established, allowing the team to plan better, manage expectations and deliver quality projects to the business in a consistent approach (P4, 2018). There is increased efficiency and productivity which reduces employee turnover. (P6, 2018) observed that a PMM involves business at the right time to reduce risks and ensure effective communication. Managing change through a PMM

facilitates a streamlined approach through targeting and communicating to the right audience. (P7, 2018) suggested that methodologies introduce quality into the process, improving product development, facilitating a higher ROI. Both methodologies included a lesson learnt activity that allows teams to learn from the past projects to improve the future projects.

In the light of DT and the uncertainty it introduces, being able to respond to changes in a flexible but structured method is crucial to the implementation as it gives the stakeholder confidence to continue contracting with the organisation (P4, 2018).

4.9 Project Management Competencies

Majority of the respondents articulated their concern that project management as a discipline is going to be obsolete in a few years. It is evident from the observation and interviews with the team that more agile driven roles are required, such as scrum masters, product management and owners to drive the delivery of the initiatives. When asked what competencies will be required in the future in order to ensure project managers delivers value, a few cited change management and strategic project management and leadership roles which is depicted in Table 23.

Sub-Theme	Participant Code	Frequency
Change Management	P2, P6, P10	8
Strategic project management and Leadership	P1, P2, P4, P5, P6 P10, P11, P12	12

Table 22. Theme 3. Project Management Competencies

Although most of the respondents highlighted collectively that traditional and agile competencies are required to implement projects in general. A few cited change management and strategic project management and leadership. Table 24. Highlights the findings.

Project Management Competencies	Findings
Change Management	(P2, 2108), insinuated that DT is multi-faceted and has many complexities and driving the change within the organisation and the market is important to the adoption of the technology. (P10, 2018) stated that DT are increasing organisational change but not all organisations have change management disciplines (P11, 2018) argued that complex projects are meant to have change managers but, due to budget constraints and the notion that anyone can do change management, little or no projects have a dedicated change manager. This leaves the project without key roles to drive penetration and adoption of the technology. For this reason, project managers should manage the project in its entirety which includes change management.
Strategy	(P2, 2018), advised that due to the complexities introduced by DT, the need to deliver faster to the market requires project managers to understand the business strategy. On the other hand, (P7, 2018) opined that project managers should be delivery focused rather than strategy focused as project managers should not focus on the big picture thinking, but rather in the detail of the current project. Many of the respondents had the same view as P2, as their opinion was that most projects are a result of a strategy and linking projects and strategy will only be an advantage to the project implementation. In the case of DT and a host of strategic project. (P9, personal communication, December 14, 2018), elucidated that understanding the DT strategy will allow project managers to prioritise and make decisions accordingly.

Table 23. Project Management Competencies

4.10 Research Gap and Summary

The literature has revealed that although both traditional and agile project management has been in use for a number of years however has been proven to successfully deliver complex and uncertain projects which is the norm of disruptive technology. On the other hand, the hybrid approach even though it's at its infancy has been shown to manage both customer and organisations expectations in delivering a more successful project. Organisations do not have the option to select the hybrid approach, as the principal approach is often traditional or agile. There are currently no studies clearly indicating that for DT needs to follow a specific defined process, to select a project management approach. Furthermore, project managers are not skilled in managing both agile and traditional projects, therefore always opt for the more dominant skill to select a PMM.

Organisations are becoming project based due to the benefits associated with it however due to the complexities introduced by innovative DT, selecting the correct PMM is becoming a critical success factor. Yet, management do not know or see the value in matching a project to a specific approach therefore resulting in inevitable failures. Relying on only

traditional and agile project management in this VUCA environment will result in effective management of projects. Furthermore, project management needs to evolve to be able to manage DT.

5 Discussion

This chapter presents the discussions on the findings, for conclusions and recommendations to be drawn based on the research objectives in Chapter 1 of this study.

5.1 What is the Influence of DT Implementations on Project Management Styles Selection in the ICT Sector?

Through a qualitative and comparative analysis of three case study projects using the grounded theory methodology, distinct patterns of classifying project management styles of DT were identified by applying the Project contingency theory frameworks.

5.1.1 Impact of DT

When respondents were asked to characterise DT, they associated it with volatility, complexity and uncertainty. This was common, and they experienced these characteristics on the IoT, CC and RPA projects. The respondents clearly articulated that DT are built on the network infrastructure and needs to be implemented in a robust and secure manner.

It was found that respondents fully understood the complexity that DT introduces to the project world. DT require intense collaboration, working on unexpected outcomes that are continuously evolving due to the many assumptions and variables highlighted at the onset of the initiative. Unknown and important elements only come into play midstream of the implementation. Although DT was put through a lean management process to identify the impact of the complexities on the project team, the governance body did not follow a set criteria to check the validity of the complexities. The complexities were classified based on the traditional approaches of resource allocation, budget and timelines requirements, rather than the contingency theory constructs of the Innovation and Diamond Framework. A noteworthy point is that respondents were able to articulate that both the CRM and IoT correlated to radical innovation, therefore the assumption can be made that even though the formal process did not include the correct classification, employees were aware of the characteristics of DT.

Respondents classified the technology based on Henderson and Clark's Innovation framework and the Diamond Framework constructs, but only took complexity and pace into

consideration. This resulted in incorrectly classifying a project. In the case of the RPA implementation, the central focus on ensuring that employees understand and prepare themselves for other responsibilities as key business processes are automated. The Diamond Framework focuses on the dimensions of a technology, yet the people aspect of DT, as crucial to the adoption of the product, seems to be negated from the model.

Table 25. highlights the outcome of the application of PCT on the three projects after observation and insights into the detail of the project highlighting that the research model does support the outcomes of the research objectives. Even though the results of the application clearly articulate the output of each project, it is evident through observation and interviews that one cannot change what the selection process can be for a PMM from the bottom up as the decision needs to be made from the top down. The organisation's leadership must understand that 'one size fits all' is not the only option in project management methodology selection.

The reason for this conclusion is that project management tools are driven on the selection of the project management types at a strategic level. Organisations do not generally support more than one project tool due to feasibility. Therefore, it is noted that a project management style selection is based on what project management tool is available within the organisation, and not on the constructs of the complexity of the project.

Project Name	Novelty	Technology	Complexity	Pace	Innovation	Existing Project Management Style	New Project Management Style
CRM	Breakthrough	Super-High Tech	System	Blitz	Radical	Waterfall	Flexible, ready to accept many changes and tolerate long periods of uncertainty
IoT	Breakthrough	High Tech	System	Time-Critical	Radical	Agile	Flexible, ready to accept many changes and tolerate long periods of uncertainty however a little more detailing planning at the onset
RPA	Platform	High Tech	System	Time Critical	Radical	Agile	Flexible, ready to accept many changes and tolerate long periods of uncertainty

Table 24. Application of Project Contingency theory Frameworks

5.1.2 Project Management Style

Shenhar suggested that by classifying a product into the Diamond Framework dimensions, based on the respective values within each dimension, the appropriate management style can be selected (Patanakul et al., 2012; A. Shenhar & Dvir, 2007; A. J. Shenhar, 1993, 1998). Shenhar looked at the framework based on the marketing aspect however the researcher looked at it from a project management perspective.

The project management style selected for the CRM initiative was a traditional approach, but, through the observation, the more appropriate selection would have been a hybrid approach. The approach selected was to support the executive stakeholder's expectations.

Authors such as Ralf & Rodney (2007) outline that it is important that organisations are aligned with the project management methodology and processes that exists throughout the organisation. However, the project management body needs to be cognisant that a project cannot be forced into a methodology as a result of the incorrect expectations set by the executives. Both organisations in the case study practise traditional and agile project management methodologies. As explained in the findings, a few strategic initiatives use agile while the other projects are known to use traditional. Merging these projects at a portfolio level is cumbersome, leading to unnecessary frustration and time spent consolidating project reports.

It has been evident that in some cases, projects have informally opted for a hybrid approach and spend significant time in reporting in a traditional approach. Even though the organisations have invested significantly in tools that support the methodologies such as Agilecraft, Jira and Sciforma for agile and traditional projects respectively, respondents have advised that only segments of the organisation are practising a specific methodology. (P12, 2018) implied that having the entire organisation "march to the same drum beat", ensures that the implementation of a PMM guarantees benefits to the implementation and adoption of the product. The researcher observed disconnect across the business leads to poor adoption of the projects. Kerzner insinuated that implementing the correct methodology for a project, and not one that merely exists for the organisation, will drive project performance and sustainability in the value of PMM's (Kerzner & Kerzner, 2017).

Furthermore, benefits of a project management methodology selection include better control of project goals and scope, reduction in risks, more efficient processes, including decision making, faster time to market and quality management process, improved customer satisfaction, increased knowledge management by enabling information exchange between projects (Kerzner & Kerzner, 2017; Project Management Institute, 2018b). Agile methodologies can deliver complex DT with much more certainty. However waterfall is used when the project goals are much clearer and structured (Edivandro C. Conforto, 2016). Theory applied have revealed that both agile and traditional project management styles have limitations, and the need for a hybrid approach is warranted. In the case of DT, the limitations of agile identified is that very limited planning is done of the entire product at the initiation phase. On the other hand, traditional project management only delivers at the end of the project which does not allow the business to get the ROI or the competitive edge the stakeholders have been expecting. The conclusion can be drawn that a hybrid style focuses on business value instead of the triple constraint and the ability to customise the project management methodology, instead of applying a single method to deliver complex DT.

The norm has been that organisations have not constituted project failure to the incorrect selection of a project management style, but rather associate failure to a mismanagement of budget, resources and quality. For this reason, the conclusion can be drawn that understanding the full limitations of a specific methodology for a specific project, should become the focus of organisations.

Based on the findings, selecting the correct style is not the only criteria for the success of DT implementations. If the organisation and project team do not fully understand project scope, there are no tools or techniques within any methodology that will guarantee project success. However, it must be recognised that the incorrect methodology can have negative impact on the project's success, or at least, make managing the project rigid (Chronéer & Backlund, 2015). Further findings regarding the inadequate or non-existent commercial model draws the attention to the contract engagement process. It is cumbersome engaging with the customer on an agile project as it allows the customer to revisit costs, making contract negotiations unpredictable, as the customer's mind-set has not yet changed on how to operate in an agile manner. Customers need to be a part of the change management process to be able to transition them from an orthodox contract engagement to a new work of contracting. The ability to cost per feature could be a viable choice for the customer as

this allows the customer to get a service quicker than previously. This will also allow the customer to opt out of the contract should they need to.

Respondents have clearly identified the need for the integration of innovation and project management to successfully deliver complex solutions. DT require innovative thinking, but traditional project management has been known to stifle this method of implementation. (P4, 2018) solicited that, for this reason, new product development is becoming a phenomenon to drive innovation through project management. Considering that agile is taking over the software and other industries, merging these disciplines seems like a viable choice, as it supports a quicker go to market strategy.

The organisation wanted to be the first to market the IoT solution to retailers, however the investment was not approved as the business case was not completed at the onset of the initiative. In recent studies, the focus has been on front end radical innovations and ensuring highly skilled project managers leads the initiative from ideation to concept phase (Florén & Frishammar, 2012). Highly Radical Innovations' include the application of major new technologies, or new combinations of technologies, to new market opportunities, enabling increase of new products or services. Whilst the study focuses on a hybrid of project management methodologies, the concept of a hybrid project-product management methodology has been introduced to manage DT. Pajares et al., (2017), attested that project management needs to take into consideration that the timelines required to take a product to market needs to be quicker than previously. (P4, 2018) validated that for a DT to be delivered to the market in aggressive timelines, integrating the project management and product development processes allows all processes to be managed more effectively by mitigating risks much earlier in the process.

5.2 Will Project Management Competencies Need to Change Based on the Impact of DT on a Project Management Style Selection?

The PMI Pulse of Profession reported that the agile and waterfall approaches (Project Management Institute, 2018b) were selected above all other approaches to implement DT. Organisations often use incumbent project management style to implement customer projects. Customers tend to find this to be an issue as it's not always the preferred methodology as the process and principles are not well understood. This tends to reduce

the efficiency and effectiveness of the project. For this reason, it is imperative project managers need to have both agile and traditional project management competencies. The observation during the case study has highlighted that project managers with only traditional project management exposure are working on a limited set of projects, due to limited agile experience. Research has revealed that during this technological revolution, having a single project management style competency does not add the business value as expected (Edivandro C. Conforto, 2016). Even through executives are cognisant that only one methodology is accepted within the organisation, the expectation is that project managers should be able to operate in a traditional and agile mode at any given time.

Project managers are requested to be scrum masters or to implement agile projects without the recommended training and upskilling. DT require flexible high-performing teams and require the same level of commitment and expertise of project managers. From the findings, the generalisation is that even though the correct project management style is selected, the success of the initiative is dependent on the competency of the project manager. Over and above the selection of the correct project management style, the development of project management competences, from a technical and behavioural perspective, influences the success of a DT. Organisations need to be cognisant that not any project manager or scrum master can implement a DT.

DT is imposing new challenges to the project team due to its uncertainty and complexity, and a project manager should not only focus on completing tasks, but needs to play a significant role in strategic interactions. The correlation of project management competencies and project success is widely recognised (Pajares et al., 2017). Project managers must have the capability of knowing which DT is ready to be taken to the market and to understand the products adoption in the market and how it will be develop in the future (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). Projects are generally related to the business strategy, and it is apt that project managers can articulate the project vision effectively to the project team. Instead of focusing on only the triple constraints of a project, the end users' expectations, competitive advantage, and future market success becomes a focal point allowing the project manager to provide insights into the change requirements to remain competitive. It is becoming evident that leaving the strategic deliverables to executives is not equipping the rest of the organisation to take accountability for the strategy. Project managers are best to assist with converting strategy to execution, for this reason

project manager's strategy competency levels need to increase. Project managers must be in the position to answer the relevance of the project, define the opportunity to be addressed based on the organisations need, focus on the long term need and what product will be best to deliver the competitive edge required for the organisation. Inclusive of this, project managers need to have the strategic focus to know what behaviour is required and what project management styles should be selected to fulfil the project requirements.

This allows the project manager to make sound decisions around technical competence, change management and interpersonal and leadership skills that the team and the project manager needs to possess to successfully manage a given project based on the selection of the project management style.

Previously it was noticeable that project managers did not need to have technical competence to implement a project. However, with the rapid changes in the complex DT, not having this capability to merge project management with product development is becoming a liability in the FIR. Project management competencies to connect innovation and project management to drive economic and strategic value is of great importance. Choosing to manage with only agile and traditional project management competencies will create frustration for the project manager and the executive team, resulting in the benefits of implementing a DT not be realised, or taking a long time to materialise, questioning the relevance and capabilities of project managers in the new FIR.

5.3 Conclusion

There has been a significant amount of development in evolving project management within the ICT sector however organisations are very cautious on implementing new PMM's due to budget constraints and being risk averse. This study makes a great contribution to what influences disruptive technologies project management style selection. The literature reviews and qualitative research through interviews and observations gave insight into what variables should be considered to classify a disruptive technologies for better project management in the ICT sector in South Africa. Based on the findings of this study, it can be derived that the results supports the conceptual model. The findings of this research that Innovation, Novelty, Technology, Complexity and Pace has a significant relation on selecting the appropriate PMM.

The mounting pressure to reduce time to deliver DT to the market is becoming a fundamental position within organisations. Based on the complexity and uncertainty that is being introduced, selecting the incorrect project management without considering all dimensions of the technology has resulted in project failures or less than desirable business benefits. The analysis completed through the exploratory exercise of the two organisations has provided insight that while both agile and traditional project management individually have delivered successful projects, this may not suffice with the implementation of the DT. Project managers and the organisation need to be cognisant that while both approaches are available, the selection must be based on the classification completed of the technology which will dictate which stream of the project adopts which style in order to facilitate a successful DT implementation.

Considering the current experiences within both organisations, where informal hybrid project styles were selected, project managers ascertained that having both agile and traditional project management competencies have assisted tremendously in delivering successful projects. Project managers recognised the value in being more strategically focused to make correct decisions based on what was required from a technical, change management and skills perspective to ensure that project managers contributed positively throughout the idea to deploy phase of a DT.

6 Recommendation, Future Studies and Limitations

6.1 Recommendation

This study recommends that Henderson and Clark's Innovation and Diamond Framework be applied to all ICT projects, irrespective of whether they are disruptive or not. This will allow the relevant teams within the organisation to classify a project more correctly in order to assign the appropriate PMM. To facilitate this, a governing body, consisting of a project lead, at the ideation phase needs to classify a project before it is submitted to the project management office. Further recommendations that are merely suggested is depicted in Table 26.

Recommendations	Additional Details
Make all PMM's available for selection to the Project Management Office	Even though the organisation has a single tool, the options to select the appropriate PMM must be made available
Formalise a hybrid Project Management Methodology	Ensure Project Managers are trained to have both Agile and Traditional competencies.
Formalise a commercial model for Agile and Hybrid Projects	Ensure the contract management process allows organisations to contract via implementing in a an agile or hybrid approach
Define the collaboration of project and product management	In order for project managers to be more involved in the implementation of disruptive technologies to ensure its success, project managers should understand New Product development and be more involved in the product development
Measure project success throughout the project and not at the end as a project management style may need to change based on the impact of the DT.	Project Governance Processes within the Agile and Traditional PMM needs to be evolved to ensure the project is measured for appropriate approach and ROI
Ensure all project managers and team members are skilled based on both agile and traditional project management competencies.	Teams must be able to be managed via both methodologies at any point within the project life cycle
Ensure project manager develop change management and strategic competencies to lead teams to be adaptable to any PMM	Implementing changes introduced by Disruptive technologies requires change management to more prevalent to ensure adoption. Due to the rapid changes and complexities that disruptive technologies introduces, project manages needs to understand the strategic intentions of that specific product is aligned to the organisations strategic goals

Table 25. Recommendations

6.2 Limitations to the studies

DT has an impact on most project-based organisations and the ICT organisation has its own limitations, therefore the framework should be examined for its applicability to other industries. Since the research was conducted in only one organisation across two subsidiaries, cross-validation was required with other industries to generalise the framework therefore the subjectivity was a limitation.

6.3 Future Studies

Shenhar (2007), insinuated that a project type needs to be matched with the correct project management approach however has not considered the project management competencies required from a soft and hard skills perspective. Even though this study focused on project management competencies, there is a need for more empirical research, as without the appropriate competencies, there are no benefits in selecting the correct methodology According to Chipulu (2013), understanding the human elements required to manage a specific project management methodology is likely to improve the result of the implementation. Research in this area will give the agile and hybrid approaches more credibility. Agile and hybrid approaches have seen to be more successful in internal projects, due to the limitations that businesses put on organisations in selecting their incumbent project management approach. A commercial model has not been tested on how to manage an agile or hybrid contract engagement with a customer. For this reason, exploring the commercial model using an agile or hybrid PMM is necessary as DT implementation is increasing rapidly.

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Appendix A – Consent form

Topic: The Impact of DT implementations on project management styles in the SA ICT Sector

PARTICIPANTS' INFORMED CONSENT

Please tick (√) each box below.

□ I hereby confirm that I have been informed by the researcher, Rohendrie Pillay about the nature of the study.

□ I have also received, read and understood the Information regarding the study.

□ I am aware that all information that I provide will be anonymously processed in the research report.

□ In light of the requirements of the study, I agree that the data collected during the study can be processed in a computerised system by the researcher.

□ I may at any stage, without any prejudice, withdraw my consent and participation from the study.

□ I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study and voluntarily agree to participate in the study.

Name of participant in print: ……

Signature of participant: ……...

Date: ……..

Time: …….

Appendix B – Interview Questions

Current Role	
Total Number of years in the role	
Total Number of years at this company	
Level of Education	

Questions for the Respondents:

1. What is your understanding of a DT?
2. Are you aware of any DT that is being implemented in your company, such as Internet of Things, Cloud Computing and Robotic Processing Automation?
3. How many project management styles/methodologies does your company practise?
4. What project management style is currently being used to implement DT projects?
5. What factors are considered when choosing a project management style for a new innovative product?
6. What approach do you use to assign or agree on a project management methodology to be used for a project?
7. Drawing from past projects, do you think a project management style can make the difference between a project's success and failure?
8. What do you believe are the reasons for a DT implementation failing?
9. Are these factors (Novelty, Complexity, Technology and Pace - Diamond Framework) considered when deciding on a project management style

10. What is the impact on the business value on selecting the incorrect project management style?

11. Are there any DT that assist your project management practise to allow you to focus on more strategic and leadership functions?

12. What competencies does a project manager require to implement a DT in your company?