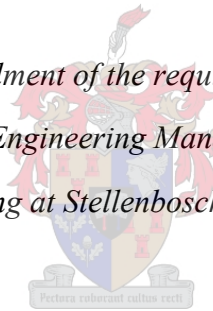# The development of a conceptual framework for enabling a value-adding digital transformation

by

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Master of Engineering (Engineering Management) in the Faculty of

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DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

December 2019

ABSTRACT

The advent of the fourth industrial revolution, or Industry 4.0, is set to disrupt industry. New technologies have enabled new streams of revenue for organisations and has disrupted incumbent organisations at a rapid pace. The manner in which organisations adapt to these technological changes will determine their long-term financial sustainability. Many organisations attempt the integration of Industry 4.0 concepts through digital transformation, but few successfully manage to create value from it. Organisations face various challenges that inhibit the successful enactment of a value-adding digital transformation. Limited research exists about this topic, and thus there is a need to develop a framework that would assist organisations to successfully undergo digital transformation.

This research addresses the need by developing a conceptual framework through using a combination between the conceptual framework development methodology by Jabareen and Enterprise Engineering principles. The research approach starts by focusing on creating context and to identify relevant concepts pertaining to a successful digital transformation. This is achieved through a literature review of the relevant concepts, existing evidence of the impact of Industry 4.0 on industries, and the different approaches to a digital transformation. A challenges landscape is created to find the reasons why few organisations manage to successfully enact a digital transformation. The conclusions drawn from the literature was integrated to generate a set of conceptual framework design requirements.

The next step of the research focuses on the development of the conceptual framework and is introduced by a systematic literature review about existing frameworks or models to test the novelty of the identified design requirements. A preliminary framework is developed by synthesising all the relevant concepts identified from the existing scholarship. This framework is validated through semi-structured interviews with subject matter experts and a case study.

The preliminary framework is constructed into a final conceptual framework. The final framework consists of two over-arching phases, each expanded into sub-phases. Phase 1 provides the user organisations with the concepts that require consideration through the digital transformation process, and Phase 2 aims to integrate the outcomes from Phase 1. Phase 1 consists of five sub-phases, namely, industry disruption, customer needs identification, customer value design, digital capability assessment, and challenges assessment. The outcomes from these sub-phases are integrated in Phase 2, which comprises of the sub-phases: assessment report, value equation, and challenges index. The framework provides the user organisations with suggested tools and processes to achieve the desired outcomes, while allowing the organisation to make tool selections based on their needs, permitting that the outcomes remain the same.

The research and its resulting conceptual framework contribute by providing organisations with a resource that will guide them in their decision-making process regarding digital transformation, and also contribute as an educational tool in Industry 4.0 principles and its integrated applications. The conceptual framework further serves as basis that can be evolved through future research to include new concepts and account for new challenges as technology, industries, and people evolve.

OPSOMMING

Die koms van die vierde industriële rewolusie, oftewel Industrie 4.0, gaan ontwrigtend wees vir meeste bestaande organisasies. Nuwe tegnologieë het nuwe inkomstestrome vir organisasies moontlik gemaak wat bestaande organisasies ontwrig. Die wyse waarop organisasies by hierdie tegnologiese veranderinge aanpas, sal hul finansiële langtermyn-volhoubaarheid bepaal. Organisasies integreer Industrie 4.0-konsepte deur middel van 'n digitale transformasie, maar min slaag daarin om waardevolle veranderinge mee te bring. Organisasies ervaar verskeie uitdagings, wat die suksesvolle implementering van 'n waardetoevoegende digitale transformasie belemmer. Daar bestaan beperkte navorsing oor hierdie onderwerp, en daar is dus 'n behoefte om 'n raamwerk te ontwikkel wat organisasies sal help om 'n digitale transformasie suksesvol te ondergaan.

Hierdie navorsing spreek die bogenoemde behoefte aan deur 'n raamwerk te ontwikkel deur gebruik te maak van die konseptuele raamwerkontwikkelingsmetodologie van Jabareen en beginsels van ondernemingsingenieurswese. Die navorsingsbenadering begin deur relevante konsepte rakende 'n suksesvolle digitale transformasie te identifiseer, en uit te brei daarop. Dit word bewerkstellig deur 'n literatuurstudie van die bogenoemde konsepte, die impak van Industrie 4.0 op industrieë, en die verskillende benaderings tot 'n digitale transformasie. 'n Uitdagingslandskap word geskep om die redes te vind waarom min organisasies daarin slaag om 'n digitale transformasie suksesvol uit te voer. Die gevolgtrekkings wat uit die literatuur gemaak is, is geïntegreer om 'n stel vereistes vir 'n konseptuele raamwerkontwerp te genereer.

Die volgende stap van die navorsing fokus op die ontwikkeling van die konseptuele raamwerk en word ingelei deur 'n sistematiese literatuurstudie oor bestaande raamwerke of modelle. 'n Voorlopige raamwerk word ontwikkel deur al die relevante konsepte wat uit die bestaande literatuur geïdentifiseer is, te sintetiseer. Hierdie raamwerk word gevalideer deur semi-gestruktureerde onderhoude met vakkundiges sowel as 'n gevallestudie.

Die voorlopige raamwerk is verder ontwikkel tot 'n finale konseptuele raamwerk. Die finale raamwerk bestaan uit twee oorkoepelende fases, elk uitgebrei tot subfases. Fase 1 stel die geïdentifiseerde konsepte wat oorweeg moet word tydens 'n digitale transformasie voor aan gebruikersorganisasies, en Fase 2 integreer die uitkomste van Fase 1. Fase 1 bestaan uit vyf subfases, naamlik bedryfsontwrigting, identifikasie van die behoeftes van die kliënt, die kliëntservaring ontwerp, digitale vermoënsassessering en assessering van uitdagings. Die uitkomste van hierdie subfases word in Fase 2 geïntegreer, wat bestaan uit die subfases: assesseringsverslag, waardevergelyking en uitdagingsindeks. Die raamwerk maak voorstelle rakende hulpmiddels en prosesse vir elke fase om die gewenste uitkomste te bereik, terwyl die organisasie die geleentheid gegee word om seleksies te maak op grond van hul behoeftes, mits die uitkomste dieselfde bly.

Die navorsing en konseptuele raamwerk dra by deur organisasies 'n hulpbron te gee wat hulle sal lei in hul besluitnemingsproses rakende digitale transformasies, en dien ook as 'n opvoedkundige instrument in die beginsels van Industrie 4.0 en die geïntegreerde toepassings daarvan. Die konseptuele raamwerk dien verder as basis om deur toekomstige navorsing nuwe konsepte en uitdagings in te sluit wat gepaard gaan met tegnologiese-, industriële- en menslike ontwikkeling.

ACKNOWLEDGEMENTS

CONCEPT GLOSSARY

Industry 4.0

The development of technologies, especially information and communication technologies, that will see systems gather and analyse data across machines, processes, and value chains to enable more effective and efficient business processes; ultimately enabling the creation of higher-quality goods and services at lower costs (Schwab, 2016).

Digital transformation

The process in which organisations integrate new digital-technologies, skills, and processes into every relevant organisational dimension to build a digital business model with the ultimate objective of increasing their operational performance and improving their value-proposition to customers that results in more profitable revenue and greater competitive advantage (Khan, 2016; Ismail, Khater and Zaki, 2017; Schwertner, 2018).

Digitization

The optimization of operational efficiency by adapting and enhancing existing business processes with modern digital technology (Stein and Schmidt, 2018).

Digitalization

The increasing use of digital technologies or computer technology to transform business models, processes, and work environments to become more digitally enabled (Khan, 2016; Schumacher, Sihn and Erol, 2016)

Digital initiative

Independent, digital business innovations, disruptive and sustaining, that creates new or improved value-offerings to customers launched by, but can function separately from, a parent organisation(s), with the potential of being integrated into the parent organisation(s) over a time period.

Digital maturity

The extent to which a specific digital process is explicitly defined, managed, measured, controlled, and effective (Paulk, Curtis, *et al.*, 1993).

Digital capabilities

Outcomes that can be achieved through implementing a specific process (Paulk, Curtis, *et al.*, 1993).

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LIST OF ACRONYMS

AI – Artificial Intelligence

CEO – Chief Executive Officer

CMM – Capability Maturity Model

ESB – Enterprise Service Bus

IoT – Internet of Things

OECD – The Organisation for Economic Co-operation and Development

P.A. – Per Annum

PwC – PricewaterhouseCoopers

QFD – Quality Function Deployment

SME – Small-to-Medium Enterprise

TQM – Total Quality Management

TRIZ – Theory of Inventive Problem Solving

UK – United Kingdom

USA – United States of America

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CHAPTER 1. RESEARCH INTRODUCTION

1.1 Introduction

With the advent of the fourth industrial revolution, or Industry 4.0, traditional business models are becoming outdated, and subsequently organisations are at risk of losing market share. Start-up organisations are disrupting incumbents with digital-based business models, and traditional business models cannot keep up with the demands of the new digital economy, and their sustainability is threatened. Although this new market is threatening the existence of traditional business models, there is an opportunity to create significant value.

Chapter 1 aims to provide background to the problem statement that is discussed in Section 1.3, and also aims to support the argument as to why the problem statement is worth researching. An overview of the design of the research is discussed, and the research objectives for this thesis are presented. The research objectives are supplemented with a set of guiding questions that guided the research. An overview of the following chapters is provided to create context and to enable the reader to gain a holistic view of the research. Figure 1 indicates how Chapter 1 fits into the thesis.
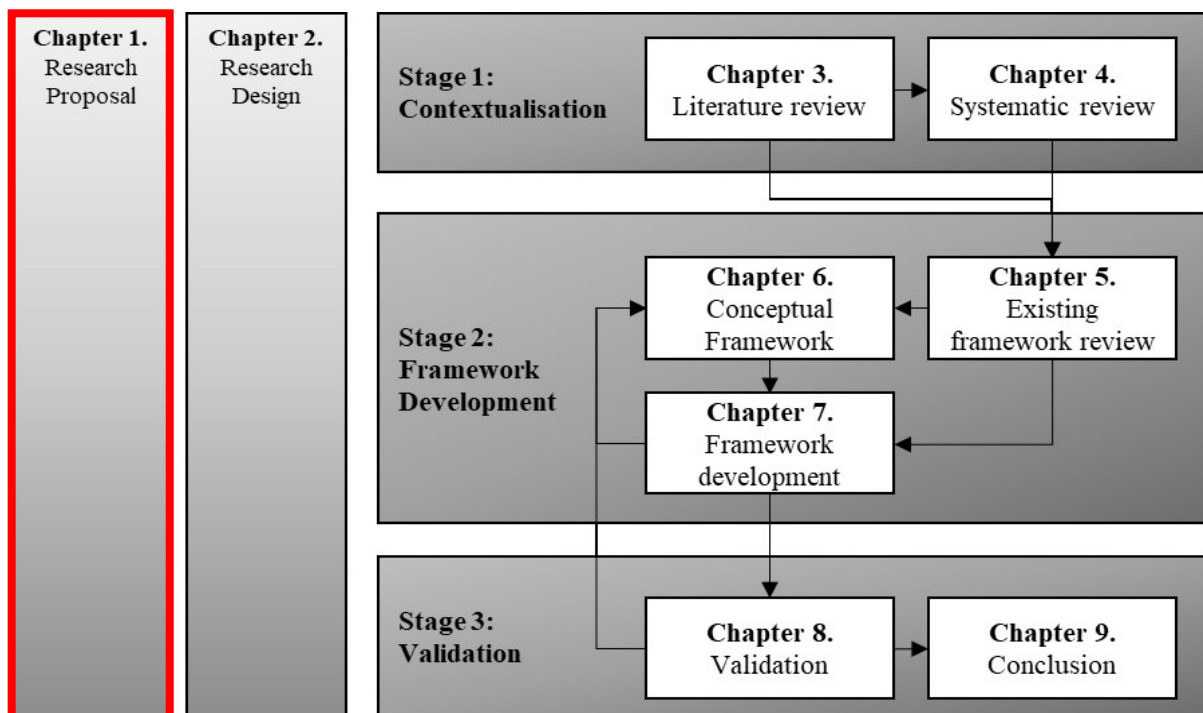
Figure 1: Research design: Chapter 1

1.2 Background

From the late eighteenth century to the late twentieth century, society has undergone a continuous technical and technological evolution – and each era of rapid increase in capabilities is referred to as an Industrial Revolution. Each revolution is epitomised by the creation of a new energy and increased trade capabilities due to greater productivity. The first revolution birthed the steam engine and led to the mechanisation of the textile industry. The second revolution led to the discovery of gas, oil, and electricity. The third revolution automated

production and was accompanied by the discovery of Nuclear energy. It also led to the development of electronics – cell phones, computers, and the internet became indispensable for the modern-day economy (Xu, David and Kim, 2018).

The increase in the use of electronics led to the increased connectivity of humans around the world – and laid the platform for the fourth industrial revolution, often referred to as Industry 4.0 (Schwab, 2016). Although still in its early phases, technologies such as robotics, AI, machine learning, and the Internet of Things (IOT), are potentially disruptive for organisations across industries that are reluctant to change (Xu, David and Kim, 2018).

Klaus Schwab, author of *The Fourth Industrial Revolution*, argues that there will be various impacts as a result of Industry 4.0 – the economy, the business sector, national and global, and society (Schwab, 2016). The scope of this research focuses specifically on organisations, and therefore the impact on the economy and business sector is the key theme.

Leading economists are still in disagreement regarding the exact impact Industry 4.0 will have on the economy. Vacek (2016) argues that 45% of activities that people are remunerated for will be automated, with 30% automation reached in 60% of all jobs. Kelion (2018) showed the disparity between predicted impacts through two contradicting studies – Oxford University predicted 47% and 35% of jobs were at risk of being automated in the United Kingdom (UK) and United States of America (USA) by 2020 respectively, whereas the Organisation for Economic Co-operation and Development (OECD) maintains that the true numbers are 12% and 10% respectively. Although the extent of the impact is not exactly known, the implementation of Industry 4.0 concepts is widespread. A total of 86% of US executives from various industries indicated in a survey that they approve of the use of Industry 4.0 concepts in their organisations (Ashby, 2017).

Executives expect an increased rate of disruption in various sectors of the economy. Russell Reynolds and Associates (2017) surveyed executives (n=1500) who work for companies that have a digital strategy, and according to the survey, the percentages of executives in the technology, consumer, and financial services industries who are expecting disruptions over the next 12 months are 81%, 76%, and 77% respectively, compared to 74%, 73%, and 65% respectively that say they have experienced disruptions at the time of the study.

With various sectors of the economy in line to be automated, organisations will have to adapt their business models to incorporate the new technology, or run the risk of being disrupted by, and losing market share to start-up organisations that have built their businesses on new technologies, or existing organisations that incorporated the new technologies and are crossing industry boundaries (Piccinini, 2015; Schwab, 2016).

Klaus Schwab identified four major impacts on organisations with the development of Industry 4.0 – (i) a shift in customer expectations, (ii) improvement in asset productivity through the use of big data, (iii) increased importance of new forms of collaboration, and (iv) the transformation of operating models into digital models (Schwab, 2016). The expectations of customers are shifting, and with customer experience at the centre of Industry 4.0 (Schwab, 2015; Hood, Brady and Dhanasri, 2016; von Leipzig *et al.*, 2017), organisations have to adopt

business models to win market share by offering the most valuable experience to their customers (Schwab, 2016).

Previous industrial revolutions focused on mass-producing products, without variation. Industry 4.0 has put the customer's need at the core of its operations, and is focused on optimisation and individualisation, which could spell the end of economies of scale (World Economic Forum, 2015). Organisations need to change their models to adapt to the growing need for providing customised products and services, at competitive prices. Traditional models struggle to adhere to these requirements, and many organisations are aware of the need to transform. Various executive teams were surveyed during an Altimeter survey (n=59) regarding their company's participation in digital transformations, and 88% claimed that their business is in the process of digitally transforming, and 85% of the executive teams admit that they will need to make significant strides towards transforming their organisations digitally within the next two years, or they run the risk of being disrupted by the competition and suffering financially (Solis, 2014).

Business models and industries are changing, and according to John Moavenzadah's keynote speech at the 2015 World Economic Forum, 88% of automotive strategy officers agree that by 2030 at least one major automaker will earn more revenue from selling data and mobility services than from selling cars and their parts. He also stated that 70% of professional services strategy officers agree that by 2025, digital solutions will generate more revenue for professional services firms than services delivered by people. Furthermore, 100% of strategy officers interviewed in the insurance industry agree that by 2020, real-time data streams from sensors will be core to the business success of insurance companies (World Economic Forum, 2015). Organisations are thus aware that their traditional way of doing business will have to change with the implementation of Industry 4.0 concepts.

Having a successful strategy in place is a big contributor to the successful transformation process – as a study done by Deloitte in collaboration with MIT Sloan Management Review (n=4800) found that only 15% of companies in the early stages of digital maturity claim to have a well-defined and coherent strategy, compared to 81% of digitally maturing companies who claim the same. The study placed companies in three categories of improving digital maturity – early, developing, and maturing (Kane *et al.*, 2015).

The process of digital transformation comes with challenges, and few organisations are managing to transform successfully, although many organisations attempt it. According to a survey done by Bain & Company in 2017 (n=1012) on companies that have reported attempting a form of digital transformation, 75% settled for mediocre performances and dilution of value, 20% produced less than 50% of the expected results, and 5% achieved or exceeded their expectations with the transformation (Baculard *et al.*, 2017). McKinsey & Company drew similar conclusions when looking at the success rate of organisations attempting digital transformations, with the study indicating that 70% of large-scale change programs do not reach their expected objectives (Bucy, 2016). This was followed up by another McKinsey Digital study (n=1733) that found that 80% of respondents have begun digital transformations in recent years, but only 14% have achieved sustained performance improvements (Deakin, LaBerge and O'Beirne, 2019).

Although there is not universal agreement surrounding the success rate of organisations attempting digital transformations, the case can be made that all of the studies found that most organisations fail in their digital transformation initiatives. The conclusion was thus drawn that although many organisations are attempting digital transformations, the majority are not successful and do not achieve value-adding sustainable performance improvements.

The benefits of successfully transforming digitally are predicted to be high – with benefits including potential increases in sales, cost-saving through higher process efficiencies, value creation through innovations, and an improvement in customer interactions (Matt, Hess and Benlian, 2015). To achieve these goals, business models must be transformed or replaced. When looking at the technology-, consumer-, and financial services industries over the next five years, personalisation and data-driven marketing could lead to a revenue shift of up to $800 million to the top 15% of companies that can successfully transform digitally (Hutchinson and Aré, 2017).

Digital transformation refers not only to the digitisation of analogue data and processes inside the business – it refers to creating a digital business, and it affects not only internal operations, but also has external impacts. With Industry 4.0, business ecosystems will become prevalent, and the shared economy will become increasingly valuable. The value of the shared economy was estimated to be $15 billion in 2014, and according to PricewaterhouseCoopers, that value could increase to $335 billion by 2025 (Satopaa, 2018).

As can be concluded form the above overview, there is significant value to be created with Industry 4.0. It becomes evident that organisations are aware that to remain relevant and to retain or increase their market share, they will need to digitally transform their organisation. However, it is also evident that most organisations are unsuccessful when attempting to digitally transform, indicating that there exists a need for a resource to assist organisations, and increase their chance of enacting a value-adding digital transformation. This finding led to the problem statement – which can be found in the following section.

1.3   Problem statement

Many organisations must transform digitally to improve (i) the efficiency and effectiveness of their operations, and (ii) their customer experience. These organisations have to disrupt their existing business model and create a new digital business model – or run the risk of being disrupted and losing market share. Organisations are attempting digital transformations; however, the success rate of increasing the value of the organisations is very low. The problem statement is thus formulated as: The process of transforming an organisation digitally is ill-defined, and many organisations lack the context, ability, and/or resources to guide the development and implementation of a successful, value-adding digital transformation.

The following set of guiding questions were developed based on the problem statement that will guide the research efforts:

i.   Why should organisations digitally transform?
ii.   Why do so few organisations manage to successfully enact value-adding digital transformations?

   iii.   What should organisations consider when attempting digital transformations?

   iv.   What components should a framework have that would assist organisations in enacting digital transformations?

By considering these guiding questions, the research objectives, discussed in Section 1.4, were developed.

1.4   Research objectives

Based on the problem statement that digital transformations are ill-defined, and organisations struggle to enact value-adding digital transformations, the following research objectives were identified. These objectives, if addressed, will serve as the solution to the problem statement.

RO1.   Create context surrounding Industry 4.0, digital transformations, and digital disruption to educate organisations around the relevant concepts within the Fourth Industrial Revolution.

     i.   Create context through research of what Industry 4.0 entails, and how business operations will need to change in the new economy.

    ii.   Assess the challenges organisations face whilst undergoing a digital transformation to evaluate which concepts are relevant within a digital transformation.

   iii.   Create further context through research of what core principles are present in a successful digital transformation and subsequently a successful digital organisation.

RO2.   Develop a framework to facilitate the digital transformation process, to consequently increase the value organisations create.

     i.   Determine the various elements that have to be included in the framework and subsequently develop a set of design requirements for the conceptual framework.

    ii.   Compare existing frameworks/models to the set of design requirements.

   iii.   Conceptually develop the framework based on the design requirements.

   iv.   Expand the framework with the development of tools that could achieve the desired outcomes for each phase in the framework.

RO3.   Determine the validity and feasibility of the created digital transformation framework.

     i.   Present the framework to industry experts and test the feasibility of implementing the framework.

    ii.   Conduct a case study to further validate the use of the framework.

1.5   Research strategy

The research is conducted in three stages – *contextualisation*, *framework development*, and *validation*. Each of the three stages addresses one of the three research objectives presented in Section 1.4. Each section is elaborated on in Chapter 2 but this section provides an overview of how each forms part of the research strategy.

Industry 4.0, digital transformations, and various other relevant concepts is contextualised in the first stage – *contextualisation*. Chapter 3 considers key aspects of successful digital transformations, along with what a successful transformation aims to achieve. Why certain

digital transformation attempts fail is researched, and why organisations fail to successfully transform even with a successful strategy. The market is analysed to identify how organisations can use the principles identified in the research to improve their operations, as well as their customer experience. Chapter 4 is a systematic literature review used to determine what challenges organisations face whilst undergoing a digital transformation, with the aim to gain a deeper understanding of why organisations fail in their digital transformation attempts. This chapter concludes the first stage, aims to meet RO1, and is used to create a set of design requirements for the framework that would address RO2.

Once all the relevant concepts are defined and contextualised, the second phase – *framework development* –commences. This phase is initiated with the comparison of other models and frameworks to the set of design requirements in Chapter 5 to ensure the developed framework addressed the identified need. Chapter 6 follows with the development of the conceptual framework that addresses the design requirements presented in Chapter 4. The conceptual framework is developed using Jabareen's methodology in Chapter 6, and Chapter 7 is dedicated to the development of tools used in the framework to meet RO2.

The third stage, *validation*, is presented in Chapter 8 through using various methods of validation, underpinned by the triangulation methodology, elaborated on in Section 2.5. The developed framework is presented to industry experts, and the relevance and feasibility of the framework is tested through using questionnaires. The framework is also validated through a prescriptive case study of an organisation that managed to successfully initiate and implement a digital initiative. Correlations between their process and the framework is drawn. This phase addresses RO3.

Chapter 9 presents the findings of the research and compares the results of the framework developed to the research objectives identified in Chapter 1. Recommendations for future research are put forward, and the thesis is summarised and concluded.

1.6   Expected contributions

Organisations will be able to use the framework presented to them through this research to identify, evaluate, and plan a digital transformation process of their operations to increase their digital capabilities and maturity. Organisations will gain a deeper understanding of what Industry 4.0 entails, and what they must do to remain relevant in the ever-changing industrial world. This research will guide them in aligning their organisations with what is needed to remain relevant, and to identify the relevant concepts that are at play in a digital transformation.

1.7   Research methodology

Chapter 2 speaks to the research methodology followed to address the problem statement, and various resources is researched that could address the problem statement and give effect to the research objectives. The conclusion drawn is that a *Conceptual Framework* addresses the problem statement the best and is able to meet all of the research objectives. Refer to Section 2.2 for an analysis of the various resources considered to address the problem statement and subsequently meet the research objectives.

Both an inductive and deductive approach is followed in this research. It uses existing literature, and tests the validity of the theory, which are traits of a deductive approach. By using an existing methodology, a framework will be created for organisations to initiate value-adding digital initiatives, which qualifies as new theory, and thus an inductive approach (Gabriel, 2013). The theory will be tested using a case study, where companies will be asked to evaluate the model and identify how it would use the model to improve certain aspects of the organisation.

Qualitative research is done in such a manner that it generates a deeper understanding of the topic at hand, and contextualises the problem by creating a holistic view of the problem, whereas quantitative research is focused on testing a hypothesis or specific research question (Abusabha and Woelfel, 2003), as well as being more particularistic in nature (Surbhi, 2016). The purpose of qualitative research is to explore the meaning of experiences and how certain issues or cases are viewed, whereas quantitative research is centred around the examination of the relationships between variables – dependent, independent, and extraneous (Elkatawneh and Scandal, 2018).

The approach followed with qualitative research is more of an exploratory, observant nature where the data is unstructured and open for interpretation, while quantitative research is conducted through testing and measuring structured, often numbers-based, data (Elkatawneh and Scandal, 2018). Qualitative research makes use of verbal data, such as written reports, interviews, etc., whereas quantitative research uses statistical methods to draw objective conclusions regarding measurable data (Surbhi, 2016).

Certain limitations are inherent in each type of research. Samkange (2012) investigated what various authors found when researching qualitative research methods – and the key limitation was found to be the lack of generalisability within the findings. The argument is made that the level of generalisability within the research does not allow for the application of the findings to other contexts outside of the area that it was applied in – and although it is conceded that qualitative methods are applied to gain a subjective understanding of social reality (Denzin and Lincoln, 2011), the lack of applicability outside the researched context is a limiting factor.

To counter this limitation intentional focus is put on the transferability of qualitative findings to other areas, and the argument is made that the vastness of information accompanying qualitative research allows for certain principles to be applied in other areas. Be that as it may, qualitative findings can be applied to other cases, but with a significant risk of error (Samkange, 2012).

Digital transformation is a complex problem with a wide variety of facets, and it therefore requires a multidisciplinary approach. When researching complex problems, an integrated approach between qualitative and quantitative methods leads to a more holistic perspective on the problem. However, Abusabha and Woelfel (2003) argue that a qualitative approach may enable researchers to gain a deeper understanding about the problem, as a qualitative approach is focused on generating a holistic view of the problem, and gaining more context surrounding the problem. Due to the complexity of the topic at hand, a qualitative research approach was selected. The method of research to develop the framework was chosen to be a combination

between Jabareen's (2009) method of developing conceptual frameworks, and the Enterprise Engineering methodology researched by Du Preez, Essman, Louw, Schutte, Marais & Bam, (2015). Section 2.2 elaborates on this methodology.

1.8   Document outline

This section provides a brief outline of the thesis and summarises each chapter individually with consideration given to the key outcomes of each chapter.

Chapter 1.   This chapter introduces the research. It gives background to the problem, which leads to the definition of the problem statement. Research objectives are derived that would, upon completion, solve the problem statement. The research-methodology, contribution, and design is given. The chapter ends with an outline of the chapters.

Chapter 2.   This chapter describes the research design. The research process is defined, with various resources looked at that can be used to address the research objectives. The framework development methodology is looked at, with attention given to the various development phases of the framework. The research strategy is explained, and the validation method is described.

Chapter 3.   This chapter contextualises Industry 4.0 and is conducted in the form of a literature review. The various components and impacts of Industry 4.0 are described, after which digital transformations are researched. Digital transformation strategies are looked at, followed by an in-depth analysis of digital business models, and the digital transformation approach used for the framework in this research. This final section concludes with the definition of the digital dimensions that a digital organisation comprises of – these digital dimensions form the basis of the framework that is developed later on in the research. This chapter supports the problem statement presented in Chapter 1 that there is significant value to be created for organisations by digitally transforming, but few organisations manage to execute value-adding digital transformations.

Chapter 4.   Based on the findings that organisations struggle to enact value-adding digital transformations, this chapter considers the various challenges that organisations face when undergoing a digital transformation. The research of challenges is conducted through the use of a systematic literature review – a rigorous research method aimed at ensuring the scientific legitimacy of the findings. The chapter presents a challenges typology, where the various challenges identified are summarised and categorised. This chapter also uses the findings from the previous chapters – the research objectives, contextualisation of digital transformations and digital organisations, and the challenges that organisations face whilst digitally transforming, and creates a requirement specification for the framework.

Chapter 5.   Based on the requirements set out in Chapter 4, Chapter 5 uses the set of requirements and conducts a systematic literature review to compare these requirements to existing digital transformation frameworks or models. The findings from this systematic literature review are that no existing model or framework addresses all the requirements of the framework this research is proposing.

Chapter 6. The framework is developed conceptually in Chapter 6. The various phases are presented, with inputs, outputs, and processes all included in each phase. This chapter discusses the outcomes of the framework and how it will address the requirements set out in Chapter 4, and thus meets the research objectives presented in Chapter 1.

Chapter 7. Based on the conceptual framework presented in Chapter 6, Chapter 7 discusses the expansion of the various tools that are proposed to be used in the framework. An analysis is done to determine to what extent specific tools exist that can complete the various steps, and how each tool must be amended to adhere to the requirements presented in Chapter 4.

Chapter 8. The validation chapter completes the triangulation method for validation presented in Chapter 2. The framework is taken to industry experts, and the feasibility of each phase is determined. The prescriptive case study concludes this chapter.

Chapter 9. Chapter 9 serves as the conclusion to the research and presents the findings of the study. The thesis is summarised, the research contributions and limitations are discussed, and recommendations are made for future research.

1.9 Chapter 1: Conclusion

This chapter introduced the research and created context around the problem statement. Research objectives were discussed that, when achieved, would solve the problem statement. The research methodology, expected contributions, research design, and document outline were discussed. In Chapter 2 the various methodologies used throughout the research is presented. Chapters 1 and 2 underpin the rest of this research document, and reference is made back to these chapters throughout the research document.

CHAPTER 2. RESEARCH DESIGN

2.1 Introduction

Chapter 1 speaks to the need for a model or framework that will address the successful execution of a digital transformation within an organisation. Chapter 2 discusses the methods used to create the resource that will enable a value-adding digital transformation.

This chapter considers the various academic methods that can be used to address the research objectives mentioned in Section 1.4. The various strengths and weaknesses of each method will be considered, and a conclusion will be drawn on which method will best meet the research requirements. The selected methodology will be elaborated on further in this chapter. The development of the selected resource can be found in Chapters 5 and 6.

Specific reference is also made to the methodology applied in the validation of this research. The conclusion of this chapter introduces the first chapter of Stage 1 of the research process. Figure 2 indicates how Chapter 2 fits into the thesis.
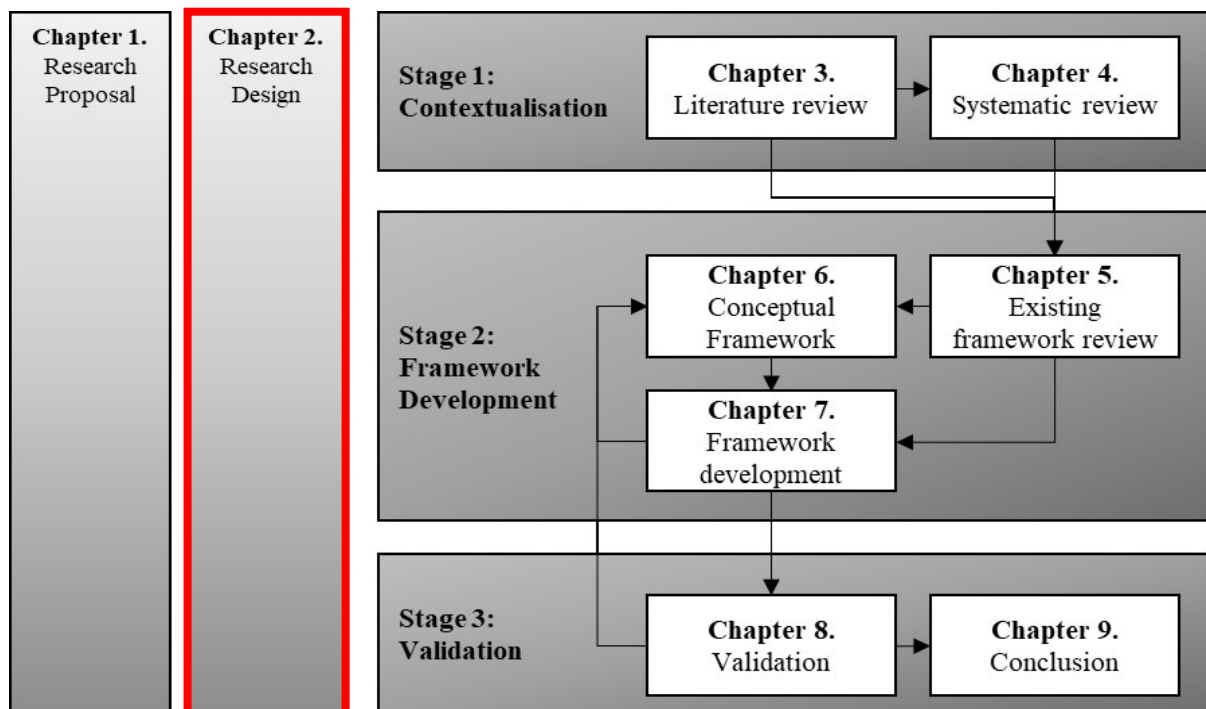
Figure 2: Research design: Chapter 2

2.2 Research methodology selection

Various academic methodologies exist that can be used to assist organisations in a digital transformation process, as can be seen in Table 1. As was concluded in Section 1.7, for this research the following methodologies were considered: roadmap, model, logic model, framework, conceptual framework, blueprint, strategy, and toolkit. Each will be considered, and conclusions will be drawn as to which methodology best fits the research requirements.

Table 1: Research methodologies

Research tool	Description
Roadmap	• A roadmap is a holistic overview of how organisations are going to execute on their vision and strategy (*What Is a Product Roadmap?*, 2019). • The organisation's vision is a prerequisite if they wish to implement a roadmap. A strategy to give effect to the vision is also a requirement (Kirsch, 2019). • The roadmap stipulates how the strategy must be executed by providing organisations with steps of how to achieve the vision (*What Is a Product Roadmap?*, 2019).
Model	• Models are representations of real-life scenarios or constructs and enjoy a wide range of use (Achinstein, 1965). • Models have an information input, processes that work with the information inputs, and a set of information outputs that results from the processes (*What is a Model?*, 2006)
Logic Model	• Logic models indicate the causal relationships between various concepts which leads to some outcome. Logic models thus predict what the cause and effect relationship between various elements are (Renger and Titcomb, 2002; Frechtling, 2015). • Logic models usually include inputs, activities, outputs, and outcomes (Renger and Titcomb, 2002; Frechtling, 2015)
Framework	• A network, or 'a plane' of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena (Jabareen, 2009). • The concepts that constitute a conceptual framework support one another, articulate their respective phenomena, and establish a framework-specific philosophy (Jabareen, 2009). • Frameworks are used to deal with certain problems or to indicate the best course of action (*Framework definition and meaning*, 2019).
Strategy	• A strategy is a set of plans or ideas to achieve a specific goal under undefined circumstances (Freedman, 2013). • Strategies consists of a problem definition, guiding policy that states how the problem will be solved, and actions that when executed give effect to the guiding

	policy that reaches the intended objective (Rumelt, 2011).
Toolkit	• A set of tools used to perform a specific function and reach a specific objective, or solve a problem (*Toolkit definition and meaning*, 2019).

Based on the findings in the table above, the conclusion was drawn that a *Conceptual framework* would most effectively address the requirements set out in Section 1.4 as these requirements necessitates of various items to be linked together to work towards the specific objective of facilitating a digital transformation. The conceptual model further aims to link the concepts involved into a network that provides a comprehensive understanding of the topic at hand. Digital transformations are a relatively new concept without clear guidelines, thus providing organisations with a deeper understanding of digital transformations is desired.

Due to the complexity and uncertainty surrounding digital transformations and Industry 4.0 (Schumacher, Erol and Sihn, 2016), *Strategy* and *Roadmaps* were eliminated as these digital transformation resource will not provide organisations with a set of actions to complete in order to achieve the objective of a digital transformation. The scope of digital transformations is also too big to present every organisation with the same strategy. *Models* and *Logic Models* were also eliminated, due to the tool only being representations of a real-life system using inputs, processes, and outputs. Aspects of *Models* will be used in the developed tool, but not as the overarching research tool. *Toolkits* were not considered because of the simplicity of the research tool, and it was also identified as a tool that will be used within the final research tool. The contextualisation of the problem and linking of all relevant concepts by *Conceptual frameworks* led to the author choosing this research tool.

Although a conceptual framework was selected as the methodology, components of the other methodologies will be used in the conceptual framework. Each of these characteristics will be explained where it becomes relevant. The creation of the digital transformation conceptual framework was based on the methodology developed by Jabareen (2009).

2.3 Research process

This section will provide a broad outline of the process that was followed throughout the creation of this thesis.

Based on the objectives mentioned in Section 1.4, three overarching objectives exist: (i) creating context surrounding Industry 4.0 and digital transformations, (ii) developing a resource that will assist organisations to initiate a value-adding digital transformation, and (iii) validating the findings of the research. Based on these objectives, the layout of the study was divided into three stages, with each stage addressing one of the objectives. The layout is visually represented in Figure 3.

Stage 1 – In order to fully understand the topic at hand and subsequently be able to successfully address the problem statement, a rigorous review of relevant research is required. This research review was conducted in two parts – Chapter 3 through a literature review to contextualise Industry 4.0, digital transformations, and relevant available information, and Chapter 4 through a systematic literature review concerning the challenges organisations face whilst undergoing a digital transformation. This stage is referred to as the *contextualisation* phase. This stage addresses the first research objective.

Stage 2 – Once the research review was completed, a conceptual framework development followed that stipulates, based on the preceding literature-based chapters and semi-structured interviews with subject matter experts, what the requirements of the framework are that are going to address the issues mentioned in the literature, and that give effect to the research outcomes. A review was then done to compare the extent to which existing models or frameworks are addressing the requirements set out for this conceptual framework. This stage is referred to as the *framework development* phase. This stage addresses the second research objective.

Once the requirements were validated through literature and semi-structured interviews with subject matter experts, the development of the conceptual framework's various tools commenced as Stage 2. Jabareen's methodology was used to guide the development of the conceptual framework, which is based on the Grounded Theory technique. The conceptual framework was validated through literature and semi-structured interviews with subject matter experts. This was an iterative process and the preliminary validation gave the author key insights which were used to amend the framework. Section 2.4 elaborates on the framework development methodology.
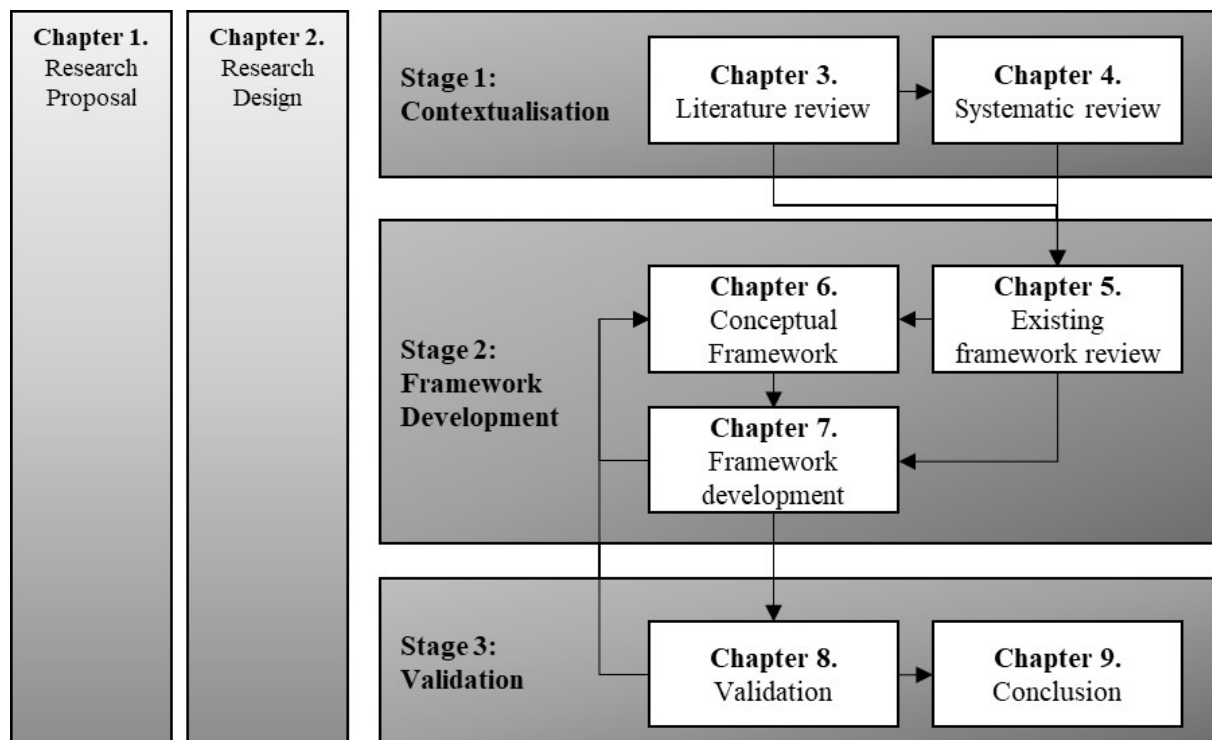
Figure 3: Research design

Stage 3 – Once the framework was developed, it was subjected to a validation process elaborated on in Section 2.5. The research rationale, relevant concepts, and user applicability were validated through semi-structured interviews with subject matter experts, with the results of the interviews discussed in Section 8.4. This was followed by a prescriptive case study that was done on successful digital initiative – to compare the principles followed in a successful digital transformation with the principles this research proposes. This stage is referred to as the *validation phase*. This stage addresses the third research objective.

The following sections will elaborate on how the research process was conducted through the use of Jabareen's methodology.

2.4   Framework development methodology

This section will elaborate on the methodologies used to develop the digital transformation conceptual framework. Background of the methods will be given, with careful consideration of key concepts of the method to determine if this technique is applicable in this research.

A combination between Jabareen's methodology was used to create a conceptual framework, integrated with Du Preez *et al.'s* enterprise engineering methodology. Each method will be contextualised in the following sections, with key consideration given as to why the methodology was included in the development of the conceptual framework.

2.4.1   Conceptual framework methodology

As mentioned earlier, Jabareen's (2009) methodology was used in the development of the digital transformation conceptual framework. He defines a conceptual framework as "[…] a network, or 'a plane', of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. The concepts that constitute a conceptual framework support one another, articulate their respective phenomena, and establish a framework-specific philosophy."

He based his method of developing conceptual frameworks on the Grounded Theory (GT) technique, developed by Anselm Strauss and Barney Glaser in 1967 to provide social science researchers with a new, qualitative methodology of research. The method has since developed, and various versions have been created, with three versions generally accepted as the leading versions in the field: Strauss revisited the theory they created in 1967, and with the assistance of Corbin they created an amended version of their original work in 1990 and later in 1998, McCallin in 2004, and lastly Charmaz in 2006 (Glaser, 2008).

The GT was developed to allow new theories to arise directly from the data, and to minimise the bias of authors on the development of theories regarding the definitions of categories found in the data they gathered. It is a method with a variety of applications which can be used to answer a wide spectrum of research questions (Glaser, 2008). Further benefits of the method are its flexibility, the capacity for modification, and its focus on understanding rather than prediction (Jabareen, 2009).

Jabareen elaborates on conceptual frameworks by defining key features that it possesses, which include that conceptual frameworks are not an assembly of concepts, but rather a construct that

makes use of concepts to support the construct. Concepts are a key feature in the development of conceptual frameworks, and Jabareen defines it as having "[…] components and is defined by them" (Jabareen, 2009).

The framework suggests compiling and defining various concepts that are relevant to the research. This thesis used the approach of defining concepts as they became applicable within the research – thus various concepts are defined throughout the research in the different chapters.

Conceptual frameworks do not predict outcomes and are thus indeterministic in nature. They are also of qualitative nature, as they provide an understanding of the construct that they are addressing, compared to a quantitative model which provides users with a theoretical explanation of the construct at hand. These frameworks can thus be developed through a qualitative analysis process (Jabareen, 2009). The various phases of Jabareen's methodology can be seen in Table 2.

Table 2: Development of a conceptual framework – adapted from Jabareen (2009)

Phases	Description
Phase 1: Mapping the selected data source	• Relevant literature must be gathered surrounding the research topic. • Review various, multidisciplinary literature types – such as written text and interviews with subject-matter experts.
Phase 2: Categorise data sources	• Carefully read identified literature. • Categorise data according to importance, type of research, and representative power within each discipline.
Phase 3: Identifying and naming concepts	• Based on the categorisation of relevant research, identify concepts from the data. • Concepts may be contradicting.
Phase 4: Deconstructing and categorising concepts	• Contextualise and deconstruct concepts to determine their key attributes, characteristics, assumptions, roles, and features.
Phase 5: Integrating concepts	• Iteratively group and categorise concepts to identify similar concepts and thus reduce the number of concepts.
Phase 6: Synthesis and resynthesise	• Use the identified concepts to create a theoretical framework. This process is done iteratively.
Phase 7: Validation of the conceptual framework	• Validate the theoretical framework through external perspectives. • Iterative process, the author must be open to the idea of amending their framework.
Phase 8: Rethinking the conceptual framework	• Feedback from external sources are used to amend the framework to ensure the relevance of the framework.

These phases guide the creation of a conceptual framework and are used as guideline in the research design of this research.

2.4.2 Enterprise engineering methodology

Du Preez *et al.*, (2015) considered various definitions of enterprises which resulted in the following definition: "*A complex system of cultural, process, and technological components that interact to accomplish strategic goals; under the ownership or control of an organisation; which ultimately strives to create wealth for its stakeholders; and operates at one or several locations*", and subsequently they defined Enterprise Engineering as "*the design, re-design, deployment and subsequent transformation of an enterprise.*"

The methodology is based on the rationale that enterprises change over time as technology develops, to remain competitive, and thus they propose a framework that enterprises can apply to adapt and transform their enterprises to create more value for their stakeholders. The steps proposed by this framework can be found in Figure 4. The authors define the process as involving "[…] a multi-phased approach that coordinates strategic, operational, and organisational demands in taking the enterprise from an 'As-Is' state to a 'To-Be' state. It is executed in the form of a project or projects".

The *Initiation phase* includes the definition and identification phase, which seeks to identify the enterprises that are to be redesigned, and to secure the commitment from top management to transform the identified enterprises, whilst conceptualising potential solutions to the identified problems. The *Master planning phase* seeks to create conceptual solutions to the identified problems in the previous phase, that results in a master plan that proposes specific projects that will take the enterprise from the As-Is state to the To-Be state. The *Deployment* phase aims to execute the plans presented in the previous two phases but falls outside the scope this research (Du Preez *et al.*, 2015).

This methodology was selected due to (i) the intentional focus on creating wealth for the stakeholders, (ii) the specific focus on the interaction between various relevant concepts which supports Jabareen's definition of a conceptual framework, (iii) the transformative nature of the application of the methodology, and (iv) the definition of digital initiatives in Section 3.6.1 alludes to the fact that these digital initiatives are independent and must be able to function separately from the parent organisation(s), which correlates to Du Preez *et al's.*, (2015) definition of an enterprise. Thus, the relevant processes presented by Du Preez *et al.*, (2015) are incorporated into the development of the conceptual framework.

In order to implement digital initiatives, enterprise engineering principles can be applied to create and deploy these digital initiatives. Du Preez *et al.*, (2015) present an enterprise engineering process that can be seen below:

Initiation Phase		
Definition and Identification		

Master Planning Phase		
As-Is Analysis	To-Be Concept Design	Transition Planning

Deployment Phase		
Detail Design	Implementation	Measure & Optimise
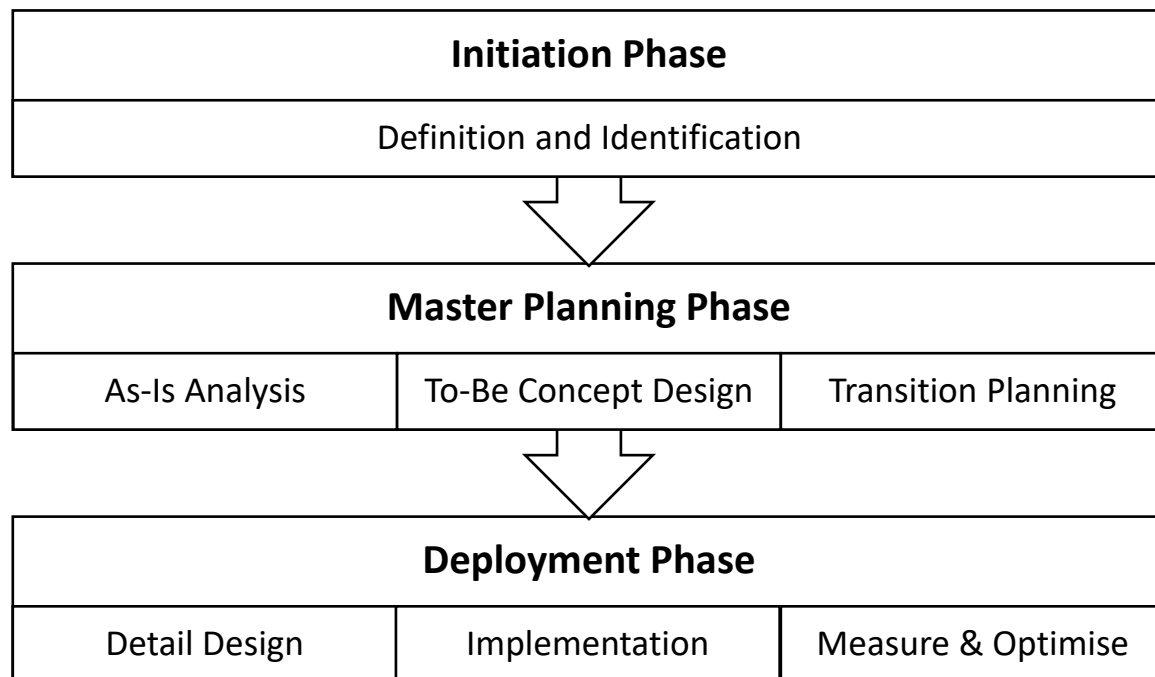
Figure 4: Enterprise engineering phases (Du Preez et al.*, 2015)*

2.5 Validation

The validation of the research was done through using two methodologies – triangulation as an overarching methodology, and an interpretation of Borenstein's (1998) method was applied within the triangulation methodology. This section will elaborate on how the two methodologies were integrated to ensure the validity of the conceptual framework.

2.5.1 Triangulation

The process of triangulation was used as the overarching method of validation for the framework. Triangulation is defined as a strategy used to ensure and improve the quality and validity of research. The objective of triangulation is to ensure that various independent sources will lead to the same unique conclusion(s) regarding the topic that is researched (Mathison, 1988). The method was developed in the 1970s, with Norman Denzin identifying four types of triangulation:

1. **Data triangulation** – Using multiple data sources in one study.
2. **Investigator triangulation** – Using multiple researchers to study a specific topic.
3. **Theory triangulation** – Using multiple perspectives to evaluate the findings of a study.
4. **Methodological triangulation** – Using multiple methods in one study.

Sources: (Mathison, 1988; Hales, 2010).

This research was conducted using data triangulation, as various types of sources were used to ensure the validity of the findings. The first part is literature-based – various literature sources were reviewed to gather data for the development of the framework. The second part was through interviews – the literature-based findings were presented to subject matter experts, and their interviews were used as validation for the conceptual framework, and to adjust the framework to incorporate their inputs. The final part is a practical case study – the framework was applied in an industry case study to test the framework in the real world. A visual depiction of the triangulation process is shown in Figure 5. An interpretation of Borenstein's method was used to execute the triangulation validation method and is further elaborated on below.
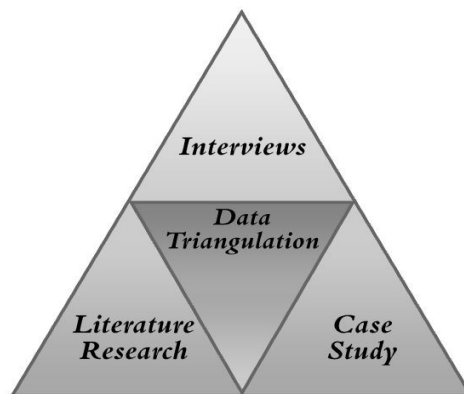
Figure 5: Data triangulation

2.5.2   **DSS model validation interpretation**

The triangulation validation process was executed by using an adaptation of the validation methodologies presented by Borenstein (1998) to validate Decision Support System (DSS) models, and the methodology to design case studies by Yin, Venkatesh, Brown, Bouzid, Bhaskar, *et al.*, (2010). Both will be evaluated, and a combination between the two will be used to validate this research.

Borenstein defines validation as "the process of defining whether the model behaviour represents the real-world system in a particular problem domain". This method was adapted to use in the validation of a conceptual framework, and was thus used to determine the applicability of the conceptual framework in a real-world system in a particular problem domain (Borenstein, 1998).

This section will contextualise the methodology that Borenstein presents, and the process of applying it to a conceptual framework will be explained. Each step will be interpreted to show how to validate a conceptual framework, and the adaptation of the method will be presented. Figure 6 visually depicts Borenstein's validation process.
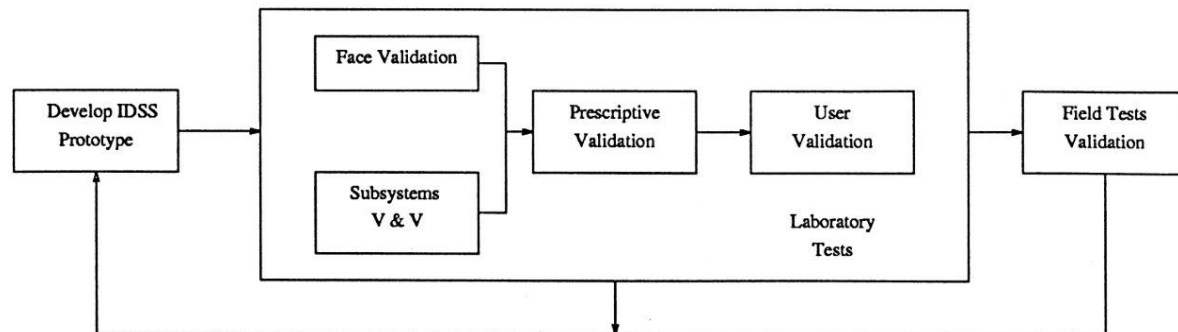
Figure 6: Borenstein's DSS model validation methodology (Borenstein, 1998)

Once the IDSS Prototype is developed, the (1) *Face validation* step commences to determine whether the designer of the prototype and the end user agree as to which problem this model is solving. (2) *Subsystems validation and verification* focuses on validating and verifying the individual modules of the system to ensure their quality. Like the face validation step, the internal validity is ensured through the execution of this step. (3) *Prescriptive validation* commences once the internal quality of the DSS model is verified and validated. The model is applied to laboratory test cases where the results are known – thus the input data is given to the model, and the output of the model is compared to the existing results to test the overall model's validity. (4) *User validation* Once the model has been tested against existing data, the model is taken to external individuals to test firstly the applicability of the model by potential users, and secondly to evaluate the assumptions, methods, simplifications, and model structure. (5) *Field tests validation* is the final step in the validation method – where the DSS model is applied in the field to solve existing problems. The performance issues that are identified through this testing are used to amend the DSS prototype and improve its performance. This approach is an iterative validation method, and the findings from each step are used as input to amend the prototype (Borenstein, 1998).

This method is however applicable to DSS models where the testing happens in a laboratory – where the validation required for this research is that of a conceptual framework. The validation method is of an analytical nature, and focus is put on internal and external verification and validation – methods that were identified to be applicable to and useful for conceptual frameworks. Certain parallels can be drawn between DSS models and Conceptual frameworks, where the following paragraphs will contextualise how each step was interpreted for a Conceptual framework. The adapted validation method is presented in Figure 7, and the correlation between this method and how it applies to the triangulation method is also shown.
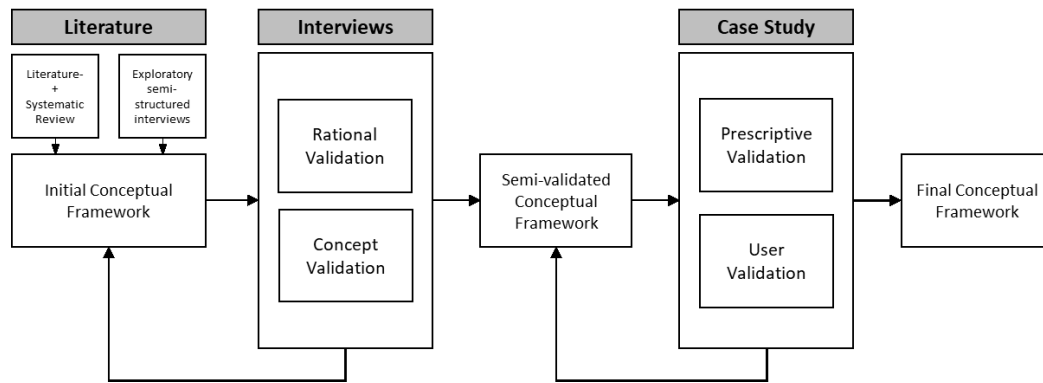
Figure 7: Validation process

This validation strategy involves using the semi-validated conceptual framework as input, and then exposing this framework to a variety of validation tools. These steps include rational validation, concept validation, prescriptive validation, user validation, and then conclude with a case study validation. Within Borenstein's original validation strategy to validate DSS models, the steps were conducted within a laboratory. The logic applied to validate the DSS models was extrapolated to validate a conceptual framework, and the following sections will elaborate on each step in the validation process and how it relates to a conceptual framework.

Research rational validation – at its core a conceptual framework is a network or plane of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena – which is considered the 'problem' that the framework is trying to solve (Jabareen, 2009). In order to validate the conceptual framework, it is important for the developer and potential user to agree about what the problem is that the conceptual framework is aiming to solve, and if the problem is worth solving. This process must ensure that the developer of the framework understands the entire problem, and that the problem is sufficiently structured to ensure a credible solution can be created for the problem (Borenstein, 1998). This step was completed through a combination between semi-structured interviews and surveys.

Concept validation – Borenstein describes this step as verifying and validating the various modules of the DSS model. Conceptual frameworks are the interlinking of various concepts (Jabareen, 2009), and this step was thus applied to validate the various concepts the conceptual framework consists of. The quality of each concept must be ensured through this stage, and areas that require improvement must be identified (Borenstein, 1998). This step was completed through a combination between semi-structured interviews and surveys.

Prescriptive validation – Borenstein describes this stage as testing the DSS model with existing data with known results to compare the results of the model to the known results. This will indicate the validity of the model. Due to conceptual frameworks being more qualitative in nature, the comparison with existing cases are not as simple as with quantitative models with known inputs and outputs. This step was amended to compare the conceptual framework to a case where the same *problem* identified in the *research rational validation* stage was solved successfully using some existing resource(s). The conceptual framework's principles are then compared to the existing resource to identify similarities, and thus validate the principles of the conceptual framework (Borenstein, 1998). This step was completed by using a case study, which is elaborated on in Section 8.5.

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User validation – This step is defined by Borenstein as "the process by which interested parties who were not involved in a model's origins, development, and implementation can determine, with some level of confidence, whether the model's results can be used in decision-making". The objectives for this stage include determining the applicability by potential users, and to assess and verify the assumptions, simplifications, methods, and structure through independent sources. This step will be completed through the creation of questionnaires and interviews with independent potential users of the conceptual framework (Borenstein, 1998). This step was completed through a combination between a semi-structured interview, a survey, and a case study.

Case study validation – Borenstein found from various sources that testing the DSS model in a field test, or a case study, was the most effective way to test the validity of the DSS model. The complex nature of this specific conceptual framework does not in this case allow for applying the framework within an organisation that wants to implement a digital initiative – as the financial implication of such a case study was deemed to be too great, and thus falls outside of the scope of this research. The case study element in the triangulation method is thus applied through the prescriptive case study and user validation – as an extensive case study will be conducted on an organisation which has successfully implemented a digital initiative. The successful nature of the implementation was used as verification of their knowledge surrounding the topic, and thus their assessment of the DIIDS Framework was used as the *user validation* phase.

The case study was designed using Robert K. Yin's work, published in his book, *Case Study Research: Design and Analysis* in 2011. The design of the case study is further elaborated on in the following section.

2.5.2.1   *Literature research*

The literature research was done in two parts – the literature review regarding Industry 4.0 and digital transformations, and systematic literature reviews regarding the challenges organisations face whilst undergoing a digital transformation, and the second regarding the existing models and frameworks and to what extent they meet the requirements set out by the author. The first leg of the validation process uses literature from other researchers to support the notion that this paper puts forward. As shown in Figure 7, this section aims to develop the initial conceptual framework.

Literature reviews are used to contextualise information that is relevant to the research topic for the reader. It sheds light on important concepts that are related to the research and is used to further establish why the research outcomes are relevant. It creates context surrounding the landscape within which the research topic finds itself, which in this case is Industry 4.0 and all the surrounding topics, as well as the digital transformation process that organisations undertake (Labaree, 2019).

Systematic literature reviews are a well-researched and commonly accepted method to systematically analyse a specific research question, and to methodically review all the relevant scientific research done on the topic of research to ensure scientific legitimacy of the findings of the systematic literature review. The process, according to Kitchenham (2004), is a rigorous

research process used to critically evaluate a research question or topic through "[…] identifying, evaluating and interpreting all relevant available research". The objectives of systematic literature reviews are to critically evaluate and summarise the current evidence regarding the research topic, to recognise where current research is still lacking and to suggest further research to fill in these gaps, and lastly to generate a framework to guide future research in these identified topics (Kitchenham, 2004).

The combination of the above-mentioned methods of research was used to determine the design requirements for the conceptual framework that addresses the problem statement mentioned in Section 1.3, and achieves the objectives set out in Section 1.4. The creation of the conceptual framework was an iterative process, and these design requirements were validated through semi-structured interviews with subject matter experts. The integration of the findings led to the creation of the final set of design requirements, presented in Chapter 5.

The following section will elaborate on how the conceptual framework presented in Chapter 5 was validated externally, to ensure its applicability in real-world scenarios, and the extent to which it met the objectives presented in Section 1.4, and whether it solved the problem statement detailed in Section 1.3.

2.5.2.2   Interviews

Interviews were used as a method to validate the initial framework that was developed through the literature research. Two overarching objectives were achieved through the interviews – validating (i) the research rational (assumptions that the author made within the research), and (ii) the concepts that the author identified to be relevant to the area of research. The following sections contextualise the profile of interviewees used, and the methodology followed to conduct the interviews.

The profile of the individuals who were interviewed must comply with two requirements: (i) they must have a strong Industry 4.0 knowledge to ensure their answers add legitimacy to the validation process, and (ii) they must be from a diverse set of industries to ensure the applicability of the research on a variety of industries. Based on these requirements six individuals were interviewed. Their profiles were compared to the aforementioned requirements and deemed to meet the two requirements.

To ensure the effectivity of the interview process, an existing methodology was followed in the creation of the process. Rabionet (2011) designed a method that stipulates how interviews should be conducted to effectively obtain qualitative data from different sources – with the objective of capturing people's experiences in a way that can be used to draw accurate and scientifically legitimate conclusions regarding the qualitative framework (Rabionet, 2011).

The methodology includes 5 stages – (1) Type of interview selection, (2) establishing ethical guidelines, (3) creating the interview protocol, (4) conducting and recording the interview, (5) analysing the data, and (6) reporting the findings. Table 3 briefly explains the various stages (Rabionet, 2011).

Table 3: Interview design (Rabionet, 2011)

Stage	Description
1. **Interview selection**	Choose between structured, semi-structured, or unstructured.
2. **Ethical guidelines**	Consider the purpose, consequences, confidentiality, consent, protection, relationships, and identity of the research.
3. **Interview protocol**	Consider how you present yourself to the interviewee and design the questions that you will ask them.
4. **Conducting the interview**	Decide how you will gather information from the interview – through written notes, from memory, reports afterwards, an audio recording.
5. **Data analysis**	Analyse and sort the data gathered from the interviews so that conclusions can be drawn from it.
6. **Reporting the findings**	Report the conclusions that were drawn from the previous step.

2.5.2.3   *Case study*

Case studies are used when the authors are researching complex issues where quantitative methods might not be applicable (Zainal, 2006). A case study completes the third leg of the triangulation method and was conducted based on the work published by Robert K. Yin. He argues that case study research is conducted when authors want to (i) broadly cover the topic at hand, (ii) rely on various sources of information, and (iii) consider certain contextual specifications within the study. The *case study* method is used as an evaluation method within this context, where the *grounded theory* methodology along with the *enterprise engineering* methodology was applied to create the theory that is to be tested by the case study. Jabareen's methodology of creating conceptual frameworks is based on the grounded theory method, as mentioned in Section 2.4 (Yin, 1993).

This section will contextualise the process from selecting the method research, to all the phases that a case study comprises of. This will be used as the guidelines of designing the case study to be conducted in Chapter 8.

Case Study Design Methodology

Robert K. Yin speaks about three considerations in his book *Case Study Research – Design & Analysis* that researchers should consider when selecting the method of research – (i) the type of research question that the research aims to answer, (ii) the degree to which the author has control over behavioural events, and (iii) favouring focus on either contemporary events or historical events. The five methods of research he mentions are experiments, surveys, archival analysis, history, and case studies. Table 4 indicates how each consideration influences the selection of research method (Yin, 2011).

Table 4: Applications of research methodologies (Yin, 2011)

METHOD	Form of research question	Requires control over behavioural events?	Focuses on contemporary events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, why?	No	No
Case Study	How, why?	No	Yes

Yin developed a methodology for designing case studies, which follows the following structure: (i) plan, (ii) design, (iii) prepare, (iv) collect, (v) analyse, and (vi) share. The various steps are elaborated on in the following sections.

Plan – The problem statement in this research, mentioned in Section 1.3, speaks to the uncertainty regarding digital transformations and how organisations are failing to successfully enact value-adding digital transformations, with the research objectives in the following section speaking to how the research will present a model or framework that will seek to show organisations ***how*** to solve this problem. The study is of an exploratory nature, and thus control over behavioural events are not possible or required – with the retrospective nature of the prescriptive case study leaving the author with either applying a *history* approach or a *case study* approach. These two approaches are overlapping, with the *history* approach often being selected when no person who was involved is alive or accessible to report on what happened, and the author must rely on primary- and secondary documents to do the research, where a *case study* is applied when the concept at hand is more contemporary. Based on these considerations, a *case study* was selected as the method of research (Yin, 2011).

Design – Yin refers to three different case study methodologies – *exploratory, descriptive, and explanatory*, that can be conducted through either a *single case study*, or *multiple cases* within the study. This forms a matrix of six options – as each methodology can be conducted in both a single- and multiple-case study.

Single case studies put focus on one specific case, whereas a *multiple case study* uses 2 or more cases within the same study. These multiple cases must replicate each other to be compatible within the study. (1) *Exploratory case studies* focus on determining the legitimacy of the research procedures and contextualise the case through defining hypotheses and/or research questions for future related research (Zainal, 2006). (2) *Descriptive case studies* are used when a description of a phenomenon is required within a specific context, and (3) *Explanatory case studies* are used when specific attention is given to explain the cause and effect relationships between various concepts within the context of the case (Yin, 2011).

Single cases are used under various conditions mentioned by Yin. A single case was selected for this research due to the selected initiative representing (i) a *critical case* that meets all the requirements for a well-tested theory, which is true in this case as the theory was tested and validated before being applied on the case study, and the manner in which the initiative was initiated closely represents the theory from this research, and (ii) a *unique case*, as few organisations, as proven by literature, manage to successfully initiate digital initiatives. The above-mentioned reasons support the selection of a *single-case* case study (Yin, 2011).

Due to the novelty of Industry 4.0 and the extent to which digital transformations are yet to be defined, the *exploratory case study* was selected to apply within this research. These case studies are often applied when new theory is discovered through the observation of concepts within a specific social context – which is what this section of the validation is aiming to do through the *prescriptive case study* – the research is looking at existing digital initiatives and drawing conclusions based on a retrospective design of the case study. The case study will also seek to define potential research questions and hypotheses for future research regarding this topic – and thus supports the selection of the exploratory case study method. The following sections will contextualise the process of developing an exploratory case study (Yin, 2011).

The case study design must also include the research question that the case study is aiming to help answer and the theory that is being tested with the case study, and the propositions that further defines the scope of the study. The unit of analysis, defined as the 'case' that is being studied through the case study, must be selected (Yin, 2011).

Prepare – Yin (2011) proposes a protocol for writing up a case study, and this research will make use of an interpretation of his structure to guide the prescriptive case study and user validation. The full protocol will not be used as the prescriptive case study will not be an extensive case study. The case study protocol for this research is as follows: (A) Case study introduction, (B) Data collection procedures, (C) Case study report outline, (D) Case study questions, and lastly (E) Case study results. This framework will allow the author to prepare for executing case study (Yin, 2011).

> Question – *how do organisations implement value-adding digital initiatives?*

> Proposition – *Organisations enact value-adding digital transformations through the implementation of digital initiatives, unless they are small enough to not be subjected to the challenges identified in Chapter 4; Organisations apply certain principles to effectively implement a digital initiative.*

> Unit of analysis – *Organisations*; *Digital initiatives*; *Digital initiative implementation principles.*

> Organisational Theory – The principles presented in the DIIDS Framework are integral to the success of the implementation of a digital initiative.

Collect – Yin (2011) mentions six different sources of evidence that can be used for a case study – documents, interviews, observations – both direct and from the participant(s), archival records, and physical artefacts. Each source has strengths and weaknesses, and the selection of

sources must be made based on the context of the case study, and the availability and effectivity of each source.

Analyse – Analysing the data effectively contributes in large to the scientific legitimacy of the findings of the case study, and subsequently the validation of this research. (Yin, 2011) proposes 5 methods of analysing data – with each briefly mentioned below.

1. ***Pattern matching*** **–** this method compares a tested method to that of a predicted method – and drawing conclusions based on the comparisons between the two.
2. ***Explanation building*** **–** a derivation from the *pattern matching* technique, this method compares a theoretical statement or prediction to the findings of an initial case study, and iteratively amending and testing the theory until the theory matches the case.
3. ***Time-series analysis*** **–** gathering data from the same source(s) over a set period, and drawing conclusions based on the trends identified within the data points.
4. ***Logic model*** **–** only different to *pattern matching* due to its sequential nature, logic models strive to match empirically observed events to predicted events, and draws conclusion based on the comparisons between the two.
5. ***Cross-case synthesis*** **–** the analysis of various independent cases, and drawing conclusions based on the findings of the independent case studies.

Each method is applicable in different case study situations, and the author must decide which method is most applicable to their case(s). The application of the case study can be found in Chapter 8.

2.6   Chapter 2: Conclusion

This chapter presented the design methodologies of this research and is used as reference to design the various concepts used throughout this thesis. Reference is made to the research methodologies and processes, and the framework development methodology is discussed. The research strategy is then elaborated on, and the chapter concludes with a discussion surrounding the validation strategy that is to be followed in this research.

This chapter concludes the research preparation and introduces the first chapter of Stage 1. The following chapter seeks to contextualise many of the relevant concepts and is conducted in the form of a literature review. The methodology for conducting a literature review is discussed in Chapter 3.

CHAPTER 3. CONTEXTUALISING INDUSTRY 4.0 AND DIGITAL TRANSFORMATIONS

3.1 Introduction

As was concluded from the background literature discussed in Section 1.2, Industry 4.0 and digital transformations are unexplored concepts that are yet to be widely understood. In order to adequately address the problem statement and subsequent research objectives defined in Section 1.4, the relevant concepts must first be contextualised to ensure the existing research has been reviewed and that this research can build on existing research and contribute towards the topic. Due to the aforementioned reasons, a theoretical literature review is conducted on the current research surrounding the topic.

Literature reviews are a research method used to do an in-depth study of a set of topics by thoroughly reporting on existing literature surrounding said topic (Winchester and Salji, 2016). It is not aimed at reporting on new work – it rather contextualises existing theories and ideas presented by other authors (Hart, 2018). It is applied in research to further understand the problem statement. Various types of literature reviews exist – including evaluative, explorative, and instrumental literature reviews (Adams *et al.*, 2008). Due to the unexplored nature of the topic of study, an exploratory literature review was selected to contextualise the topic and subsequently the problem statement. The methodology is elaborated on in Section 3.1.1.
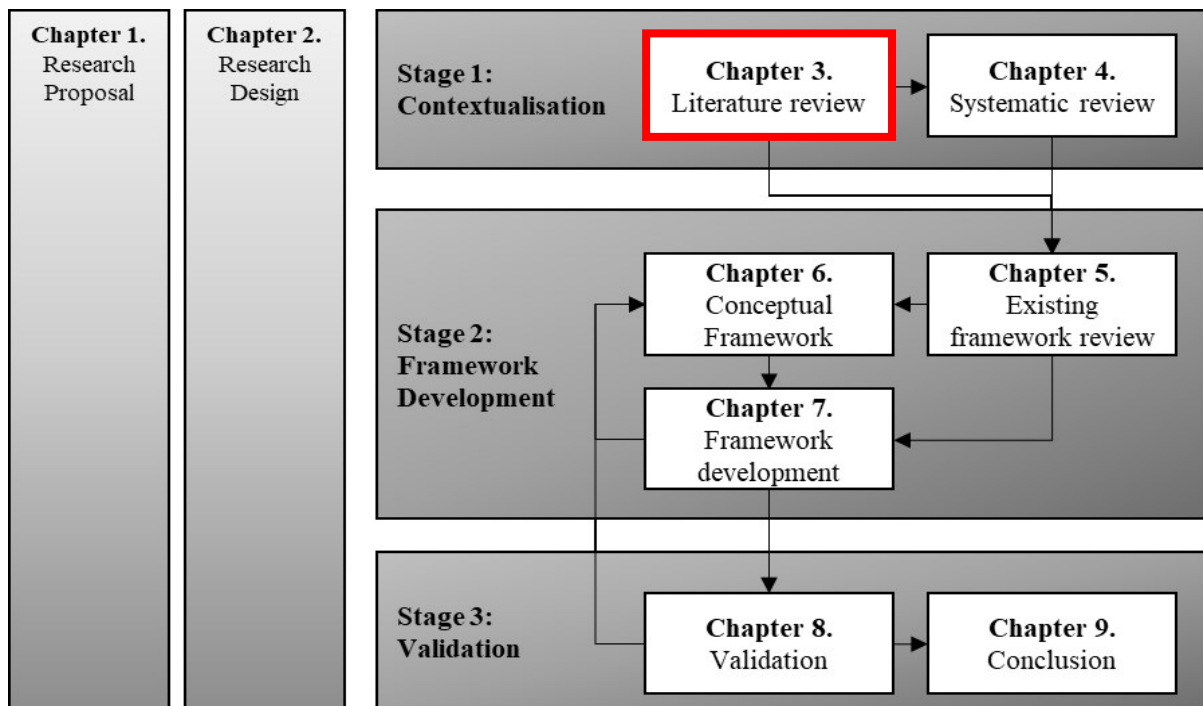
Figure 8: Research design: Chapter 3

Figure 8 indicates how Chapter 3 fits into the thesis. This chapter will, through conducting an exploratory literature review, explore Industry 4.0 and various related concepts. The different technological components will be discussed, and how they link with the objective of the fourth industrial revolution to improve the customer experience and increase operational effectivity

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and efficiency. The disruptive impact of Industry 4.0, as defined in literature, on the economy and organisations, is discussed.

Digital transformations are researched and defined, along with the different components of a digital transformation. The drivers, objectives, and challenges will be researched and discussed in depth.

Digital transformation strategies for the transformation process are researched and defined, where the different components of a digital transformation strategy will be elaborated on. The principles used to define the strategy components to ensure a value-adding digital transformation process will be defined and discussed, which will be used to introduce an agile business model.

The make-up of a digital organisation will be discussed with attention given to the various digital dimensions of which a digital organisation comprises of as found in literature.

3.1.1   Methodology

The methodology followed in conducting this literature review was based on the method presented by Winchester & Salji (2016). They presented six stages of writing a literature review, which are discussed in this section. How the stages were applied in this chapter will also be elaborated on. The stages these authors mention are:

1. Select topic of review
2. Identify keywords and search terms
3. Identify sources of information
4. Gather relevant literature
5. Evaluate literature
6. Summarise the findings in the literature review

Source: (Winchester & Salji, 2016).

These stages were applied, and the following structure found in Table 5 was created to execute the exploratory literature review:

Table 5: Literature review design (Winchester & Salji, 2016)

Stage	Description
Topic of review	Industry 4.0 & Digital transformations
Keywords and search terms	Industry 4.0, Digital transformation, Digital transformation strategy, Digital disruption, Digital business model, Digital organisation.
Sources of information	SCOPUS, ScienceDirect, Google Scholar, grey literature from relevant industries, online libraries.
Gather relevant literature	Literature was gathered from the above-mentioned sources. A total of 127 relevant pieces of literature were gathered and used.

Evaluate literature	Relevant literature was categorised according to keywords and related topics.
Write literature review	Findings of literature review are elaborated on in Chapter 3.

The methodology was applied, and the findings of the literature review are discussed under various topics that were found to be (i) prevalent in various literature sources, and (ii) relevant to the problem statement. The discussion around these topics can be found in the following sections.

3.2 Industry 4.0

The fourth industrial revolution, or Industry 4.0, is a blanket term referring to the development of technologies, especially information and communication technologies, that will fundamentally change how we live, work and interact with one another. Previous industrial revolutions focused on automating mass production, whilst Industry 4.0 builds on the digital revolution with adaptive, flexible, and customised mass production capabilities (*Industry 4.0: Definition, Design Principles, Challenges, and the Future*, 2017).

This section aims to create context as to what Industry 4.0 is and will elaborate on the different components that are prevalent in Industry 4.0. The impact of Industry 4.0 on the different sectors of society will also be explored.

3.2.1 Background

With the term first used in a publication by a German group of authors from diverse professional backgrounds in 2011, the German government used it as a strategy for 2020 to enhance their competitiveness in different industries (*Industry 4.0: Definition, Design Principles, Challenges, and the Future*, 2017). Since then, the term has come to mean the transformation of value chains to become more aligned with specific customer needs in all industries (Buhr, 2015). This value creation is achieved with the rapid development of new technologies, which has in turn driven increases in industrial productivity (refer to Section 3.2.2 for a detailed description of the different components of Industry 4.0).

Industry 4.0 aims to use technology to improve both the effectiveness and efficiency of business operations, to optimise business systems, and improve the customer experience (Schwab, 2016). Industry 4.0 sees systems gather and analyse data across machines, processes, and value chains to enable more effective and efficient business processes; ultimately enabling the creation of higher-quality goods and services at lower costs (Schwab, 2015, 2016).

The previous industrial revolutions focused on the mass production of products, whereas the fourth industrial revolution is focused on optimisation and individualisation. It will provide customers a wider variety of options to acquire products and services specific to their need(s), at an increased pace (World Economic Forum, 2015).

The key technologies, amongst others, include big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, the industrial internet of things,

cybersecurity, the cloud, additive manufacturing, and augmented reality (Rüßmann *et al.*, 2015). All of these concepts will be elaborated on in the following sections.

3.2.2 Industry 4.0 components

Different technology components have enabled the fourth industrial revolution, and the integration between these different components have created cyber-physical systems – systems that can interact and communicate with each other through internet-based protocols. These cyber-physical systems can be used to gather and analyse data to optimise processes, and increase quality of products and services whilst reducing costs (Rüßmann *et al.*, 2015). The effect of these systems within organisations is increasing collaborative efforts from different departments within the organisation, as well as from different organisations.

McKinsey & Company identified three technological trends that are driving the fourth industrial revolution: (i) connectivity – with the internet of things, big data and analytics, cyber-security, and cloud computing included, (ii) intelligence – under which artificial intelligence, big data and analytics, and autonomous robots fall, and (iii) flexible automation – which includes additive manufacturing, augmented reality, and system integration (Leurent *et al.*, 2018).

3.2.2.1 *Big data and analytics*

Big data is a broad term used to describe a variety of processes and pieces of information. According to a study conducted by Forrester Consultants, big data differs from traditional data in three ways: volume of data, variety of data, and the velocity at which data is gathered, (Witkowski, 2017).

With increased sensor development and computing capabilities, along with the internet, organisations are enabled to gather data from a variety of sources. The gathering and analysis of data from different sources supports companies in making more informed decisions. Big data sources include: sensor data, machine log data, data storage, the internet, social media platforms, business apps, media, and documents (*The Big 9 Big Data Sources [Infographic]*, 2018).

Advanced analytics is focused on using the large volumes of data to enable more accurate real-time decision-making. Improved decisions lead to increased operations efficiency, which in turn leads to higher value creation within the business. The increase in analytics capabilities has enabled non-specialists to execute complex data analysis procedures that allow organisations to gain insights from the large volumes of data that was previously not possible (Greiser, 2017).

3.2.2.2 *The internet of things (IoT)*

The internet of things is a broad term describing the connectivity between the internet and physical objects, enabling these objects to connect, send and receive data (Hendricks, 2015). Whilst the internet is focused on connecting humans, IoT is focused on integrating objects embedded with sensors and actuators over the internet. These objects are referred to as smart objects, due to their ability to connect and interact over the internet. Smart objects, along with other technologies, form part of cyber-physical systems (Hendricks, 2015).

This has contributed to the move from traditional data to big data. Smart objects are equipped to collect data using existing technologies such as sensors, and through their connection over the internet, they can share and receive data to and from other smart objects. The connectivity between the physical realm and the internet enables a wide variety of new applications and services (Hendricks, 2015).

In 2015, there were 14 billion IoT devices installed, and this number is expected to increase to 26 billion by 2020 (Ericsson, 2015). The global market value of the IoT is estimated to be $7.1 trillion by 2020 (Hsu and Lin, 2016). In line with the aim of Industry 4.0 is – IoT strives to increase operations efficiency and create customer value.

IoT applications vary greatly. Smart homes, where different technological devices in your house engage over the internet, healthcare industries, where doctors can receive real-time data about the health of their patients, are but a few applications of IoT (Witkowski, 2017). IoT can be used to optimise systems and increase performance, that leads to greater value creation. As showed by a survey done by Forrester Consultants, organisations are aware of the possibilities that IoT possesses – 90% of companies from the transport and logistics sector have already implemented IoT solutions, and half of all surveyed organisations admitted that IoT will improve their supply chain efficiency, and in turn increase their value creation (Witkowski, 2017).

With the move to big data and the exponential increase in connected devices, increasingly more data about people is gathered and stored on the internet. This increase in data-vulnerability has become a growing concern for safety and privacy, and according to a study conducted at Glasgow University regarding the privacy of the Internet of Things, most current research going into IoT is focused on the security concerns of IoT (Aleisa and Renaud, 2016). In a survey conducted by Accenture involving 28 000 people from 28 different countries, more than 66.67% indicated that they were aware of recent security breaches by hackers, and 47% identified privacy and security concerns as a primary barrier to the adoption of IoT devices (Accenture, 2016). These findings are supported by a study conducted by Hewlett Packard where it was found that 80% of IoT devices lacked requiring passwords of sufficient complexity and length to effectively protect these devices from hackers (HPE, 2015), and they were thus at risk to be easily hacked.

3.2.2.3   The cloud

Cloud computing is the move of computer services, such as storage, analytics, networking, and many other higher-level services, from physical infrastructure to the internet (Bigelow, 2012). It is further defined as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Botta *et al.*, 2016). It aims to create more accessible, decentralised, and user-friendly storage places for data to flow freely between devices with internet connectivity (Bigelow, 2012).

Cloud computing offers many advantages compared to traditional infrastructure. It increases cost-efficiency, it is not limited to geographical boundaries or storage limits, easy access to

access information, and it is deployed quickly (Bigelow, 2012), (Al-ruithe, Benkhelifa and Hameed, 2018). Companies are also equipped to scale their computing capabilities up or down as the demand varies and eliminates the need to invest money into traditional infrastructure – infrastructure that may be unused should it not be required anymore (Bigelow, 2012). Data stored on the cloud is safer than data stored on physical infrastructure, as backing up data and data recovery is easier compared to traditional data-handling infrastructure (*What is cloud computing? A beginner's guide | Microsoft Azure*, 2018).

Security and privacy concerns are big with cloud computing, as the fact that the data is stored online allows hackers the opportunity to access the data should the security be breached. Large companies are investing vast amounts of money into their cloud capabilities to increase operating ability and improve security – Microsoft spent $8.6 billion on the development of their cloud in 2011 (Jackon, 2011). The confidence that organisations have in cloud computing is increasing – in 2016, approximately 17% of total market revenue from IT services, such as infrastructure, business services, and middleware, shifted to cloud computing, and that number is predicted to increase to 28% in 2021 (Ranger, 2017).

3.2.2.4   *Artificial intelligence (AI) and autonomous robots*

Autonomous robots refer to mechanical devices, robots, that can receive data and be programmed to perform tasks autonomously for extended periods of time without the need for human intervention (*RobotWorx - What are autonomous robots?*, 2018). This technology has been applied to many industries – the automobile industry, healthcare, governmental surveillance, amongst others (*RobotWorx - What are autonomous robots?*, 2018). These robots are only able to perform tasks that humans program them to do – they lack intelligence, and this is what the latest technology in robotics are working towards – artificial intelligence for robots.

Artificial intelligence is the design and creation of intelligent machines (Paschek, Luminosu and Draghici, 2017). Intelligence refers to the ability to react appropriately under the perceived circumstances to attain its goal and adapting and reacting to different circumstances and goals intelligently. It is the ability to learn from past experiences, and apply the knowledge gained from that experience to react better in future. The study of artificial intelligence is based on the premise that intelligence is computational, and the goal is to design methods to enable machines to have the ability to act intelligently. Although artificial intelligence is not a new technology, its development has increased with the development of computational capabilities, big data, and theoretical understanding of what it is (Poole, Mackworth and Goebel, 1998).

Artificial intelligence is not an exact science, and researchers around the world disagree on many aspects of it. There are many ways in which machines can attain intelligence, and one of the most widely used methods is machine learning (Das, 2018). The goal of AI is to apply the intelligent machines to solve problems, and machine learning is a way of enabling the machines with problem-solving techniques. Machine learning is a technique whereby machines use big data to look at multiple examples of situations, and through the analysis of these examples, the machines learn independently how to react when confronted with similar problems (Paschek, Luminosu and Draghici, 2017, Das, 2018).

3.2.2.5   Horizontal and vertical system integration

System integration refers to the bringing together of different subsystems and integrating their functions to ensure they operate as a single system (Lau, 2005). It is linked with IoT and cyber-physical systems, as systems connect and integrate over the internet to form new systems with increased functional capabilities. The goal of the new systems is to increase operational effectiveness and efficiency, and it can be created in one of three ways – vertical integration, horizontal integration, or star integration (*Understanding System Integration*, 2016).

Vertical integration is the process of creating a system comprised of different subsystems with similar functional capabilities, to create functional entities referred to as silos (Lau, 2005). Horizontal integration, or enterprise service bus (ESB), refers to the creation of a new system by creating a single subsystem that communicates with all the other integrated systems. Star integration is a system where all the different subsystems are connected to each other directly. The name comes from the perspective of the subsystem, as the connection between the other subsystem creates the perception of a star. (*Understanding System Integration*, 2016).

3.2.2.6   Cybersecurity

Cybersecurity is the act of protecting the cyberspace, and all users, personal or organisations, who are using the cyberspace, and their assets within the cyberspace. There are many threats that pose a danger to data stored online, and any device with internet connectivity is at risk to be hacked (van Schaik *et al.*, 2017). Cybersecurity refers to both the prevention of access to the physical hardware, and the online access through online networks (Schatz, Bashroush and Wall, 2017). With the increase in use of IoT devices, big data, and the reliance of organisations on online infrastructure, increasingly more data is at risk to be hacked, and therefore cybersecurity has increased in relevancy. The market is set to increase to $170 billion by 2020 according to Forbes (*What is Cybersecurity? - Palo Alto Networks*, 2018).

Accessing private information can be done in several ways, and although large companies have the most valuable data to be stolen, a study done by Duo Security showed that more than 45% of smaller companies incorrectly see themselves as not being a potential target to a cyberattack (*Duo Security*, 2017). Hackers can access information through a backdoor (a way of bypassing authentication) through malware, ransomware, phishing, social engineering (convincing the user to disclose personal information such as passwords under false pretences), amongst many other techniques. Cyberthreats not only include hackers – the greatest cyberthreats to organisations according to research by PwC are hackers, current employees, organised crime, foreign nation-states, and activists (Kitchen, 2015).

As the reliance on computer systems increases, so does the vulnerability to attacks. Organisations are becoming more aware of the need to have measures in place for effective cybersecurity, and 76% of business-respondents to a survey conducted by PwC indicated that they were more concerned about cyberthreats in 2015 compared to 2014, and 87% of CEO's surveyed in America agreed that cyberthreats were a threat to potential growth of their companies (Kitchen, 2015).

3.2.2.7 *Additive manufacturing*

Additive manufacturing is a blanket term describing methods used to create objects layer by layer, with material such as plastic, metal, or concrete (*AM Basics | Additive Manufacturing (AM)*, 2016). These techniques allow machines to create functional parts of varying complexity from a design file – often a 3D model of the desired object, vastly increasing the speed at which new prototypes can be created and tested. These techniques can produce complex items within hours that would have taken weeks to manufacture with traditional methods, and they are not subject to geographical limitations. This increases operational efficiency in the manufacturing industries, and it adds to the manufacturing capabilities of the organisations (Cummins, 2010).

The possibilities with this manufacturing method are vast, and Prof Richard Hague, who leads the Additive Manufacturing Research Group at the University of Loughborough, is quoted as saying, "We have technology that can make more complex things than we can design" (Cummins, 2010).

The adoption of additive manufacturing is increasing, where a PwC survey in 2016 found that 71.1% of US manufacturers are using 3D printing technology in some way, but there are certain adoption barriers. According to the same PwC study, the biggest barriers as stated by US manufacturers are cost and lack of skill or expertise in the field with 41.3% and 42.1% respectively, which changed significantly from the same study conducted in 2014, when quality of products, at 47%, was the biggest perceived adoption barrier. This has not curbed the spending on additive manufacturing worldwide, as it is predicted to grow at a compound rate of 27% to more than $26 billion in 2019, as the adoption rate increases (Sulavik and Waller, 2016).

3.2.3 Impact of Industry 4.0

As the different components described in the previous section are integrated into society, change will be brought about in the business sector, the economy, and society (Schwab, 2016; Moraes and Lepikson, 2017; Nagy *et al.*, 2018). This section considers the impact of the different technologies on some of the areas that Klaus Schwab identified that are supported through other referenced literature. The envisaged impact that the different technologies will have on the economy and the business sector is considered below. Society and national and global impacts are excluded as the focus of this research is on the digital transformation of organisations.

3.2.3.1 *Economy*

The impact that the fourth industrial revolution will have on the economy is so widespread and multidimensional that leading economists are still in disagreement about the exact impact it will have. In a survey done among US executives, 86% indicated their approval of the use of Industry 4.0 concepts in their respective industries, as described in Section 3.2.2 (Ashby, 2017). Based on the same survey, Table 6 provides a summary of which industries in the US use and are projected to use Industry 4.0 concepts in 2017 and 2022.

Table 6: Percentage of use of Industry 4.0 (Ashby, 2017)

Industrial Sector	2017 (%)	2022 (%)
Electronics	45	77
Aerospace/Defence	32	76
Industrial Manufacturing	35	76
Chemicals	32	75
Forest products/Paper	38	72
Transportation	28	71
Engineering/Construction	03	69
Automotive	41	65
Metals	31	62

There exists a debate around the economic impact of the fourth industrial revolution on employment and economic growth. Both play a role in decreasing poverty worldwide, with techno-optimists arguing that Industry 4.0 will create unprecedented economic growth, as access to basic services will be increased, and jobs will be created that will increase employment. Techno-pessimists argue that the components of Industry 4.0 will ensure a rise in high-skilled jobs, with lower-skill jobs being replaced by new technologies (Schwab, 2016), (Nuttall, 2018).

A forecast by Oxford University in 2013 stated that 47% of jobs in America, and 35% of jobs in the United Kingdom were at risk of being automated by 2020, with the employees thus losing their jobs. The Organisation for Economic Co-operation and Development (OECD), however, disputed these numbers, stating that they believe the true numbers to be 10% in America and 12% in the United Kingdom (Kelion, 2018). In 2016 a study done by McKinsey & Co found that few jobs will be eliminated – however, automation will affect parts of every job. It concluded that current technologies could automate 45% of activities that people are remunerated for, and that about 60% of all jobs could see 30% of their activities automated (Vacek, 2016).

Technological innovation has previously led to a shift in the demand for types of jobs. As new innovations disrupt traditional supply and demand structures, leading to the loss of jobs, the capitalisation effect leads to the creation of demands for new products and services, leading to the creation of new jobs and industries (Schwab, 2016: p43), (Nuttall, 2018).

With the fourth industrial revolution expected to create wealth of up to $3.7 trillion by 2025, it is unsure who will share in that wealth (Leurent *et al.*, 2018). Many believe the gap between the high-income earners and low-income earners will increase drastically, as the jobs created centred around the new technologies require high levels of skill to be effective – skills low-income earners often do not possess. This has opened many questions surrounding education and co-curricular development, as education is the tool for people to develop themselves to become relevant in the economy to add value to the economy (Jong-Wha, 2014), (Flynn, Dance and Schaefer, 2017).

With the development of Industry 4.0, different economic models have emerged. These models have changed how employers interact with employees, especially after the rise of the 'on-demand' economy. Projects are dissected into different tasks, and due to increased connectivity, these tasks are outsourced online to anyone with internet connectivity that can perform the task. This has vastly increased the productivity of companies, as they are not laboured with responsibilities to their employees – they can get tasks done at quickly with high resulting quality (Schwab, 2016).

3.2.3.2 *Business*

The impact of Industry 4.0 has caused disruption in various areas for existing organisations (Bucy, 2016). Organisations face disruptive threats from start-up companies that built their organisations on digital platforms, and can supply goods and services of higher quality, quicker, and cheaper. Start-ups are not the only source of disruptions – as existing organisations which manage to successfully transform are able to cross industry boundaries and take sections of the market share (Schwab, 2016). Organisations thus need to disrupt their own business models from within the business, or they run the risk of being put out of business by new start-up organisations (Matuszak, Hanley and Wong, 2016), (Morgan, 2017).

Industry 4.0 is also disrupting the supply side of business, as customers are empowered with access to big data and analytics to make more informed decisions regarding products and services, resulting in organisations having to rethink their design, marketing, and delivery methods (Schwab, 2016)

Klaus Schwab identified four major impacts on organisations with the development of Industry 4.0 – the shift in customer expectations (Earley, 2014), (Gokalp, 2017); improvement in asset productivity through the use of big data (Gokalp, 2017); increased importance of new forms of collaboration, and the transformation of operating models into digital models (Schwab, 2016). Refer to Section 3.7 for an in-depth discussion regarding the digital business model that will be created through the digital transformation process.

Customer expectations
Customer expectations are defined as "[…] expectations (customers have that) serve as standards with which subsequent experiences are compared, resulting in evaluations of satisfaction or quality" (Van Thai, 2004). During Industry 4.0 these customer experiences have changed and has led to the improvement of customer experiences being at the centre of the fourth industrial revolution. Organisations are focusing more on the experience than just the product or the service they provide, due to the shifting customer expectations (Schwab, 2016). With the rise of big data and analytics, companies have access to information which they can use to refine their customer experience, as they are able to provide customers with the exact experience they expect.

Consumer trends have not only been shaped by the willingness of organisations to share data, but also due to customers sharing data with each other (Schwab, 2016). Customers, specifically those born after 1980 and who form the majority of the customer-base of digital organisations, have indicated in research conducted by Ernst & Young that peer-to-peer reviews are their preferred way of gathering information about products and services – as 80% indicated they

trust peer-to-peer reviews, with only 14% indicating they trust advertisements from organisations (Ingleton, Ozler and Thomas, 2011). Organisations can no longer rely on brand loyalty or customer ignorance – customers can gather information about quality, availability, and price comparisons in no time, thus requiring organisations to win market share by offering the most valuable experience (Schwab, 2016).

Enhanced products

With the use of big data and analytics, the quality and reliability of products has increased. Organisations design the products with more knowledge about the quality of their parts, as well as the specific needs of customers, leading to better designed products with higher desirability (Schwab, 2016).

Most organisations' manufacturing strategies assume constant equipment availability – a scenario which is unlikely (Lee *et al.*, 2013). With the development of smart objects and cyber-physical systems, machines are equipped with sensors and software that enable them to 'self-diagnose', supplying personnel with the required information to perform effective predictive and preventive maintenance techniques, increasing the utilisation of equipment, and decreasing downtime and breakdowns (Lee *et al.*, 2013).

The ability to predict the performance of equipment empowers the customer, as they are now informed about the quality and reliability of the equipment. The evolution of enhanced, smart products is not only useful for maintenance purposes, it also empowers organisations to make more informed strategic decisions regarding the outsourcing of activities, allowing business to make cost-effective decisions based on accurate data (Lee *et al.*, 2013).

Collaboration

Increasing the customer experience requires collaborative innovation from organisations, especially taking the quick rate of disruption into account. Organisations need to be adaptive to changing customer expectations, and as customer expectations can change much quicker than business models, organisations will need to collaborate to ensure they can offer competitive customer experiences (Bughin *et al.*, 2018).

When organisations collaborate, they become more adaptive, and they create value both for themselves, and the industries in which they operate. As shown in a report compiled by Co-Society on business collaboration, many organisations are increasing their collaborative efforts with other organisations, for example Toyota and Microsoft started a collaborative project in 2011, where they are working on developing motors with a software platform developed by Microsoft which includes energy management analytics, GPS systems, and multimedia technologies (Turiera and Cros, 2013).

Operating models

As can be seen from the previous sections, the fourth industrial revolution is set to disrupt most industries and the organisations within these industries. These organisations will need to transform to be more data-centred, as they will need the capability to use big data to improve their productivity and customer experience, or they run the risk of losing a large share of the market value (Matuszak, Hanley and Wong, 2016).

The way organisations hire employees, data acquisition, the digitisation of their processes and analogue data, the creation of a digital culture, among other things, will have to happen for their business models to remain relevant, and to ensure sustainability (Schwab, 2016).

The following section will explore the disruptive effect that Industry 4.0 has had on organisations, with specific focus put on the domains where disruption has been experienced by organisations, and the different stages of disruption that incumbent organisations can experience.

3.3 Digital disruption

The disruption that Industry 4.0 concepts has caused has been widespread in most industries (Skog, Wimelius and Sandberg, 2018), ('Be Disruption-ready', 2017), (Schreiber, Forer and De Yonge, 2018). Organisations are tasked with trying to satisfy evolving customer needs, adapting to new market requirements, competing against new market entrants, and incorporating new technologies into their business operations (Accenture, 2017; Schwieters *et al.*, 2017; Schreiber, Forer and De Yonge, 2018). In the past, established organisations who have been losing market share follow a trend – they focus too much on what has brought them success in the past, and not on what will bring them success in the future. They have thus not adapted to the increased demands from the disruption, and subsequently lost market share (Teplykh and Mikhailova, 1987).

This section will focus on what disruption is, and how it manifests within industries. The effect that disruption has on existing organisations will be explored, and lastly the various domains in which organisations can experience disruption will be discussed. Disruption plays a key role in the approach that organisations take to digitally transform, and this section introduces the following section that elaborates on the digital transformation process.

3.3.1 Background

It is well documented that incumbent organisations find it challenging to adapt to the disruptions caused by new market entrants. Disruptive technology is defined as "[…] *new technologies introducing new performance parameters that satisfy emergent customers, but that underperform on existing attributes that satisfy mainstream customers*" (Cozzolino, Verona and Rothaermel, 2018). Various types of disruption exist, and Christensen and Raynor (1995) speak about two types of disruption in their book, *The Innovator's Solution: Creating and Sustaining Successful Growth*: new-market disruption and lower-end disruption.

New-market disruptions are organisations who uses the novel capabilities of the new technology to create much more affordable and easier-to-use products and services that large groups of people who could previously not afford the product can now do so, and thus a new market is accessed. Canon's cheap photocopiers is an example of new-market disruption – people could afford to own a photocopier and make their own copies, instead of going to a photocopying company (Christensen and Raynor, 1995; Christensen, Raynor and McDonald, 2015).

Lower-end disruptions are organisations who do not create new markets, they disrupt markets by focusing their attention on the lower end of the market, growing steadily by offering low-

cost, existing products and services to their customers. Walmart disrupted the department store industry by offering basic products such as paint, hardware, sporting goods, etc., nationwide at lower prices than anyone else. Both forms of disruption systematically take the market share of incumbent organisations (Christensen and Raynor, 1995; Christensen, Raynor and McDonald, 2015).

The process that the above-mentioned disruptions undergo to take market share from industry incumbents is depicted in Figure 9, from point of origin to the point of singularity. The straight red line represents the supply performance from incumbent organisations, the broken red line represents the performance requirements from the mainstream market, the broken black line represents the requirements from niche markets, and the solid black line represents the performance of the disruptive organisations.

Once the disruptive organisation gets a foothold in the niche market, the growth in performance from these organisations is exponential due to the increased capabilities from the new technologies that the organisations incorporate. Although the incumbent organisations' performance is increasing and above the mainstream market performance demands, it is increasing linearly. The disruptive organisation increases in performance until it reaches the mainstream market performance requirements – referred to as the *point of disruption* and keeps increasing in performance exponentially until it surpasses the incumbent organisations' performance levels, takes their market share by offering the market much higher performance solutions, and renders the incumbent organisations obsolete to the market.
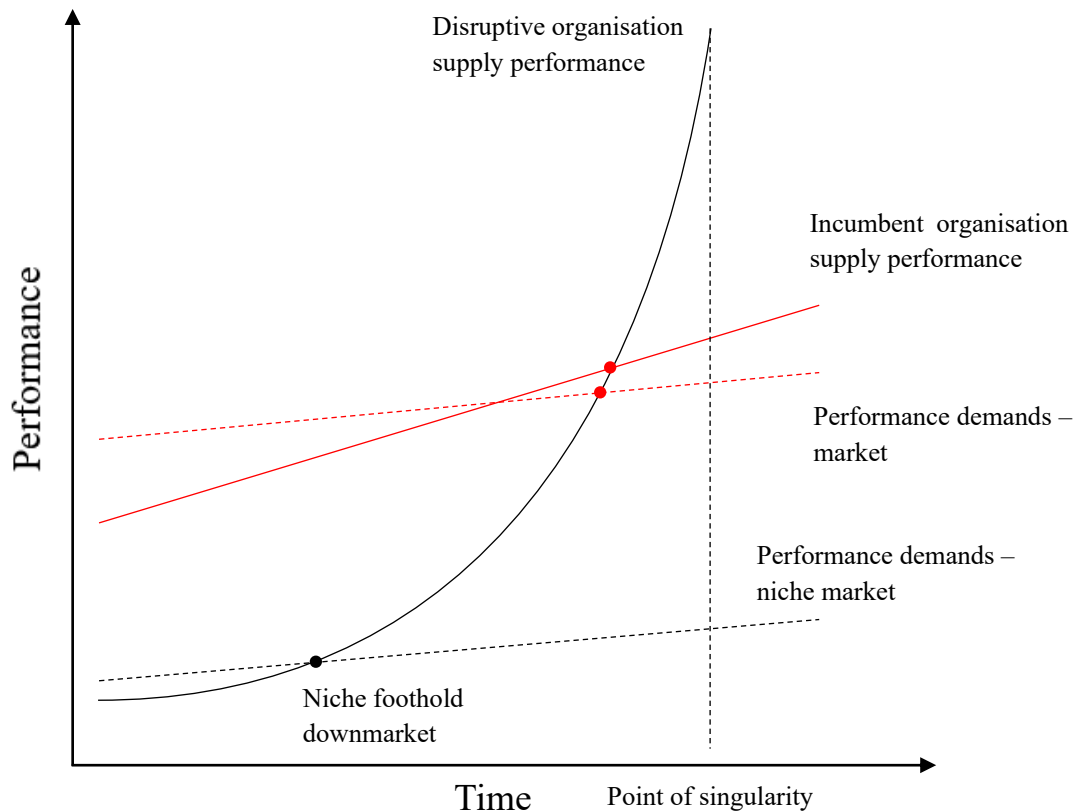
Figure 9: Disruption curve (https://www.digitaldisruption.aau.dk/).

McKinsey & Company researched the process that disruptive organisations take from being in their infant phase to where they render incumbent organisations obsolete in the market and they found that various industries experience different levels of digital disruption. Figure 10 depicts the various stages of digital disruption within industries, and the effect that it has on organisations. The progression of the curve is dependent on the extent to which organisations and customers have embraced digitisation within the relevant industry (Hirt and Willmott, 2014).

Organisations could use this graph as an indication of how at risk their organisation is for disruption and subsequently losing market share. The digital transformation strategy that the organisation adopts is highly dependent on its position on this curve. The further the industry is on this curve and thus the more the industry has adopted digitisation, the more at-risk incumbent organisations are of being disrupted and losing market share. Understanding where an organisation is on this curve will create a sense of digital transformation urgency (Hirt and Willmott, 2014).

Based on this curve, disruption was further contextualised within industries to determine where organisations can be disrupted. Disruption is not a new concept – however, this thesis will focus specifically on the disruption caused by Industry 4.0 concepts, as described in Section 3.2.2, referred to as digital disruptions. The effect that incumbent organisations experience as a result of the implementation of these technologies within various industries will be elaborated on. The following section considers the various domains that incumbent organisations

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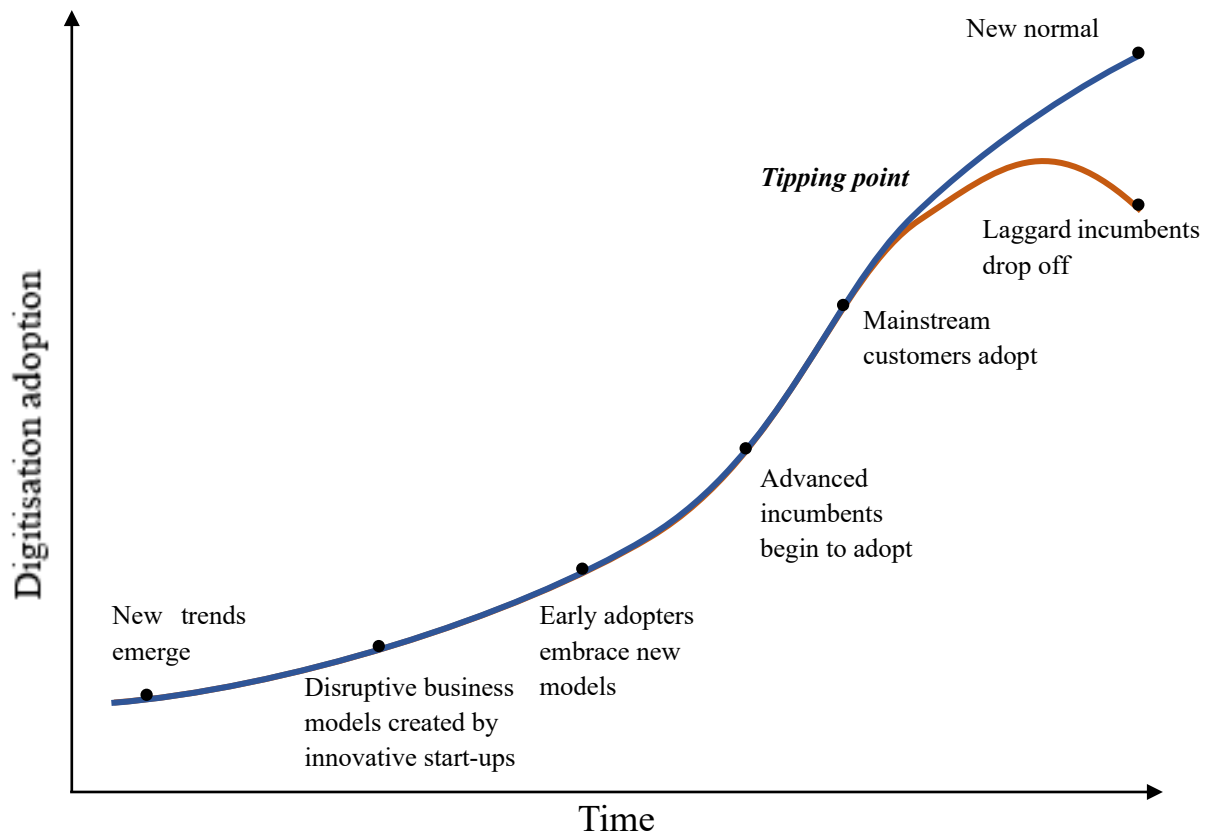
Figure 10: Digital disruption of incumbents (Hirt and Willmott, 2014)

experience digital disruption in, and how that could affect their organisations. This section will create context around what the requirements of digital organisations will be, and how organisations will have to transform to retain their market share in the new digital economy.

The degree to which disruption has been experienced within the various disruption domains will play a key role in determining in which region the industry lies on Figure 11, and subsequently how urgent a digital transformation is for organisations in order to remain relevant in the digital economy and retain and gain market share. Bradley & O'Toole, (2016) divided the figure into different stages and contextualised the various approaches that organisations should adopt based on where they find themselves on this graph. The following section will discuss these stages.

3.3.2 **Disruption stages**

The four stages correlate with the disruption curve diagram in Figure 9 but builds on that to specifically look at the impact that each region of the graph has on the organisation. Based on the level of disruption that is evident within the industry, the following stages shown on Figure 11 will contextualise an appropriate response from the incumbent organisations.
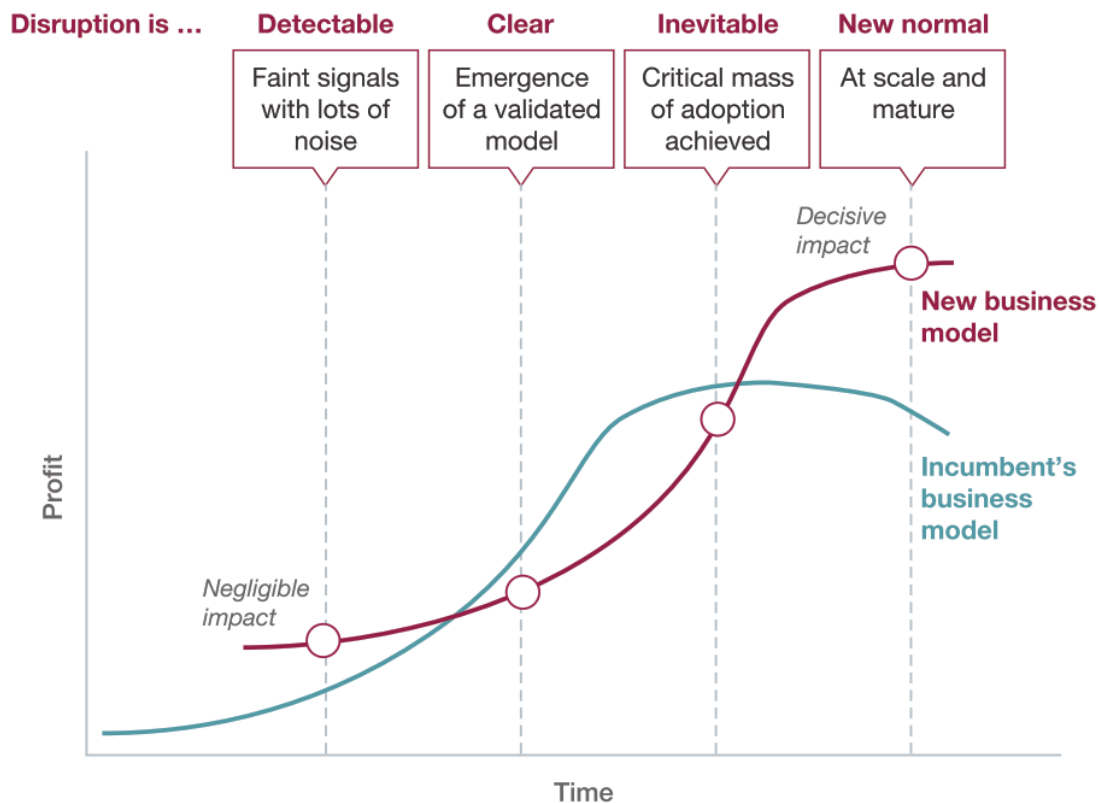
Figure 11: Disruption stages (Bradley and O'Toole, 2016)

3.3.2.1 *Detectable disruption*

Incumbent organisations barely feel the impact of the disruptive organisations, and this makes it difficult to effect any changes to the organisation's business model. Incumbents are required to critically assess their value creation strategy and intentionally seek insights into the potential disruptors in their industry – but are challenged to discern between emerging trends that will be relevant, and those that will disappear over time (Bradley and O'Toole, 2016).

3.3.2.2 *Clear disruption*

The trends that will cause disruption are clear at this point, and organisations are more aware of the effect that these disruptors will have on the organisation. Incumbent organisations must commit to the implementation of initiatives that include the emerging disruptive trends. Organisations are in a favourable position since their traditional revenue streams are unlikely to be disrupted to such an extent that they do not generate revenue, and can experiment with various digital initiatives (Bradley and O'Toole, 2016).

It is important for these initiatives to be independent and autonomous from the parent organisation so that the initiatives, often performing at lower performance levels than required from the market (see Figure 9), are not tasked with immediately replacing the revenue

generated from the traditional revenue streams. Organisations often lack motivation to invest in these initiatives, as their traditional revenue generators are still performing well (Bradley and O'Toole, 2016).

3.3.2.3   *Inevitable disruption*

At this point the performance level of the emerging business models have surpassed that of the incumbent business models, and the incumbent organisations are tasked with allocating the majority of their resources to the initiatives that it initiated in the 'clear disruption' phase. The executives of incumbent organisations are often reluctant to invest the majority of their resources in the new initiatives, but risk losing market share if the resource allocations are not amended to favour the new initiatives (Bradley and O'Toole, 2016).

Organisations often lack the internal capabilities to design and launch the required initiatives, and if they neglected commencing with emerging initiatives in the previous stage, are often left with having to acquire the relevant capabilities through existing initiatives (Bradley and O'Toole, 2016).

3.3.2.4   *New normal*

The disruptive business models have scaled and are the new normal in the industry – which leaves incumbents with decreased profits and significant market share losses. Incumbents are tasked with restructuring their business models to adapt to the new performance requirements from the market (Bradley and O'Toole, 2016).

Incumbents' capabilities are often too integrated with the legacy business model to make internal restructuring not possible – if the business model is built on technologies that is too different from the new normal in the industry, the core problem cannot be solved through restructuring the organisation – and the organisation must redesign their business model and value creation strategy. For example, restructuring organisations that sell video tapes would not have solved the core issue that online streaming is fundamentally a more desirable product for customers. The organisation would thus have to reconsider its value proposition to customers to retain its market share (Bradley and O'Toole, 2016).

3.3.3   **Disruption domains**

Disruption was researched and conclusions were drawn on the various domains that disruption can occur in. These domains include: (1) the market, (2) competitors, (3) the customer, (4) and technology (Porter, 1980; Accenture, 2017; Schwieters *et al.*, 2017; Schreiber, Forer and De Yonge, 2018). Each of these disruption domains represents areas where digital disruption has manifested in different industries, and further understanding of where industries have been disrupted will play a key role in the creation of digital transformation strategies for organisations to mitigate the disruptive effects from Industry 4.0, and how organisations can use these disruptive technologies to create value for their organisation.

Du Preez, Essman, Louw, Schutte, Marais & Bam, (2015) refer to these disruptions as external change drivers, and they speak about how organisations constantly go through change cycles due to these external change drivers to gain the competitive advantage over their competition, to thus be the preferred product or service provider within an industry. Organisations thus have

to take these disruptive domains into account in order to undergo certain changes to gain competitive advantage. This thesis refers to this change as a digital transformation.

3.3.3.1 Legislative environment

Organisations are forced to change some of their products and services due to the implementation of governmental regulations within their industries – for example the automotive industry had to deal with new CO_2 emissions regulations that were implemented in the European Union in 2014, and in the United States of America by 2016 (Du Preez *et al.*, 2015).

PwC Global conducted a study regarding digital disruption and found that 75% of CEOs that were interviewed indicated that they believe regulation changes will affect their industries within the next five years. The lack of regulatory reform can hinder the progression of disruptive technologies, such as with self-driving cars, but tighter regulations can also lead to new innovations – e-cigarettes were invented as a result of the tight regulations on tobacco (Schwieters *et al.*, 2017).

3.3.3.2 Competitors

Industry 4.0 has enabled the development of digital ecosystems that challenge the traditional layout of the competitive landscape (Accenture Interactive, 2013), which has caused disruption from competitors that were previously not there. Bughin *et al.*, (2018) argues that by 2025, 32% of the global revenue, which is $60 trillion, will be accounted for by digital ecosystems.

Organisations face disruptive threats in two key areas with regards to competitors: (i) incumbent organisations who are crossing industry boundaries, and (ii) start-up organisations who often operate on digital platforms (Schwab, 2016). Examples include Uber entering the transportation industry as a start-up organisation, or Amazon entering the food retailing industry as an established organisation crossing industry boundaries (Schwieters *et al.*, 2017).

3.3.3.3 Technology

Technology is at the core of disruption, as it enables organisations to have new capabilities which can create new market offerings or increase the performance of traditional offerings. Technology can thus disrupt organisations in two areas: (i) disruption caused by technology increasing the productivity of operations and subsequently cutting expenditures on operations which can decrease the cost of products or services (Frolov *et al.*, 2017; Nagy *et al.*, 2018), and (ii) new technologies can create new market avenues (Accenture, 2017; Schreiber, Forer and De Yonge, 2018), for example the development of applications on cell phones only became a market avenue with the development of new cell phone technology, and was estimated to be more than a $100 billion industry by 2015 (Rakestraw, Eunni and Kasuganti, 2013).

3.3.3.4 Changing customer demands

Michael E. Porter developed a model for analysing the competitive forces that shape various industries. He mentions, among others, that the power of suppliers and the power of customers both influence the power of the organisation within the industry, and this was interpreted as being internal (suppliers) and external (clients) customers, which forms part of the 'customer' disruption domain (Porter, 1980).

Externally, the changing of customer demands has been identified as a disruptor for various industries as customers are more demanding in terms of the quality of organisations' offerings, which pressurises organisations to adapt their value proposition to customers based on their changing demands (Westerman *et al.*, 2011; Henriette, Feki and Boughzala, 2016). Customers not only expect organisations to adhere to their current needs, but also to proactively address their future needs (von Leipzig *et al.*, 2017).

Customers expect personalised products and services (Accenture, 2017), the faster delivery thereof (Paschek, Luminosu and Draghici, 2017), and an overall enjoyable customer experience across all the relevant touchpoints (Martino, Schaffner and Quach, 2016). Organisations are subsequently tasked with altering their business model to satisfy these changed customer demands.

3.3.4 Disruption and innovation

Du Preez *et al.*, (2015) argue that the competitiveness of any organisation is created by the level of innovation of the organisation. Innovation is defined as "*The successful generation, development and implementation of new and novel ideas, which introduce new products, processes and/or strategies to a company or enhance current products, processes and/or strategies leading to commercial success and possible market leadership and creating value for stakeholders, driving economic growth and improving standards of living*" (Du Preez *et al.*, 2015).

Du Preez *et al.*, (2015) further argue that through innovation, organisations can mitigate the external change factors, or disruption, and gain the competitive advantage. Their argument is thus that the change cycles that organisations are going through to gain the competitive advantage are rooted in innovation, and subsequently the success of organisations in industries that experience changes is determined by their ability to innovate.

There exist various innovation models and types of innovation, with not all types of innovation being disruptive (Moore, 2008). Clayton M. Christensen's disruption theory is widely regarded as the basis of how to view innovation and its link to disruption, and he classifies innovation as falling into two categories: (i) sustaining and (ii) disruptive. Disruptive innovation, defined as "i*nnovation that prompts a disruption towards current existing products, market and value network, thus subsequently replacing previous technology,*" refers to the low-market and new-market entrants elaborated on in Section 3.3.1, where sustaining innovation is initiatives that focus on improving the performance levels of existing product and/or service offerings (Christensen, Raynor and McDonald, 2015; Rahman, Hamid and Chin, 2017).

For this thesis, both disruptive and sustaining innovation will be looked at as Industry 4.0 capabilities can both disrupt existing markets, as well as significantly improve the performance of existing markets (Bughin, LaBerge and Mellbye, 2017; Schreiber, Forer and De Yonge, 2018).

The argument of this thesis is that innovation is the key for organisations to adequately deal with the effects of Industry 4.0, and a digital transformation should be executed from this

perspective. The following section will explore how this innovation perspective can be applied to conceptualise a digital transformation approach.

3.4   Digital transformation

As described in Chapter 1, Section 1.2 – the economic benefits of embracing Industry 4.0 concepts are substantial, and the effect of not embracing these concepts decreases the revenue and profitability of organisations and could render the organisation obsolete in certain cases. This section will further elaborate on this statement.

Although organisations might be aware of this – the success rate of companies adopting these concepts is very low. The gap between wanting to digitally transform and successfully transforming is causing organisations to be tentative about attempting the transformation process (Baculard *et al.*, 2017). Section 3.3 explored the effect of Industry 4.0 on incumbent organisations, and further supports the argument that organisations enact some processes to integrate some of the aforementioned concepts into their organisations to create value for their customers and remain financially sustainable. This process is referred to as a digital transformation, and this section considers the digital transformation process to provide context to what the process entails, and to define the different relevant concepts in the process.

3.4.1   Definitions

This subsection aims to define the key concepts in the process of digital transformation – digitisation, digitalisation, and digital transformation. These terms are often used interchangeably without understanding of their meaning – and for this research the terms will be defined to create a reference for when these terms are used in the paper.

3.4.1.1   Digitisation

Digitisation is the process of converting analogue data into digital data. It is defined as "[…] *the optimization of operational efficiency by adapting and enhancing existing business processes with modern digital technology*" (Stein and Schmidt, 2018). This refers to converting anything analogue, or non-digital – documents, sound, voice, photographs, into bits and bytes so that it can be stored digitally on, and used by, a computer to automate the business' operations, with the goal of improving the effectiveness and efficiency thereof (Klotzer, Weibenborn and Pflaum, 2017), (*Digitization, digitalization and digital transformation: the differences*, 2018).

3.4.1.2   Digitalisation

Whereas digitisation is defined as the conversion of analogue data into digital data, digitalisation is process-focused, and it speaks to how organisations use digitisation to transform business- models and operations. Thus, to undergo digitalisation, one requires the digitisation of non-digital data within the organisation (Khan, 2016).

Digitalisation also refers to the transformation of a specific environment, such as the workplace. This definition refers to when the working environment changes, and incorporates more digital technologies in how everything operates, such as using mobile devices to increase the collaboration opportunities within organisations and changes the way people engage within the organisation. Digitalisation could also refer to digitalising supply chains, creating new

revenue streams through innovative business solutions, etc. At the end – digitalisation leads to a digital business (*Digital Organization*, 2018)

3.4.1.3   *Digital transformation*

Digitalisation and digital transformation are often used interchangeably, yet for the sake of this thesis the difference will be highlighted. Where digitalisation is the process that creates a digital business, digital business models, and even new business opportunities through using digitisation, the term digital transformation could mean numerous things and is viewed from a variety of perspectives – both academically and from industry. Ismail, Khater & Zaki, (2017) conducted a study on the various perspectives of digital transformations, and concluded that, amongst possible others, Figure 12 depicts the pertinent perspectives.
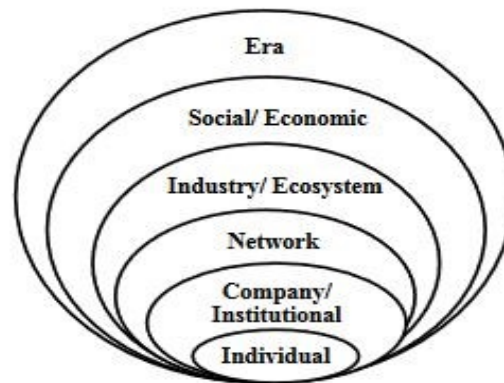
Figure 12: Digital transformation perspectives (Ismail, Khater and Zaki, 2017)

The **era** refers to how the new digital technology has influenced the world we live in, **social/economic** speaks to how the new digital concepts have influenced the economy to breed a more competitive economy, **industry/ecosystem** infers that industry boundaries are merging and how the digital concepts have changed the way organisations operate, **network** refers to the decentralisation of value creation and how customers can cocreate value with the organisations, **company/institutional** refers to how Industry 4.0 has impacted organisations and created the need to digitally transform, and the **individual** has been influenced through these concepts in how people communicate and interact with each other. The key concept and difference between digitalisation and digital transformation is thus the scope of its impact – where digitalisation is specifically focused on organisations, a digital transformation looks at the holistic impact of integrating these Industry 4.0 concepts into society. (Ismail, Khater and Zaki, 2017).

As this research is specifically aiming to answer the questions pertaining to how **organisations** would enact value-adding digital transformations, the perspective chosen for this research is **company/institutional**. Although it should be made clear that each perspective influences all of the others, the direct focus of this research is on the digital transformation of organisations.

Subsequently, a digital transformation of organisations is defined as follows: "*the process in which organisations integrate new digital technologies, skills, and processes into every relevant organisational dimension to build a digital business model (elaborated on in Section 3.7) with the ultimate objective of increasing their operational performance.*

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3.4.2 Transformation drivers

The Forrester Consulting group researched the key drivers of digital transformations, and they concluded that there are three key drivers of said transformations – customer satisfaction, profitability, and increased speed-to-market (Babar and Yu, 2015). The findings are supported through other literature and are referenced in the sections that follow. They defined digital transformation not as the adoption of technology for business operations, but rather as a "customer-driven transformation initiative" (Babar and Yu, 2015). The following sections will explore these transformation drivers, and what the effect of each is on organisations.

3.4.2.1 *Customer satisfaction*

As mentioned in Section 3.4.2, digital transformations aim to realign an organisation's focus to be on customer satisfaction (Babar and Yu, 2015). In a study conducted by Watermark consulting, it evaluated how well organisations who focus on customer experience do compared to the market – and according to their research, these organisations outperform the market considerably. The study looked at six years of stock market performance of organisations, and it concluded that organisations that focused on customer experience attained cumulative gains of 43%, compared to 14.5% for the S&P Index in the United States of America. Organisations who failed to put emphasis on the customer experience fell behind with cumulative returns of negative 33.9% (Accenture Interactive, 2013). Refer to Figure 13 for a visual representation of the data. From the data it is evident that focusing on the customer experience yields financial gains, and subsequently supports the notion that intentional focus should be put on customer satisfaction during digital transformations.
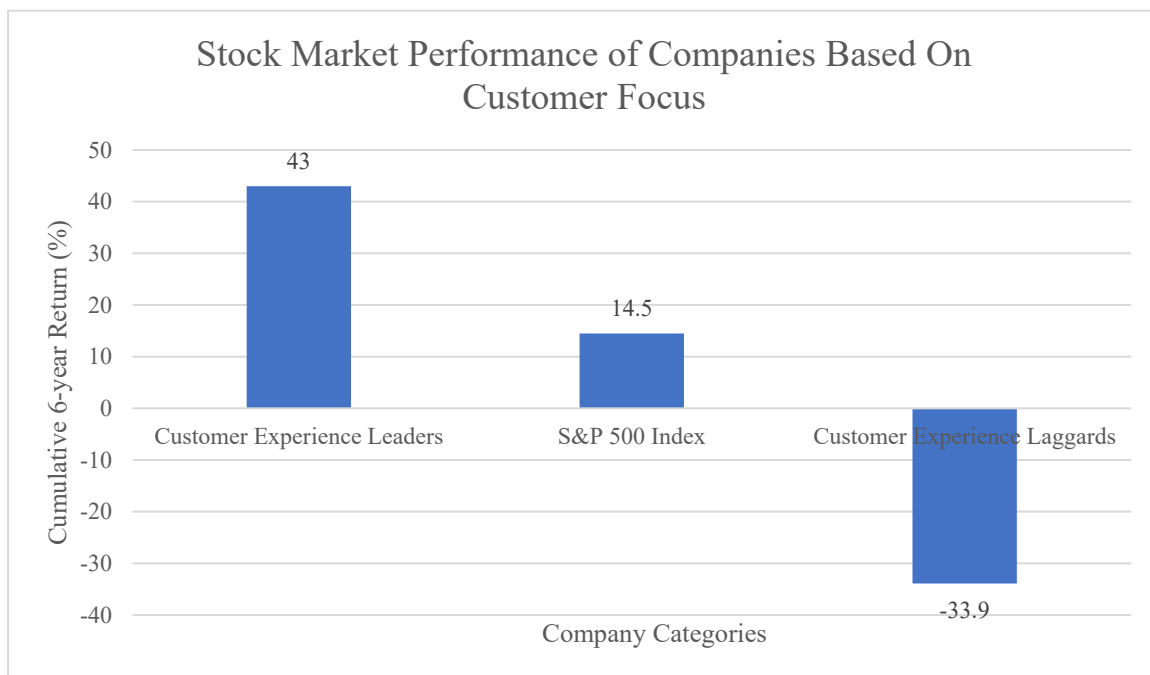
Figure 13: Stock market performance based on focus on customer experience (Accenture Interactive, 2013)

According to a study done by Altimeter Group on the state of digital transformation, 53% of organisations indicated that it is extremely challenging for them to understand customer behaviour (Solis, 2014). This presents organisations with a challenge – it is apparent that to digitally transform with the customer experience at the centre of operations yields great

rewards, as can be seen in Figure 13, but to understand the customer's behaviour is very challenging. It is thus difficult for organisations to align their customer-focused digital transformation strategy with the precise needs of the customer.

3.4.2.2   Speed-to-market

Industry 4.0 has enabled rapid growth of companies – Fortune 500 companies took on average around 20 years to reach a valuation of above $1 billion, whereas new digital start-ups are reaching the same valuation within four years (Snabe and Weinelt, 2016). The World Economic Forum concluded through a value-at-stake analysis that the combined societal and industrial value to be added by digital transformations is upwards of $100 trillion over the next ten years (Snabe and Weinelt, 2016).

The demands that society puts on organisations is increasing. The world's energy usage doubled over the three decades preceding 2012, and with an unsustainable energy supply, innovative solutions will have to be found. Earth's population took until 1804 to reach one billion people, whereas it took 12 years for the most recent billion people to be added. The world's population doubled over the last 50 years, with forecasts indicating that there will be 11 billion people at the start of the next century. The societal impact of the aforementioned statistics, along with the digital disruption elaborated on in section 3.3, and how technology has developed at exponential rates, organisations do not have the same amount of time to deliver products and services granted to organisations in previous years (Snabe and Weinelt, 2016).

Traditional models are not capable of achieving those needs, as new start-up companies, who are building their enterprises on digital technologies, are disrupting the traditional business models. Delivering products and services quickly in an age where customers want things immediately has become a competitive edge. The interconnectivity that has accompanied the digital age has allowed more organisations to create quality products and services, where the market leaders have mastered the delivery of these products to the market (Brozek, 2015).

3.4.2.3   Profitability

Increased profitability is at the core of digital transformation drivers – as organisations seek new avenues of income to increase the wealth they generate. MIT Sloan Management conducted research to exactly determine how profitability is impacted through the digital transformation process.

The study found that there are benefits in terms of profitability when organisations attempt a digital transformation, but these benefits depended on the level of digital maturity that the companies attained. It divided the researched organisations into four quadrants, based on two metrics – digital intensity, that increases in the y-direction, and transformation management intensity, that increases in the x-direction. (Westerman *et al.*, 2012).

The study then evaluated the performance of organisations based on three metrics – revenue, profitability, and market value, and explored how digital intensity and transformation management intensity influences it. It found that organisations that are mature in both metrics outperformed all the other organisations in each of the three metrics, and organisations which exhibit low maturity in both digital intensity and transformation management intensity

underperformed in all three metrics. Refer to Table 7 for the results of the study (Westerman *et al.*, 2012).

It has thus become important for organisations to digitally transform and increase their maturity in both digital intensity and transformation management intensity, or they run the risk of decreasing their revenue, profitability, and market value.

Table 7: Company performance based on digital maturity (Westerman et al., 2012)

Company performance based on digital maturity

	Revenue	Profitability	Market Value
Quadrant 1	+9%	+26%	+12%
Quadrant 2	+6%	-11%	-12%
Quadrant 3	-4%	-11%	-7%
Quadrant 4	-10%	+9%	+7%

3.4.3 Transformation objectives

When an organisation decides that the driving factors are strong enough to start with the digital transformation process, certain objectives need to be created to work towards. This will be incorporated in the overall digital transformation strategy, which will be discussed in Section 3.5. The MIT centre for digital business and Capgemeni Consulting conducted a study in 2011 on the digital transformation process, and their findings will be discussed in this section.

The study did research on 50 organisations in 15 countries, where they interviewed 157 executives from these organisations. All the organisations they looked at generate revenue of more than $1 billion annually, and the study qualitatively explored the digital transformation process in each of the organisations through extensive interviews and research. To ensure that the perspective of the organisations represented a fair view of the digital transformation process, approximately half of the interviewees were in the top management of the organisations (CEOs, CIOs, etc.), whilst the other half were from the IT departments. The study also looked at organisations from a wide variety of industries, where the split can be seen in Figure 14 below (Westerman *et al.*, 2011).

INDUSTRY

Pie chart titled "INDUSTRY" showing distribution across industries:
- Transport, 6%
- Retail & Food Services, 12%
- Energy, 12%
- Financial Services, 22%
- Government, 8%
- Manufacturing & Distribution, 12%
- Pharmaceuticals, 8%
- Telecom & Media, 20%
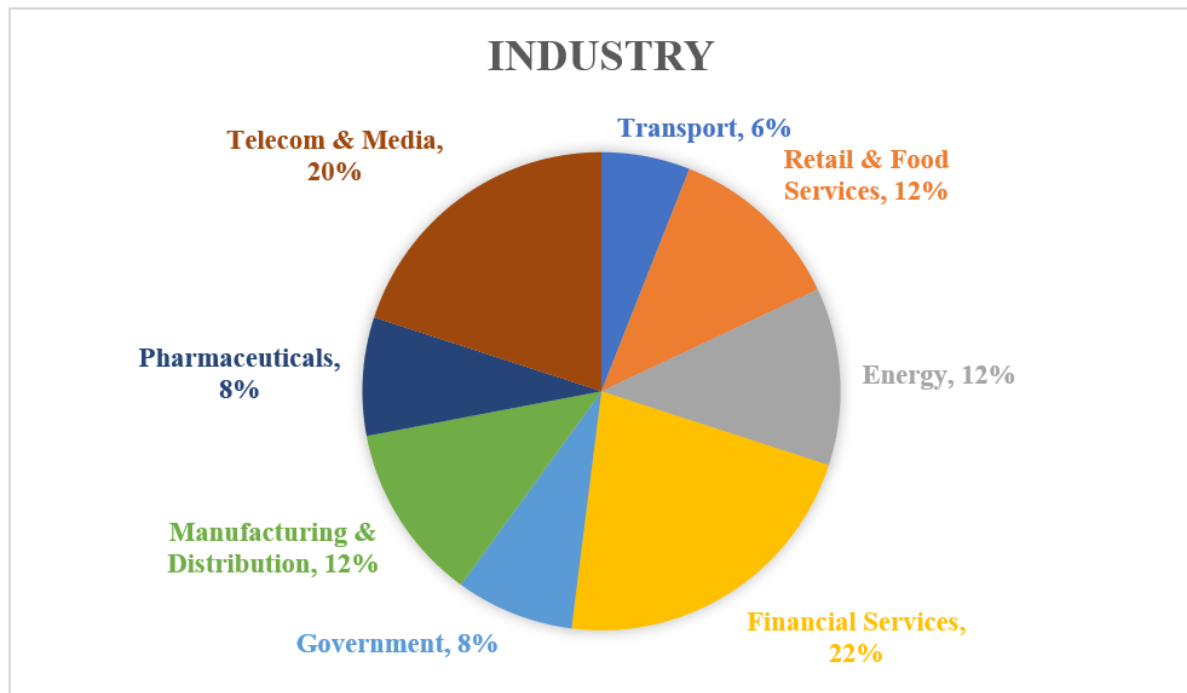
Through the interviews and research conducted on the different organisations, the study found that there were three key objectives of digital transformation – the improvement of the customer experience, which was discussed in Section 3.4.2.1, operational processes, and the business model (Westerman *et al.*, 2011). The latter two objectives will be explored in this section.

3.4.3.1   *Operational processes*

As described in Section 3.2.2, most of the technologies that will be used in Industry 4.0 are focused on achieving some level of automation with business processes. With the digitisation of data and processes, organisations can increase the quality, effectivity, and efficiency of their operations (Greiser, 2017). By tasking machines with completing repetitive tasks, the employees are empowered to focus more on strategic tasks – such as innovation and creativity (Westerman *et al.*, 2011).

The digitisation of processes, such as communication, has allowed employees to collaborate easily with people that would never have been reachable without the technology. The increased connectivity allows for more creative and innovative employees to work together, as well as increasing the diversity of teams working on problem-solving. This leads to a large increase in innovative solutions, as a BCG study in 2017 found. After surveying 1 681 executives, companies with below average diversity scores (the average diversity score was calculated using the Blau index – a statistical method of combining individual directories into an average score) reported to have 26% of their revenue generated through innovative streams, compared to 45% in companies with above average diversity scores (Lorenzo *et al.*, 2017).

By digitising operations in organisations, transparency drastically increases (Lee, Kao and Yang, 2014), which enables improved performance management from managers of projects (Bruskin *et al.*, 2017). Through the digitisation of analogue data, executives has more access

to relevant data, which allows them to make more informed decisions that will benefit the organisation in terms of wealth creation (Westerman *et al.*, 2011), (Greiser, 2017). Technology allows more people to be involved in strategic decision-making, as interconnectivity is increased using collaboration tools, which ultimately leads to more informed decisions being made. It increases the uptake of the decisions, as more people feel they were involved in their making (Westerman *et al.*, 2011).

The investment in technology has driven up productivity in various sectors, as was found by the World Economic Forum (Pricing, Sorenson and Weinelt, 2018). Figure 15 depicts the average productivity of organisations over a 10-year period – with the industry leaders seen as those who have prioritised investing in digital technologies to increase their productivity.
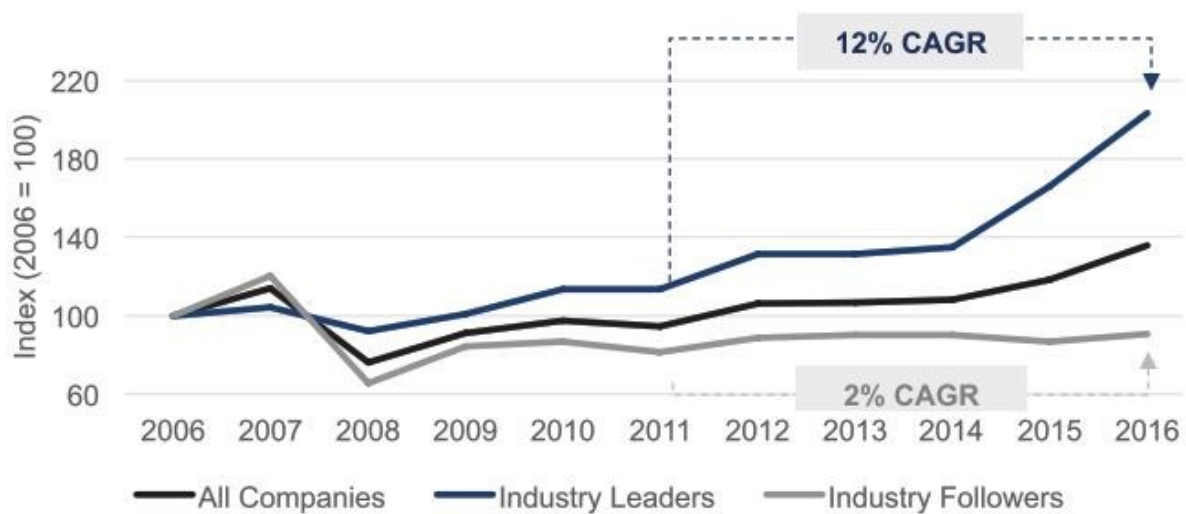
Note: CAGR = compound annual growth rate

Figure 15: Organisational productivity growth (Pricing, Sorenson and Weinelt, 2018)

The study found that return on investment on digital technologies to increase productivity is positive, where the productivity was found to be three times higher if the technologies were deployed in combinations. Industries vary – industries that rely heavily on assets realise more value from automation capabilities such as robotics, where organisations that does not generated more value from mobile & social investments. The key was to focus on efficiency-driven opportunities that are relevant to the industry (Pricing, Sorenson and Weinelt, 2018).

Although different industries generated varying degrees of productivity increases due to the investment in technology, on average the digital leaders in terms of investments achieved a 70% increase in productivity, compared to the 30% increase from digital followers. The investments in new technology to increase productivity are expected to increase by 13% yearly from 2016 to 2020 to $2.4 trillion per year (Pricing, Sorenson and Weinelt, 2018).

3.4.3.2 *Business model*
Through the process of a digital transformation, organisations are building new business models based on digital technology. These new digital business models are enabling

organisations to exceed the reach of their traditional models, which opens new avenues of potential customers, which could increase their potential revenue (Westerman *et al.*, 2011), (Loss and Crave, 2011). Digital business models are focused on being multifaceted, as organisations shift their focus from serving one need, to providing customers with an overall experience, through the integration of different products and services (Bollard *et al.*, 2017).

Business models are being built with cross-channel integration as an objective of the new model, using the digitisation of data and processes (Fairley, Kruger and Johnson, 2015). These models are focused on the customer experience, which aids the business in gaining new customers and retaining current customers. The creation of new business models not only speaks to the increased need of an improved customer experience, but also ensures business sustainability in ever-changing industries. Section 3.7 discusses digital business models in depth.

3.5   Digital transformation strategy

The section explores the principles that are prevalent in a successful digital transformation strategy and a discussion follows of how digital transformations lead to the creation of a new digital business model. This discussion is used as an introduction for the following section which looks at the composition of a digital organisation – which is one of the objectives of a digital transformation, as mentioned in Section 3.4.3.2.

3.5.1   Background and definitions

The term 'strategy' was adopted from the military by organisations and was implemented in a similar manner: it bridged the gap between policies and action plans. There is however little agreement regarding the exact meaning of strategy in the business world (Nickols, 2016). For this research, Michael Porter's definition is going to be used, due to his specific focus on its organisational application, and he refers to the purpose of a strategy as being the selection of specific activities that deliver a unique value mix. As the purpose of a digital transformation is to create a digital organisation that can create value in the digital economy, this definition was found to be appropriate. He goes further and defines strategy as "a combination of the ends (goals) for which the firm is striving and the means (policies) by which it is seeking to get there" (Porter, 1996).

MIT Sloan, in collaboration with Deloitte University Press, found that the ability to successfully execute a value-adding digital transformation is largely dependent on having a well-thought-out transformation strategy. They conducted a study on organisations currently in the process of digitally transforming and classified them according to a self-evaluation process on levels of digital maturity into three categories – early, developing, and mature. From the organisations in the study, 15% of organisations in the early phase, 49% in the developing phase-, and 81% in the mature phase indicated that they have a "clear and coherent digital strategy" (Kane *et al.*, 2015). Refer to Figure 16 for a visual representation of the data. It thus becomes evident based on the findings that in order to transform a business to become digitally mature, having a clear digital strategy is important, and thus it became relevant to research digital transformation strategies.

Strategies consist of various components, and the following sections seek to contextualise the various components and the role they play in the successful execution of a digital transformation strategy.
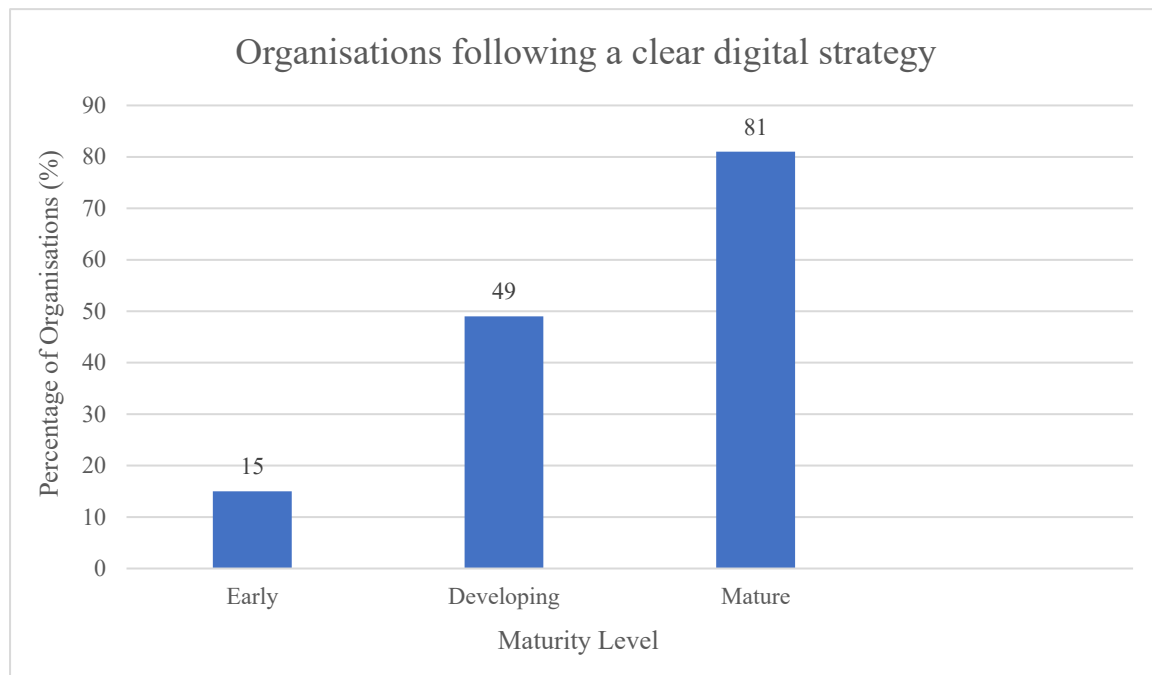
Figure 16:Percentage organisations following a clear digital strategy (Kane et al*., 2015)*

3.5.2 Strategy components

When organisations are looking at the creation of a new digital business strategy, there are five key strategy components organisations need to consider according to a report compiled by MIS Quarterly and Russel Reynolds & Associates respectively – strategy scope, strategy scale, strategy speed, sources of value creation in the strategy (Nsights, Sawy and Pavlou, 2013) , and relevant stakeholders (Russell Reynolds and Associates, 2017). This is used as a framework to create a digital transformation strategy, and each concept should be considered. This section will elaborate on these subjects.

3.5.2.1 Strategy scope

The creation of a digital transformation strategy stretches beyond the traditional functional processes within a business – marketing, IT, logistics, etc. As mentioned before, a digital transformation strategy needs to enact change throughout the organisation, thus encompassing all other functional processes within the organisation (Nsights, Sawy and Pavlou, 2013). The scope of the strategy must act as an overarching theme presenting a vision for all other functional processes to move towards, with the businesses digital resources facilitating the transformation (Matt, Hess and Benlian, 2015).

Determining the scope of a digital strategy is a complex task – as the adoption of digital initiatives within industries extends the boundaries of operation, ultimately leading to the creation of dynamic digital ecosystems. Business must consider the design of new digital products and services, and their interoperability with other internal services, and external

platforms, must be included in the digital transformation strategy (Nsights, Sawy and Pavlou, 2013).

As discussed in Section 3.3, digital disruption has caused big changes in various industries, and organisations need to be aware of the degree of change they need to undergo, and the pace at which they must transform. This is a key concept when establishing a strategy, as it determines the risks the business needs to take to remain relevant, sustainable, and profitable (Bughin *et al.*, 2018).

It should be noted here that organisations from different industries have different capability-driven focus areas to achieve the objectives set out in Section 3.4.3.

3.5.2.2 *Strategy scale*

When the scale of the strategy is determined, the strategy must look at what the demand of the digital infrastructure is to supply the business with a competitive edge (Nsights, Sawy and Pavlou, 2013). In the age of big data and analytics, having the digital infrastructure to analyse the data effectively and efficiently is important – as this contributes to the ability a business possesses to supply their customers with a satisfactory customer experience, and thus create value for the organisation (Greiser, 2017).

The scaling of digital capabilities also influences the scaling of physical infrastructure – as more data is stored on cloud services, there is a lesser need for large physical infrastructure. The strategy needs to evaluate what the impact of scaling digital capabilities is on the physical infrastructure, and how the physical infrastructure needs to be scaled in order for the business to be successful (Nsights, Sawy and Pavlou, 2013).

The increase in digital initiatives has largely contributed to the creation of dynamic digital ecosystems, as organisations make more use of each other's resources to be more productive. The strategy must look at how the business is going to increase its interoperability, to allow for the collaboration with other organisations (Crowley *et al.*, 2017). The scale of the digital strategy will evaluate how the business can rely on other organisations to achieve its desired scale, where it does not see a competitive edge in industry (Nsights, Sawy and Pavlou, 2013).

3.5.2.3 *Strategy speed*

As described in Section 3.4.2.2, speed-to-market is a strong driver of digital transformation and is therefore a component that needs to be addressed in the creation of the strategy. The speed of the strategy is dependent on the business it caters to, but there are certain key aspects that it needs to address.

The speed-to-market is largely dependent on the supply chains of the business. The strategy needs to incorporate digital initiatives that will increase the speed of the supply chain, through the collaboration of different organisations to create a quality customer experience (Nsights, Sawy and Pavlou, 2013). As the speed of the supply chain is then dependent on the collaboration of different networks (Bondar *et al.*, 2017), the strategy also needs to incorporate the speed at which these business networks are formed (Nsights, Sawy and Pavlou, 2013).

The capabilities that digital initiatives add is not exclusive to the products and services it delivers – the use of digital initiatives within the business increases effectiveness and efficiency

of functional processes inside the business, and the access to vast amounts of data leads to the ability to make informed decisions (Bughin *et al.*, 2018) and to react to customer concerns much quicker than before (Nsights, Sawy and Pavlou, 2013).

3.5.2.4   *Strategy value creation*

A key concept of the creation of the strategy is determining where the value is going to be created with the transformation, and how the business needs to digitally transform to create this value in the most effective way possible. With the use of digital initiatives, organisations have access to more data, the capabilities of the business are increased, and the network that the business falls in is extended (Earley, 2014), (Pagani, 2017).

Useable data can increase the customer experience and increase functional process effectiveness and efficiency, and business can start leveraging value from the information they have. This information can be media, advertising, healthcare, energy, etc., and the strategy must evaluate how the business is going to use the data it has to create value (Nsights, Sawy and Pavlou, 2013), (Oracle Corporation, 2013).

As business networks increase, the business must evaluate how multidimensional it must be to create the most value. This entails analysing the networks wherein the business finds itself, and how the business should use the multifaceted nature of Industry 4.0 to create value in different areas compared to the traditional model – for example Google entered the mobile phone industry where they gave their users the Android operating system at no cost, whereas Google leveraged value through the advertisements that they control (Nsights, Sawy and Pavlou, 2013).

3.5.2.5   *Strategy stakeholders*

The role of the people through the process must be clearly defined. Although a survey by Russel Reynolds & Associates shows that CEOs are the biggest drivers of digital transformation, it requires a collaborative effort between the heads of marketing, digital, IT, strategy, technology, amongst others. As the new digital business model facilitates the increased collaboration between internal processes and external partners, all departments in the business are stakeholders in the creation of the strategy, and the strategy should incorporate and define all their roles in the transformation process (Russell Reynolds and Associtates, 2017).

Capgemini Consulting argues that successful digital transformation is largely dependent on leadership at the top who make digital transformation a priority, and a successful transformation is driven from the top down. Leaders determine the ambition for the business, as they translate the broad strategic vision into ambitions and objectives (Westerman *et al.*, 2011).

3.5.3   **Successful strategy principles**

Although strategies differ for organisations, the key principles prevalent in most successful strategies are similar. These principles will be discussed in this section. Each of the principles identified in this section builds on the previous principle, as it is aimed at defining the roadmap for the digital transformation process. Where Section 3.5.2 considered the outline of a digital transformation strategy, the following sections speak to the principles that should be considered within the outline mentioned in Section 3.5.2.

3.5.3.1 *Vision and leadership*

It becomes the responsibility of the leaders to create a broad strategic outline of where the organisation is headed, and they must account for continuous changes. It is argued that a successful digital transformation is largely the responsibility of the top leadership in the organisation who make digital transformation a priority, and a successful transformation is driven from the top down (Khan, 2016). Leaders determine the ambition for the business, as they translate the broad strategic vision into ambitions and objectives (Westerman *et al.*, 2011).

With digital transformations, the vision and objectives must account for corrections to be made along the way – as transformation is an iterative process and it is impossible to predict exactly where the business must go from the start (Danoesastro, Freeland and Reichert, 2017).

Specific goals need to be set to ensure the continuous migration to a business model where technology and operations work together, and the vision needs to address the need to develop a new mindset and approach to technology – not to use technology to solve problems, but to incorporate technology into the culture of the business (Danoesastro, Freeland and Reichert, 2017).

Digital transformations require the intentional transformation of existing structures and resources to be successful. Executive teams need to ensure that digital transformation is a priority in the business, and as a successful transformation needs resources, it is their responsibility to allocate these resources to the transformation process. They need to commit to the transformation process, otherwise the organisation will have to settle for a dilution of value after the transformation process – a scenario true for 75% of companies attempting a digital transformation according to a study done by Bain Consulting (Baculard *et al.*, 2017).

3.5.3.2 *Experience design*

As described in Sections 3.4.2 and 3.4.3, customer satisfaction and the customer experience are strong transformation-drivers and objectives. It is therefore important to consider this for the strategy for a digital transformation – the business must look at the design of its customer experience, not the logistics of the requirements of the solution (Infor, 2016). The focus is the end user experience, and the design of products and services must be aligned to support the objective or prioritising the customer experience (Sangolt, 2016). Offering an improved customer experience serves as the competitive advantage for the organisation (Earley, 2014).

3.5.3.3 *Objective creation*

Rob Lopez, the group executive of marketing at Dimension Data, argues that each successful strategy needs to identify what transformation avenues will deliver medium- to short-term returns, as the business needs to continue generating revenue as the transformation process is in motion. If every objective is aimed at long-term gains, the business could declare bankruptcy before it reaches these goals ('Drop " plan B ": how companies survive digital transformation', 2018).

The strategy must speak to the ultimate goal of the organisation, which is the long-term objective, but also how the business plans to sustain itself through the transformation process, which is the short- to medium-term objectives (Accenture Interactive, 2013).

3.5.3.4   Digital initiative identification

Leaders must have the ability to sift through a multitude of digital initiatives to identify which initiatives will aid the business in creating value, and must therefore have a clear view of what the vision of the business is – to ensure the digital initiatives are aligned with the strategic vision of the business (Danoesastro, Freeland and Reichert, 2017). Section 3.2.2 describes the different technology components of Industry 4.0, and for organisations to be successful, they need to establish which of these technologies will add value to the organisation, should it be incorporated.

3.5.3.5   Operations and technology integration

As the access to technology increases, the competitive edge will not lie with the technology anymore, but rather how digital initiatives are being integrated with operations management (Bollard, 2016). People, through the implementation of digital initiatives, are not bound by repetitive tasks as they were in traditional business models. The role of operations management is constantly changing as technology becomes more integrated within organisations, and the skills people require to remain relevant as well. The integration between technology and operations management requires excellent managerial skills, as new skills must be taught to employees – skills regarding the use of technology to do tasks more productively (Bollard, 2016).

The integration between technology and people is important throughout the entire business, as it influences every process. A successful digital strategy must identify how to use the strengths of technology along with the strengths of people to apply each where it can lead to the most productive process (Bollard, 2016). This identification process must be done enterprise-wide and incorporated in every process in the business. This enterprise-wide integration will lead to the creation of a digital culture, and a new digital business model.

3.5.3.6   Data-driven digital business model

A key objective of any successful digital transformation is the digitisation of data and processes, a strong focus on gathering data to further improve the customer experience, and the effectiveness and efficiency of the business processes. Gathering new data enables organisations to explore new service offerings and creates new avenues of potential revenue (Berman, 2012), (Pflaum and Gölzer, 2018). Organisations must therefore establish in their strategy how they aim to create, develop, or adapt current products or services, to create a customer experience that the customer desires, and that provides the business with useful data that will improve the customer experience (Berman, 2012), and that is aligned with achieving what the strategic vision for the business is (Pflaum and Gölzer, 2018).

Organisations who are leaders in the field of data-driven digital business models have a data-driven culture, where their executives can make decisions based on instant, real-time data, which leads to informed and accurate decisions (Ericsson, 2015).

3.6   **Digital transformation approach**

Digital transformations are a new concept, and the process of enacting a digital transformation is not an exact science. As can be seen from literature, organisations struggle to enact value-adding digital transformations (Baculard *et al.*, 2017), and different organisations take different

approaches to the process. This section builds on the previous sections, and looks at how digital innovations, mentioned in Section 3.3.4, can be used to enact a value-adding digital transformation.

3.6.1 Background

Disruptive Industry 4.0 concepts can be integrated into the organisation to mitigate the effect disruption has on incumbent organisations in terms of taking their market share and can be used to create value for organisations. The previous section found that the disruption experienced within industries plays a key role in the digital transformation strategy that organisations must adopt to successfully transform (Hirt and Willmott, 2014).

Due to the focus on value creation and the activities that give effect to the value creation in Michael Porter's definition for strategy (Section 3.5.1), the various components of successful strategies were used to conceptualise a digital transformation approach.

The successful strategy components were elaborated on in Section 3.5.3 and indicated that organisations must, among other things, focus on short- and long-term investments to ensure profitability during and after the transformation process. Organisations must remain profitable whilst undergoing a digital transformation, and they must balance the integration of new concepts, which are often not yet profitable, with their existing business models to achieve financial stability throughout the process (Hess *et al.*, 2016).

This, along with the findings of the previous section that innovation is key to the successful mitigation of disruption and sustainable success of organisations, led to the conceptualisation of a transformation process through the launching of digital initiatives. This method is contextualised in the following section and was validated through semi-structured interviews with subject matter experts.

3.6.2 Digital initiative implementation

This method entails transforming your business through launching digital initiatives, defined in the concept glossary – which are disruptive innovations built on Industry 4.0 concepts that run in parallel with the current organisation and could systematically consume the business of the legacy part of the organisation. Disruptive technologies and business models often have lower profit margins than incumbent business models, and they must serve the needs of a unique set of customers, referred to as 'niche markets' in Figure 9. The new disruptive business model, or digital initiative, does not satisfy the performance demands of the market yet, and hence these digital initiatives are often ran separately and independently from the parent organisations to ensure the profitability of the organisation through existing revenue streams (Bower and Christensen, 2003).

Skog, Wimelius & Sandberg (2018) found that various authors define digital innovations as the creation of new market offerings and business models through the use of technology, which in this research was interpreted as Industry 4.0 technologies, elaborated on in Section 3.2.2. They also found that digital innovations are the driving force behind digital transformations, and thus further validated the use of this approach to enact value-adding digital transformations.

Based on these findings, the definition of innovations proposed by du Preez *et al.*, (2015) in Section 3.3.4 was further developed to specifically look at digital innovations, and the definition of digital innovations proposed by Skog *et al.* (2018) is "*the process of combining digital and physical components to create novel devices, services or business models, bundling them to constitute and enable market offerings, and embedding them in wider sociotechnical environments to enable their diffusion, operation and use*". Based on the contextualisation of disruption in Section 3.3, the novel nature of these digital innovations, and the effect it has on existing business models, these digital initiatives were further classified as being disruptive digital innovations.

Disruptive innovations are defined as the specific type of innovation in which a process takes place where incumbents are disrupted by new entrants – start-ups or established organisations crossing industry boundaries. Furthermore, disruptive innovations are categorised as either being disruptive technologies, or disruptive business models (Cozzolino, Verona and Rothaermel, 2018). Disruptive technologies are defined as technologies that introduce new performance parameters that disrupt an established trajectory of performance, or redefine what performance means (Christensen and Bower, 1995). Disruptive business models are defined as a new business model that disrupts established models or redefines what value creation and capture means. Disruptive business models are likely to use the disruptive technologies to give effect to their disruption, and in turn disruptive technologies are likely to stimulate the development of new disruptive business models (Cozzolino, Verona and Rothaermel, 2018). The use of disruptive innovations within an Industry 4.0, or digital context is subsequently defined as *disruptive digital innovations*.

Within the context of this research and the definitions of disruption and digital innovations, this author proposes the following definition [1]of digital initiatives:

> *Digital initiatives are independent, digital business innovations, disruptive and sustaining, that create new or improved value-offerings to customers launched by, but can function separately from, a parent organisation(s), with the objective of being integrated into the parent organisation(s) over a time period.*

This concept of digital initiatives became the focus of the research, as the research looks to assist organisations in enacting a value-adding digital transformation through helping them implement value-adding digital innovations, or digital initiatives, and ultimately transform their business model into a digital business model.

It should be noted that the implementation of digital initiatives is a component of a digital transformation, and not the entire process. The overarching objective of a digital transformation remains the re-imaging of the entire business model to become digital and focus on operational effectivity and efficiency (Greiser, 2017) and being customer-centric (Loss and Crave, 2011; Westerman *et al.*, 2011; Schwab, 2016). This method adopts an incremental approach, to (i) decrease the risk of the transformation, (ii) spread out the financial risks and burden over a

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[1] This definition can also be found in the concept glossary.

longer period, and (iii) mitigate various transformation challenges that will be discussed in Chapter 4.

The following section will contextualise a digital business model, to assist in the understanding of what a digital organisation looks like. The digital initiatives that are being implemented in the organisation should thus share the characteristics that will be discussed in the following section, and ultimately assist the organisation in attaining these characteristics enterprise-wide.

3.7   Digital business model

Through the digital transformation process, a business strives to change its operating model to a digital model. A digital business model is the holistic objective of a business going through a digital transformation process, as it is aimed at ensuring the sustainability of the business within the digital economy. Section 3.3 elaborated on the disruptive effect that Industry 4.0 has had on industries, and Section 3.6 built on that to contextualise an approach of how to implement digital initiatives to ultimately assist organisations in their digital transformation journey.

This section will describe what the role of a business model is, what characteristics are prevalent in a digital business model, what an agile business model is, and what dimensions a digital business model consists of in the context of this research.

3.7.1   Background

As described by Chesbrough and Rosenbloom (2002), the objectives of a business model are to: (i) identify the market segment the business wishes to address, (ii) articulate the value the business will create in this market segment, (iii) define the structure of the value chain that will deliver the value, (iv) estimate the involved costs and potential revenue from delivering the value, (v) define the position of the business in the value network linking suppliers with customers, and finally (vi) formulate the competitive strategy of how the business will gain the competitive edge over its competition. In holistic terms, the business model is the link between the technical inputs, such as feasibility and performance, to economic outputs, such as value, price, and profits (Chesbrough and Rosenbloom, 2002).

This indicates that a business model must look wider than the internal processes of the business – it must speak to how the business will interact with potential partners, customer requirements and revenue shares, amongst other elements (Chesbrough and Rosenbloom, 2002). Loss and Crave (2009) argue that although a lot of effort has been put into defining business models, the nature of the new economic landscape has found traditional business models to be lacking, especially considering the dynamic nature of industries caused by globalisation. This has brought about the opportunity to create new business models that consider the changing nature of the world, to keep organisations relevant, and to ensure organisational sustainability. One such business model is the agile business model, which is based on the principle of the collaboration between different stakeholders, enabled especially through the use of technological initiatives (Loss and Crave, 2011).

3.7.2 Digital business model characteristics

Karl Täuscher conducted a study on digital marketing places for the Fraunhofer Centre for International Management and Knowledge Economy, and through the research he concluded that there were certain characteristics of a digital business model that differentiate it from other business models. These characteristics are prevalent in organisations who have undergone a digital transformation, or a business that was initiated as a digital business. These characteristics are discussed in the following sections.

Inter-connectivity between actors – Organisations are using digital initiatives to break the traditional boundaries of business models through the increase in connectivity between the business and all the relevant stakeholders, such as customers and collaborating partners (Täuscher, 2016). By using resources outside the boundaries of the business, organisations are becoming more cost- and time-efficient, allowing them to focus more on key strategic aspects of their customer-focused business model (Bollard *et al.*, 2017). Tasks which are outsourced are often tasks that do not directly contribute to the customer experience that the business is providing, and which require hours of manual labour (Bollard *et al.*, 2017).

Lack of geographical limitations – Digital markets are without geographical boundaries by design, as digital initiatives enable organisations to reach, communicate, and collaborate with customers and other organisations on a global scale (Täuscher, 2016).

Customer mobility – Customers can switch product or service providers without any constraints at a low cost, and are empowered to make informed decisions when selecting a product or service providers as information is freely available online (Täuscher, 2016). The digitisation of business operations allows the potential for self-service, saving the customers time and money, and contributing to a better customer experience (Bollard *et al.*, 2017).

Transparent customer behaviour – Through the implementation of digital initiatives, a vast amount of data on customer behaviour is available to organisations. Increased customer interaction, big data and strong analytics capabilities has led to organisations having large amounts of accurate information on customers, leading to organisations having the ability to satisfy the needs of its customers more accurately (Täuscher, 2016). Having access to sophisticated data analysis tools in a business can contribute greatly to discovering new insights into customer behaviour, empowering the business to make decisions that will ultimately contribute to a better customer experience (Bollard *et al.*, 2017).

Transparent business behaviour – In the same way that organisations have more access to their customers' data, so too do customers have more information on the organisations themselves. Customers can share experiences from certain organisations, empowering them to have an accurate idea of what to expect when doing business with a specific firm (Täuscher, 2016).

Low operational costs – Digital business models utilise digital infrastructure as far as possible, and the lack of the same level of physical infrastructure as traditional models enables these business models to lower their operational costs. Transaction costs, price-changing costs, etc., are all lower with digital business models (Täuscher, 2016).

Various digital business models adhere to these characteristics; however, different sectors of the economy host different types of digital business models. E-commerce organisations such as Amazon.com are very different in terms of business strategy to a peer-to-peer service, like Uber. Both organisations are, however, classified as agile businesses – businesses focused on continuously delivering value through the collaboration of all relevant stakeholders (McDonald, 2011).

3.7.3   Agile business model

Where Section 3.7.2 elaborated on the characteristics of a digital business model and what a digital business model looks like, agile business models describe how these characteristics can be applied to create value for the organisation and their customers. An agile business model is defined as a business model that ensures the continuous, incremental delivery of value to the customer through the collaboration between all relevant stakeholders (McDonald, 2011). Loss and Crave (2011) compared agile business models to traditional business models and identified key differences in terms of focus areas. Refer to Table 8 for a description of these differences in focus areas.

Table 8: Current business model vs Agile business model focus areas(Loss and Crave, 2011)

Current Business Models	Agile Business Models
Static	Dynamic
Profit	Profit & sustainability
Linear value chain	Value network & digital ecosystems
Value analysis & creation	Value creation & capture
Product or service	Customer experience (service on top of the products)
Customer interfaces	Customer empowerment

An agile business model is focused on enabling organisations to react quickly and effectively to the often unpredictable changes in the market, through the digital transformation of its operational structure, to ensure an improvement in the customer experience it delivers (Cruickshank, 2017). It speaks to the key drivers of digital transformations discussed in Section 3.4.2, as it is focused on: (i) delivering a customer experience rather than a product or service, (ii) increasing the speed at which these experiences can be taken to the market, and (iii) ensuring the sustainability of the business through the increase in revenue.

Santiago Comella-Dorda & Swati Lohiya (2016) argue in a report compiled by McKinsey & Company that to transform a business to adopt an agile business model, the operating models and organisational structures of the business will have to be altered. They identified a few key aspects of organisations that will need to transform to deploy agile development at scale: (i) organisational structure, (ii) interactions between business and IT, and (iii) team roles and responsibilities.

In a study conducted by McKinsey & Company, they interviewed 1 900 executives in 2015, where 82% of them indicated that they have rethought their business strategy in the past three years, with only 23% indicating a successful implementation. Organisations must redesign their business process in order to become more agile, as research shows that agile organisations

have a 70% chance of being in the top quartile of the organisational health industry – the industry that is considered to be the best indicator of long-term performance (Aghina *et al.*, 2017).

Organisational structure – The organisational structure of the organisations needs to change from a place where resources are allocated to specific applications and projects to where resources needs to be organised around products, creating end-to-end teams that will deliver a designated customer experience (Santiago Comella-Dorda, Swati Lohiya, 2016). This transformation is necessary as organisations move away from delivering single products or services, but rather integrated offerings aimed at producing a satisfactory customer experience. The agile teams are formed around the development of products, and will be responsible for every aspect of the product – design, production, delivery, and maintenance, but can call in support from external experts with issues they might have with the product development process (Santiago Comella-Dorda, Swati Lohiya, 2016).

Business & IT interaction – To create an agile business environment, organisations must rid their operational structures of silos, defined by Business Dictionary as "A mind-set present in some companies when certain departments or sectors do not wish to share information with others in the same company" (*Silo Mentality - Business Dictionary*, 2016). Silos between the IT department and the rest of the business have a negative impact on the productivity of the business – but this challenge can be overcome by the creation of agile teams that consist of employees from both the IT department and the rest of the business (Santiago Comella-Dorda, Swati Lohiya, 2016). The collaboration between the departments will increase communication efficiency, and decisions can be made more quickly and more consistently whilst maintaining coordination throughout the groups involved with product development (Santiago Comella-Dorda, Swati Lohiya, 2016).

Team roles & responsibilities – As agile teams are key to the operation of an agile business model; the role of managers and team members has changed drastically. In traditional business models the managers need to coordinate various teams from different departments to complete their specific tasks without them having the holistic view of how their contribution is influencing the final product. This often leads to tasks not getting done on time, and greatly decreasing the productivity of the business. With agile teams, this cross-departmental coordination of tasks is minimised, as teams take ownership of the entire development of the product or service (Santiago Comella-Dorda, Swati Lohiya, 2016).

The following section will elaborate on the various digital dimensions that are found in digital organisations, with key digital capabilities within each digital dimension.

3.8   Digital initiative dimensions

The four key impacts of the fourth industrial revolution on organisations are, according to Klaus Schwab, that: (i) customer expectations are shifting, (ii) asset productivity is increased with technology, (iii) collaborative innovation between companies is increasing, and (iv) operating models are being transformed into digital models. He further argues that "[…] Customers, whether as individuals or organisations, are increasingly at the centre of the digital economy, which is all about how they are served" (Schwab, 2016).

Based on the various characteristics mentioned earlier in this chapter regarding agile business models, focus was put on identifying measurable building blocks of an organisation that is relevant to the implementation of a digital initiative. These dimensions will form the basis of the conceptualisation of a digital initiative, as the various capability levels of each digital capability will be used as a guide to design the digital initiative. Each digital dimension consists of various digital capabilities[2] of which the maturity[2] can be measured.

The dimensions have been validated through literature and interviews with experts on Industry 4.0 from various industries. It should be noted that the author is not claiming that these digital dimensions and the accompanying dimensions are exclusively the only relevant digital dimensions and capabilities to digital initiatives – they are a set list that was found to be relevant through literature and semi-structured interviews with subject matter experts.

Due to the interconnectivity of these dimensions, the dimensions were categorised according to the role that each play in the implementation of the digital initiative. These categories are: (i) guiding dimensions, (ii) enabling dimensions, and (iii) objective dimensions. Their co-dependency manifests in how the guiding dimensions set the objectives for the enabling dimensions to work together to increase the effectiveness and efficiency of the operations, and to produce a desirable customer experience. The categories and their digital dimensions can be seen in Figure 17, and is discussed below.
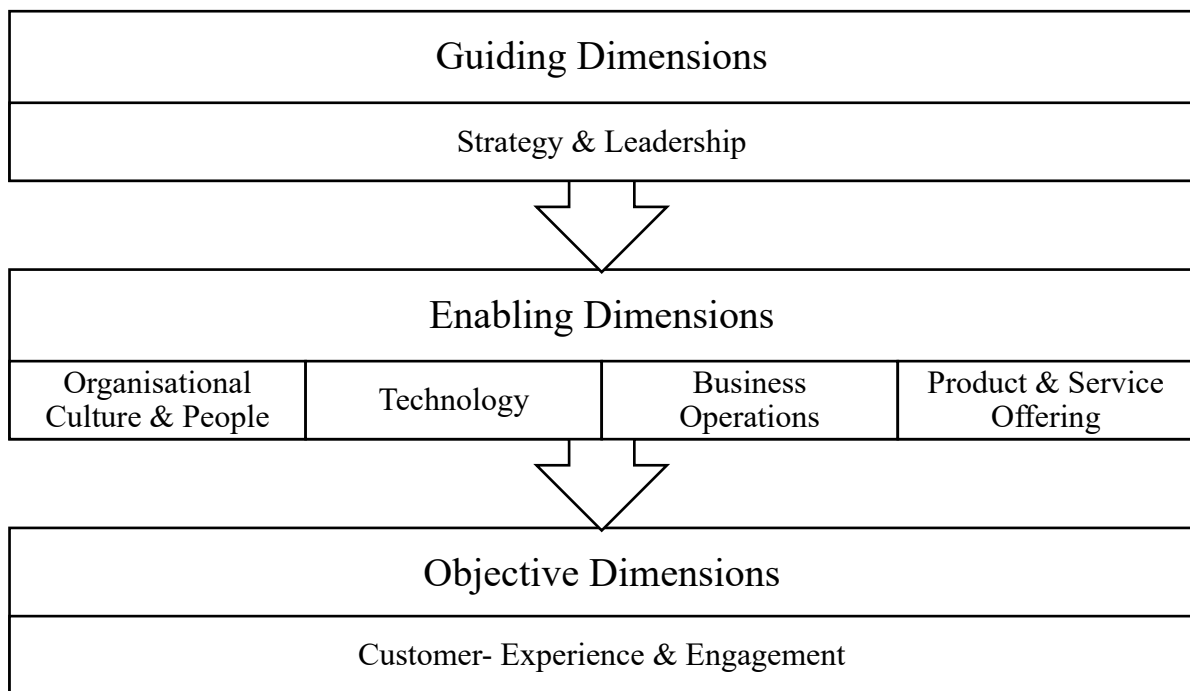
Figure 17: Digital dimensions

The guiding dimension (i) includes *strategy and leadership*, and the focus is to indicate how the various strategy and leadership digital capabilities must function to give effect to the successful implementation of the digital initiative from within a parent organisation, to achieve

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[2] Defined in the concept glossary.

the two overarching objectives of a digital transformation of: (i) increasing the operational effectivity and efficiency, and (ii) offering an enhanced customer experience.

The enabling dimensions (ii) are focused on the organisational business model of the initiative, and include *business operations, product & service offering, technology, and people and organisational culture*. Through these dimensions the initiative will give effect to the digital transformation strategy presented in the guiding dimension, and achieve the first overarching objective of a digital transformation in increasing the operational effectivity and efficiency of the organisation through the initiative.

The objective dimension (iii) includes *customer experience and engagement*. As mentioned earlier in this section in a quotation from Klaus Schwab, digital organisations revolve around the customer and their needs (Schwab, 2016). Thus, the objective dimension is a measure of how customer-centric the organisation is and addresses the second overarching objective of a digital transformation of improving the customer experience offering.

The digital dimensions are discussed in the following sections. A non-exhaustive list of digital capabilities was identified within each digital dimension, and can be found in Addendum A1 – Capability statements.

3.8.1 Strategy and leadership

For an organisation to transform digitally, they need a strategy that guides them in this process. The relevance of having a coherent digital strategy was found in a study conducted by Kane *et al.*, (2015). From the organisations in the study, 15% of organisations in the early phase, 49% in the developing phase, and 81% in the mature phase indicated that they have a "clear and coherent digital strategy".

The strategy lays the foundation of what the digital transformation will entail, and how the organisation is going to go about developing the new digital business initiative(s) (Martino, Schaffner and Quach, 2016). The strategy will define how each of the following dimensions will need to look to successfully create value for the organisation – and focus should be put into ensuring that the strategy addresses the relevant areas within the organisation.

The executives of the organisation determine the strategy for the organisation – it is also their responsibility to invest resources in the transformation plan and driving the initiative from the top down. The leadership in the organisation is thus of significance to the success of the digital transformation – as successful leaders drive the culture within organisations (Danoesastro, Freeland and Reichert, 2017). Leaders should focus on enabling an agile, digital culture that will implement the changes proposed in the strategy and embrace change as the market requires it of them (Tanguy Catlin and Tobias Lorenz, Bob Sternfels, 2017).

In order to successfully execute a digital transformation, the organisation has to appoint individuals who will take responsibility for the implementation of the digital initiative. Organisations often acquire an executive in the form of a Chief Digital Officer (CDO) (Hansen and Sia, 2015). Organisations who do not have the executive support for their digital transformations will struggle to execute a value-adding digital transformation (Tanguy Catlin and Tobias Lorenz, Bob Sternfels, 2017).

3.8.2 **Organisational culture and people**

Organisational culture

As mentioned in the previous section, leaders should focus on enabling an agile, digital culture that embraces the changes proposed in the strategy. The successful implementation of the strategy is dependent on the people and culture within the organisation and is thus seen as a dimension that enables the digital transformation.

The definition of culture used in this research is that of Edgar Schein, as his research forms the basis of many recent studies regarding organisational culture. He states that culture is "[…] *a set of basic tacit assumptions about how the world is and ought to be that a group of people share and that determines their perceptions, thoughts, feelings, and, to some degree, their overt behaviour*" (Schein, 1990). This manifests within organisations and is defined as organisational culture – a shared belief system that influences the actions of the organisation's employees (Strode, Huff and Tretiakov, 2009). With the focus on customers in a digital organisation, the culture must be a people-centric culture where the customer is put first. Having a digital culture is important in the implementation of an agile business model, and Strode, Huff & Tretiakov, (2009) identified various cultural factors that correlate significantly with an agile business model:

1. The organisation values learning and feedback – and the management style is that of leadership and collaboration. Social interaction within the organisation is trustful, competent, and collaborative.
2. The organisation values teamwork and is flexible, participative, and encourages social interaction through collaborative teamwork.
3. The organisation enables its employees through empowerment.
4. The organisation is focused on results.
5. The leadership in the organisation can be defined as entrepreneurial, innovative, and risk taking.
6. The organisational culture is based on loyalty, mutual trust, and commitment.

The organisational culture must also embrace the use of new technologies to improve operations within the organisation – the positive effect of using new technology can be negated by the reluctance of employees to use the technology (Strode, Huff and Tretiakov, 2009).

People

Through a digital transformation the roles and responsibilities of employees change. Organisations must be aware of what skills they need to effectively execute their vision, and they must actively look to attract the people with the relevant skills to their organisation. Access to the relevant skills is one of the biggest adoption barriers to a digital transformation, as the demand for talent is much greater than the supply (Esber *et al.*, 2015; Khitskov *et al.*, 2017).

The new roles of employees must be clearly defined in the strategy and effectively communicated to all the relevant parties to minimise employee resistance as a result of the transformation and equipping the employees for the new roles should be a priority for the organisation (Gerth and Peppard, 2016).

Organisations need to ensure that there is a good relationship between their top management and the rest of the organisation, as a lack of a relationship between the different tiers of the organisation leads to uncertainty regarding the differing roles within the digital transformation process. It is the responsibility of top management to effectively communicate the different expectations of their employees, and the lack of the aforementioned can lead to employee resistance to the transformation (Gerth and Peppard, 2016; Hafsi and Assar, 2016).

As mentioned in the previous section, organisations often appoint executives with the responsibility of heading the digital transformation – a study conducted by CA Technologies found that up to 80% percent of organisations undergoing digital transformations have an executive whose responsibility is the digital transformation ('The Chief Digital Officer's Guide to Digital Transformation.', 2015). The role of the responsible executive and their digital team has to be clearly defined, as a clear definition of the role(s) increases the chance of the executive achieving success (Gerth and Peppard, 2016).

3.8.3   Technology

Industry 4.0 came about through the development of new technology, and the organisation's ability to integrate the technology into their operations determines to what extent they will be able to partake in the digital economy.

The IT infrastructure represents a key technical component of a digital transformation, as big data will become relevant as organisations pursue digitisation, and leveraging value from the big data will be dependent on whether the IT infrastructure can store and process large volumes of data (Dietel, 2018). Big data is used to increase the effectiveness and efficiency of organisational processes, aimed at improving the customer experience.

As organisations increase their big data capabilities, they will need to invest in cybersecurity, as they must avoid being disrupted by cyberattacks. It is estimated that the annual cost of cyberattacks worldwide amounts to $500 billion (Schwab, 2016: p72). Merrill Lynch Wealth Management, a division of Bank of America, estimates that the cybersecurity market will grow from $75 billion in 2015, to $170 billion in 2020 (Turner, 2015).

The new technologies, such as cloud computing, IoT, artificial intelligence, etc, that came with Industry 4.0 must be integrated into the organisation for them to leverage value from using it (Schwab, 2016) – thus the organisation's IT-architecture must allow for interoperability, as this will influence the ease of integration of new technology and systems. Using these technologies will empower organisations to do business in a digital economy (Earley, 2014). Internally, the interoperability of the IT infrastructure allows for seamless collaboration between different departments through connectivity of devices and systems.

3.8.4   Business Operations

A business model is defined as the processes through which organisations capture, generate, and deliver value to the customer within various contexts and forms (Osterwalder and Pigneur, 2010). Implementing new digital initiatives thus requires of an organisation to build a new digital business model to effectively do business in a digital market.

Manual processes must be minimised in organisations using technology, as automated processes are more predictable, effective, and efficient. Due regard should be given to the employees who might lose parts of their job – as a study in 2016 done by McKinsey & Co found that few jobs will be eliminated entirely – however, automation will affect parts of every job. It concluded that current technologies could automate 45% of activities that people are remunerated for, and that about 60% of all jobs could see 30% of their activities automated (Vacek, 2016).

The business model should inspire collaboration between departments and other organisations (Schwab, 2016; Bender and Willmott, 2017). This will allow them to become more agile and flexible in how they react to sudden changes in the market (Baculard *et al.*, 2017). Refer to Chapter 2, Section 4 for an in-depth discussion of what a digital business model looks like.

Organisations should look at policy and regulatory reform within the organisation and in the external environment to ensure the fostering of an innovative culture within the organisation, and to align the digital initiative(s) to adhere to the legislative requirements to ensure: (i) the initiative will be able to function in the economy, and (ii) that the effects of the initiative remain positive on society. There exists a lack of knowledge of the long-term effects of various technologies on society, and organisations must work with their governments to ensure relevant legislation and policies are put in place to support innovation, but also to protect the well-being of the greater society (OECD, 2017; Eggers, Turley and Kishnani, 2018).

3.8.5 Product and service offering
Category: Enabling Dimensions

The offering of products and services organisations will change as they undergo a digital transformation – technology, such as sensors, must be integrated with the products and services to gather data to improve the customer experience (Schwab, 2016). The key objective of most organisations is to create revenue through the offering of a product or service – thus the products and services must be realigned to meet the customer needs (Brozek, 2015; Bender and Willmott, 2017). Organisations should allow for the customisation of products and services to further improve their customer experience offering (Agca *et al.*, 2017).

Organisations should apply agile methods of product and service design to quickly develop and test new products and services, to enable them to react to changing customer demands promptly and further increase their operational effectivity and efficiency (Sommer *et al.*, 2014).

The strategy should speak to the alignment of the organisation's offering to the customer's needs – and measures should be in place where customers are involved with the development of new products and services, as well as the amending of current products and services .

3.8.6 Customer Experience & Engagement
Category: Objective Dimensions

As mentioned by Klaus Schwab, customers are at the centre of the digital economy. For this reason, the output from the other dimensions of the model is a shift in customer engagement from the organisation. The customer experience is thus made the top priority through a digital

transformation as it was found that customer orientation is a big contributor to competitive advantage in the digital era (von Leipzig *et al.*, 2017). Organisations should focus on providing their customers with an overall enjoyable end-to-end customer experience (Westerman *et al.*, 2011).

Organisations can focus on three things throughout the customer journey to influence the customer's perception of the organisation, according to Bender & Willmott (2017). The first focus point is the sequence in which customers experiences highs and lows – customers tend to recall positive and negative experiences disproportionately from using the product or service, and organisations should focus on ending strong and giving their customers a positive experience as the last interaction.

The second focus point is segments – organisations have found that the frequency with which customers experience highs and lows influences their perception of the product or service. Organisations should thus focus on providing highs at various points for the customers and clustering all the negatives together.

The last focus point is the sense of control customers experience throughout the journey – Bender & Willmott (2017) found that the more engaged and empowered customers felt throughout the journey, the less likely they were to give blame to the organisation when something goes wrong. Ultimately the customer's perception of the service they experienced will determine whether they continue to provide their business to an organisation, and thus the organisation being customer-centric infers that focus should be put on the perception of customers.

Organisations should intentionally engage their customers throughout the customer journey, with customers also included in the product and service design phase. The collaboration will ensure the customers' needs are considered through every step of the customer journey (Hood, Brady and Dhanasri, 2016).

Attention should be given to whether organisations are effectively leveraging value from data to realign their product & service offering. This involves the use of technology through sensors, as well as using surveys to get customer feedback and input into the product and service design (Dremel *et al.*, 2017).

With the customer experience as the objective of new digital organisations, the strategic phase guides the organisation in terms of defining its objectives for all the dimensions to work towards producing an improved customer experience. Refer to Section 3.4.2.1 for a monetary comparison of organisations whose focus on the customer experience varies. The strategy should explicitly define a focus on customer experience to ensure the organisation adopts a 'customers first' approach.

3.9   Chapter 3: Conclusion

As mentioned in Chapter 1 of this thesis, the purpose of this research is to apply a framework to support organisations in the process of initiating digital initiatives. This chapter defined and contextualised the various concepts involved in this research – namely Industry 4.0, digital

disruption, digital transformations, a digital business model, and relevant dimensions that a digital initiative can consist of.

Through Section 3.2.3 it was seen that Industry 4.0, as described in Section 3.2, will have significant impacts on both organisations and the economy. These impacts were further explored.

This section specifically looked at how the digital transformation process links in with the impacts mentioned in Section 3.2.3, and how these Industry 4.0 impacts translate into transformation drivers for organisations. The objectives were explored, and the financial implications of the Industry 4.0 concepts was researched. The findings concluded that organisations stand to gain significant financial benefits should they incorporate the new technologies successfully, and various studies were referenced that looked at the impacts of the Industry 4.0 concepts. The process of incorporating these Industry 4.0 concepts to share in the value created through the impacts of Industry 4.0 was defined as a digital transformation.

Baculard *et al.*, (2017) looked at the success rate of organisations who attempt digital transformations and found that a very low number of organisations manage to successfully transform and create more value for the organisation. The conclusion was drawn that organisations face numerous challenges when attempting a digital transformation process.

The above-mentioned findings validated the research as the link between a digital transformation and creating value through Industry 4.0 became evident – however, there exists a lack of clarity regarding the process, which manifests in the low number of successful digital transformations, and which prompts furthering the research into how organisations can achieve higher success rates in their digital transformation attempts.

The following chapter will further explore this conclusion to research why organisations fail to successfully enact value-adding digital transformations. A systematic literature review was incorporated to look at the various challenges that organisations face throughout this transformation process. This will further contextualise the digital transformation process and will provide insight into how organisations should go about the transformation process.

CHAPTER 4. DIGITAL TRANSFORMATION CHALLENGES REVIEW

4.1 Introduction

Chapter 3 contextualised the process of a digital transformation and concluded that organisations stand to gain financially should they successfully enact a value-adding digital transformation but have a low success rate of enacting a value-adding digital transformation. This introduced Chapter 4 – where it was researched why organisations fail and what the challenges are that organisations face.

This chapter uses a systematic literature review to research the challenges organisations face, and the research design and methodology are explained. An analysis of the relevant literature is provided to contextualise the research and provide insights into the nature of the relevant literature. The challenges are listed, followed by an evaluation of the various challenges to find overarching themes within the challenges. The impact of the various challenges is compared from the perspective of enacting a digital transformation through the initiation of digital initiatives to a full organisational digital transformation.

The challenges identified in this chapter are used as a guide, along with the literature from Chapter 3, to list a set of design requirements that would address the barriers identified in Chapters 3 and 4.

This chapter will subsequently further support the argument that organisations are finding it difficult to enact value-adding transformations and concludes with introducing the following chapter – which proposes the solution to the identified problem. Figure 18 indicates how Chapter 4 fits into the thesis.
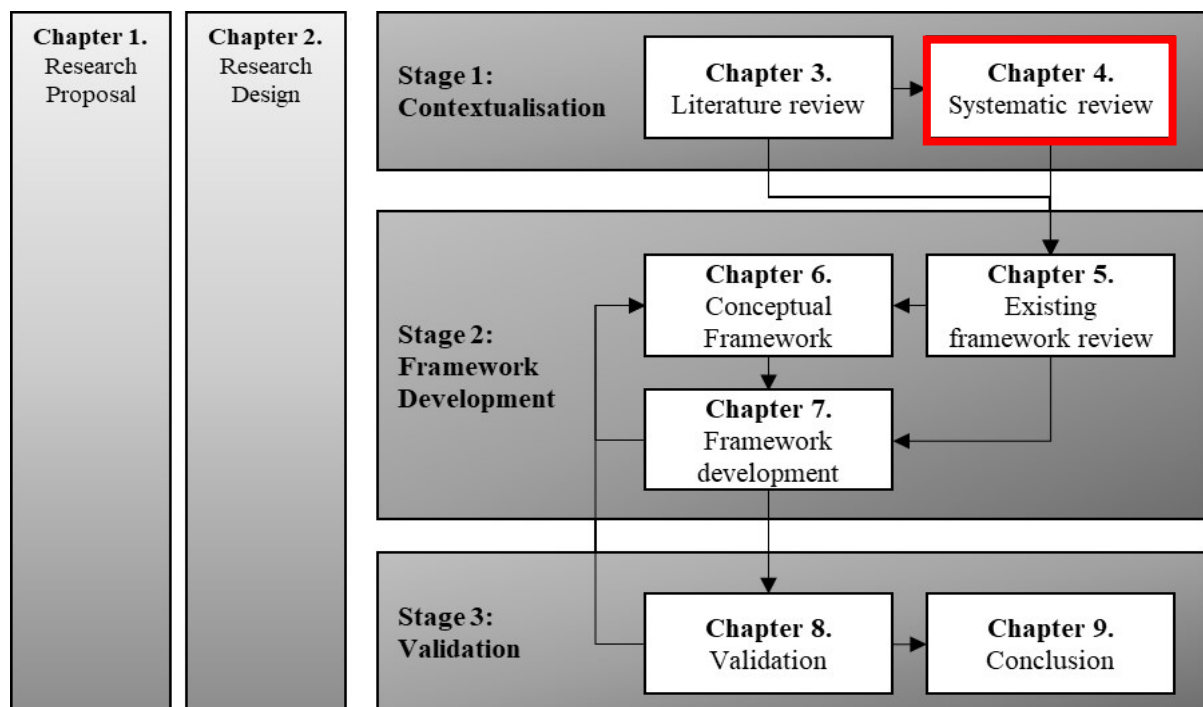
Figure 18: Research design: Chapter 4

4.1.1 Background

Organisations are aware of the need to digitally transform, as indicated in a study conducted by Kane, Palmer, & Nguyen, (2015), for MIT Sloan Management Review & Deloitte. From the organisations included in the study, 92% indicated that digital technologies would be important to their organisation by 2018. Although organisations are aware of the need to digitally transform – there is a disparity between the number of companies aware of the need to digitally transform as indicated by Kane *et al.*, (2015), and the amount of companies who achieve a value-adding digital transformation (Baculard *et al.*, 2017). Bain & Company conducted a study of what a successful digital transformation entails, and how many organisations are achieving a value-adding digital transformation relative to the objectives they set for themselves. From the 1 000 companies that were evaluated worldwide who attempted a form of digital transformation, 5% indicated that they achieved or exceeded the expectations they set for themselves (Baculard *et al.*, 2017).

As is evident from the statistical disparity found in the research conducted by Baculard *et al.*, (2017) between the success of digital transformations and the attempts of such transformations, there are many challenges that organisations face when attempting a digital transformation (Henriette, Feki & Boughzala, 2016; von Leipzig, Gamp, Manz, Schöttle, Ohlhausen, Oosthuizen, Palm & von Leipzig, 2017; Schumacher, Erol & Sihn, 2016; Schwab, 2015). To increase the chances of success of a digital transformation, an in-depth understanding of the challenges that organisations face, and the limitations and hindrances associated with such a transformation, are required before attempting to develop or propose a solution.

This systematic literature review paper will consider research from the perspective of organisations attempting a digital transformation, to identify specific challenges that organisations face. These challenges will be analysed to determine key concepts that organisations struggle with when attempting a digital transformation.

4.2 Systematic review research design

Systematic literature reviews are a well-researched and commonly accepted method for systematically analysing a specific research question, and to methodically review all the relevant scientific research done on the topic of research to ensure scientific legitimacy of the findings of the systematic literature review (Kitchenham, 2004), (Piper, 2013).

This systematic literature review is guided by the research done by Kitchenham (2004) on the creation of systematic literature reviews. This section will explore the method proposed by Kitchenham (2004), making reference to the importance of systematic literature reviews and the advantages thereof. The method will be explained, after which it will be discussed how this method was adapted for the method used in this systematic literature review.

4.2.1 Systematic review background

A systematic literature review, according to Kitchenham (2004), is a rigorous research process used to critically evaluate a research question or topic through "[…] identifying, evaluating and interpreting all relevant available research". The objectives of systematic literature reviews are to critically evaluate and summarise the current evidence regarding the research topic, to recognise where current research is still lacking and to suggest further research to fill in these

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gaps (Piper, 2013), and lastly to generate a framework to guide future research in these identified topics (Kitchenham, 2004).

Research usually starts with a literature review on the topic of interest to create context for the reader, and to allow them to better understand the reason for the research, and the research itself. The methodical nature of compiling a systematic literature review allows it to present the literature in a fair way – as is the requirement to carry scientific value. The strategy used to gather all relevant research is important as it determines the outcome of the systematic literature review and must thus be presented in the research to allow for the assessment of the scientific legitimacy of the research. Researchers must focus on including research that counters their stance and research that supports their stance, to ensure the findings are fair and scientifically legit (Kitchenham, 2004).

Although systematic literature reviews require a bigger effort to create compared to traditional reviews, they provide context and insight on the impact of phenomena on a comprehensive range of settings and empirical methods compared to traditional reviews. The findings from the systematic literature review carry scientific value and can be used to evaluate a hypotheses or problem statement in a fair manner (Kitchenham, 2004).

4.2.2 Review process

The review process is a compilation of a set of activities performed together to evaluate a problem statement or research question in a thorough, scientific manner (Kitchenham, 2004). The method proposed by Kitchenham (2004) divides the process into three phases: planning, conducting, and reporting the review. Each stage has a set of activities that together form the process of compiling a systematic literature review.

The planning phase includes two stages, namely the identification of the need for a systematic literature review, and the development of the review procedure. These stages determine whether there is the need for a methodical and impartial approach to review all available and relevant research regarding the topic at hand. If there is a need for such a review, the next planning stage is to develop the review procedure – to ensure the researcher's expectations do not influence the selection of research once the review is being conducted. The review procedure specifies the methods that will be used during the process and includes the research question that will be studied. The procedure is an integral part of the systematic literature review and partially determines the scientific legitimacy of the findings of the study (Kitchenham, 2004).

The research gathering phase includes five stages that must be concluded sequentially (Kitchenham, 2004):

i. Stage 1: Research identification
ii. Stage 2: Selection of studies
iii. Stage 3: Quality review
iv. Stage 4: Data extraction
v. Stage 5: Data synthesis

The first stage is the identification of research, where a search strategy is created to guide the acquisition of applicable research. The strategy includes decisions such as the type of research that will be accepted for use, what sources will be used to acquire relevant research, and what the inclusion and exclusion criteria are for the research. The criteria are based on the research question, and their aim is to guide the sources that are used to present data that addresses the research question (Kitchenham, 2004).

The second stage is the selection of studies. Once the relevant research according to the criteria was determined, the selection of studies stage is an in-depth analysis of the identified studies to determine whether its content will contribute in part to the studying of the research question. It is an iterative process where the studies are systematically reviewed to include or exclude studies based on their relevance to the posed research question – firstly by reviewing the title, abstract, and keywords, and later by reviewing the full text. It is recommended that the researcher discusses the inclusion and exclusion criteria with an independent panel for an unbiased review of their scientific legitimacy (Kitchenham, 2004).

The third stage is to ensure the quality of the selected studies, as studies might adhere to the inclusion criteria, but do not carry the required scientific legitimacy to contribute to the study of the research question. The quality review of selected studies serves as an additional exclusion criterion and can be used to weigh the importance of specific studies when the results are compiled. There is no specific universal definition for the quality of a study, and they use the CRD guidelines and the Cochrane Reviewers' Handbook to define the quality as "[…] *the extent to which the study minimises bias and maximises internal and external validity*". The CRD Guidelines used divide the quality of a study into several levels, each more evidence-based than the latter, and ranges from experimental studies to expert opinion based on theory, laboratory results, or consensus. The quality assessment of studies can guide the researcher to exclude certain studies (Kitchenham, 2004).

Once the studies have been selected, the data from the studies must be extracted for the researcher to use to attempt answering the research question. Data collection forms can be used to achieve this, where the form aims to gather all relevant information from the studies, and standard information such as the name of the review, date of extraction, title, authors, and publication details. The objective of this stage is to accurately extract all relevant data with minimal bias from the researcher. It is therefore recommended that two or more independent researchers do the extraction (Kitchenham, 2004).

The last stage is the data synthesis stage – which consists of summarising the results of the selected studies. Depending on the nature of the research – it being either qualitative or quantitative, the summarising activities are either a descriptive synthesis, or a quantitative synthesis, where a meta-analysis can be used to create a quantitative synthesis using statistical methods. The descriptive synthesis is aimed at presenting the findings in such a way that the reader can compare the different outcomes from the studies to highlight similarities and differences. Quantitative research should be presented in such a way that outcomes can be compared. A method of comparison must be selected, where it is suggested that the method must be selected based on how to draw a comparison between the findings most effectively. Once the data has been synthesised, it is recommended to present the quantitative results with

a forest plot, as it presents the mean, variance, standard error, and sample size of the study. A funnel plot should be included in the systematic literature review to assess the vulnerability of the review to publication bias. It compares the inverse of the variance to the mean difference between the control and intervention group, and the shape of the plot is used as evidence to determine if there was publication bias or not (Kitchenham, 2004).

Once all the data is synthesised and presented, the review must be reported on either as a technical report or section of a thesis, or in a journal or conference paper. Based on the selected format, different requirements exist for the report. Kitchenham presents structures for both formats and includes the key differences between the formats. Journal articles must be peer reviewed, whereas academic research papers are subject to an examination process (Kitchenham, 2004).

4.2.3 Research design

This systematic literature review is based on the guidelines presented by Kitchenham (2004), with this section explaining how the guidelines were used to design this systematic literature review. The review will start by explaining the methodology followed – beginning with the definition of the research question and aim, followed by an explanation of what strategy was followed to gather research data.

During the first stage of the systematic literature review, keywords were used to identify research that could possibly be relevant to the research question – subject to a review process. Inclusion and exclusion criteria were then compiled and used to review the identified research in more depth, to analyse its relevance to the research question. This was followed by a quality review of the full text of all research material to determine the relevance to the research question.

This paper will provide the reader with an overview of the selected research, focusing on sorting the data into the various categories that will contextualise the material used and allow external moderators to determine the scientific legitimacy of the findings based on the quality of the identified research material.

The results gathered from the selected research are then categorised, followed by an in-depth discussion of the results, providing the reader with insight into the findings of the systematic literature review. A recommendation was made for further research that builds on this topic.

4.3 Methodology

This section will aim to explain the methodology followed to reach the conclusions of the systematic literature review. The research question and aim, and methodology used in this systematic literature review will be discussed. This is followed by a description of the research strategy used, where the search terms used to identify relevant research are tabulated. The selection of studies is then examined, with the inclusion and exclusion criteria tabulated accompanied with a justification of each criteria. The quality review of identified research material is elaborated on, which includes an overview of the final identified and reviewed research material.

4.3.1   Research identification

For this systematic literature review, the following research question is considered: *What challenges do organisations face when undertaking a digital transformation process?* The research question was created using the PCO framework – Population, Context, and Outcome, mentioned in Kitchenham's (2004) work. The population was identified to be organisations going through digital transformation, the context was the digital transformation process, and the outcome was the challenges organisations face.

Through researching this question, the aim of the study is to contextualise the challenges organisations face when attempting a digital transformation, from the perspective of the organisation. The challenges will be analysed to identify the underlying core challenges that organisations face, with the purpose of increasing the understanding around these fundamental challenges.

4.3.1.1   Research strategy

This study used keywords to guide the selection of relevant studies from a database, and synonyms for each of the population, context, and outcome were determined to be used in the search algorithm for the database. Refer to Table 9 for the different keywords that were identified.

Table 9: Keywords

Search Terms	
Keywords	**Synonyms**
Digital Transformation	Digitisation, Digitalisation
Challenges	Obstacles, Problems, Barriers, Obstructions, Impediments, Blockages, Hurdles, Stumbling Blocks, Difficulties, Hindrances, Complications,

The database identified to be used was SCOPUS[3]. The database has a wide variety of scientific literature, and relevant research can be identified through customisable search algorithms. Full access to the database was also granted to the author.

4.3.2   Selection of studies

Certain inclusion criteria were identified to be used along with the keywords to further focus the paper collection on specific and relevant research that strongly aligns with the topic of challenges associated with digital transformation. Refer to Table 10 for the inclusion/exclusion criteria, along with a justification of said criteria.

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[3] https://www-scopus-com.ez.sun.ac.za/search/form.uri?display=basic

Table 10: Inclusion/exclusion criteria

Criteria	Justification
Research published between 2000 and 2017	Digital transformation has been an active discussion since computers have entered the societal frame around 30 years go, but the term 'digital transformation' as defined in this thesis looks specifically at the implementation of Industry 4.0 concepts and the accompanying contemporary challenges. Papers before 2000 are therefore not included. Research done in 2018 is still open-ended as this chapter was created during 2018.
Papers published in English	Only papers available in English are included in the paper collection
Challenges faced by organisations, governments, and societies, during digital transformation	Any organisation – organisations, governments, or companies, forms part of the study – as the framework will have to cater for any organisation wanting to digitally transform and must therefore include all entities. The search was therefore not limited to a specific type of organisation.
Journal articles, research articles, conference proceedings, book series, trade publications.	Research to be used in this systematic literature review includes peer-reviewed articles sourced from SCOPUS, as well as grey literature such as reports compiled by governmental institutions or companies who are experienced in digital transformation sourced from Google Scholar and ScienceDirect.

The search of keywords was executed on the paper titles, abstracts, and keywords to get the initial collection of relevant research papers, along with the above-mentioned inclusion and exclusion criteria in Table 10. The phrase 'digital transformation' had to be in either the title, abstract, or keywords, along with 'challenge', or any synonym mentioned in Table 9 also in either the title, abstract, or keywords. As mentioned in Table 10, research conducted in 2018 was excluded, with only research conducted in English used. Various sources of literature were included in the study. This was the first iteration of selecting studies and presented the initial pool of possible relevant research.

4.3.3 Quality review

The relevancy of the research papers was determined through an iterative process. The first iteration was to gather all the research from the database that adhered to the above-mentioned inclusion and exclusion criteria, and to remove all duplicate papers. The relevance of the research was then determined with a screening of the abstracts, where any papers that were identified to be irrelevant to the thesis were removed. The third iteration was to remove any inaccessible research papers from the identified list in the second iteration. The fourth iteration looked at the full texts of the remaining research, and any papers that were found to be

irrelevant to the study were removed. Refer to Figure 19 below for a visual representation of the iteration process.
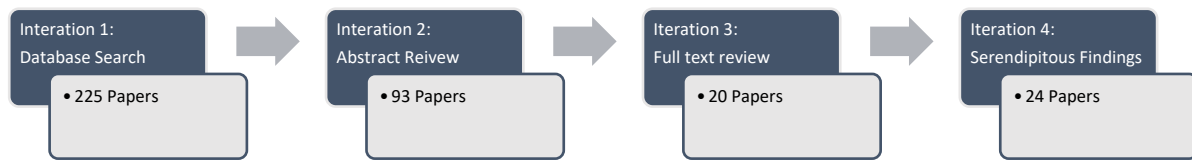
Figure 19: Quality review process

From the initial collection of 225 papers that adhered to the proposed inclusion and exclusion criteria, three papers were inaccessible due to copyright restrictions and thus did not form part of this research. The research used was reduced to 93 papers through the abstract-review process. The 93 papers were reviewed in full, and after reviewing the full text of each paper, 20 papers were identified as being relevant to the posed research question.

Further research was done outside of the SCOPUS database by using ScienceDirect and Google Scholar, and four articles that were relevant to the posed research question were found. These papers were classified as serendipitous findings and formed a part of the researched used in this paper. Conclusions were drawn based on the information contained in these 24 papers.

4.3.4 Data extraction and synthesis

The relevant papers were looked at in full, and the challenges that each addressed were extracted and tabulated. After all the challenges were identified, a review process commenced to identify overarching themes which describe and categorise all the challenges. These themes were elaborated on, with each referring to the specific papers that discussed the challenge. This ensured that each challenge was thoroughly contextualised and gives the reader a wide perspective on challenges that different entities – societies, organisations, and governments, experience as they go through the transformation process. The challenges identified are mainly relevant to all organisations and consider a digital transformation on a holistic level to ensure the relevance and applicability of this research to a wide range of scenarios.

4.4 Bibliometric analysis

This section will provide the reader with the context of the studies that were selected for use in this systematic literature review. The studies will be categorised based on different criteria, namely the number of articles published per year, subject area of the publication, document and source type, country of publication, and keywords used. The bibliometric analysis was only done on the 20 articles that were found in the SCOPUS database.

4.4.1 Published per year

As can be seen in Figure 20, all the relevant studies are from 2014 onwards, with the largest share published in 2016 and 2017, indicating that the area of research is new and relevant. From the 20 studies used, 17 studies were published in either 2016 or 2017, making up 85% of the studies. The earliest relevant study found was found in 2014. 'Industry 4.0' originated in Germany in 2014, and how companies are incorporating these concepts into their organisations became a relevant research topic after that, which supports the fact that all the research was published after 2014.
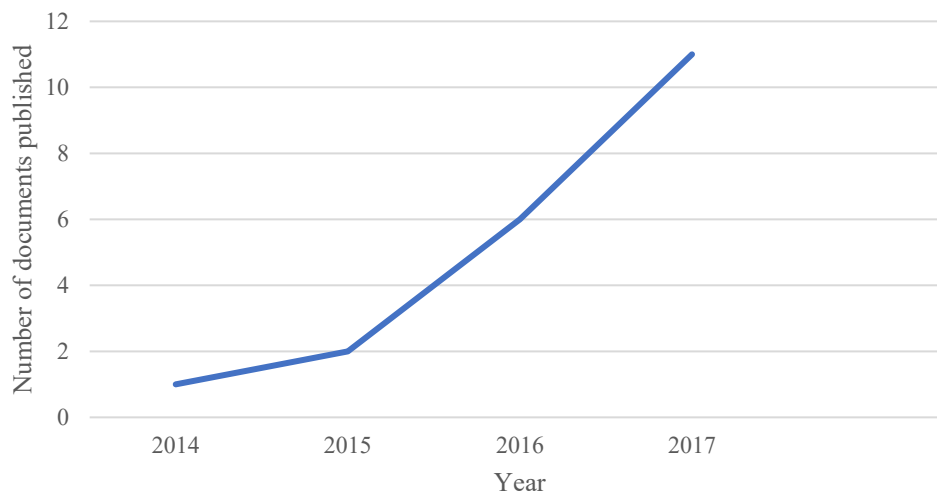
Figure 20: Documents published per year

4.4.2 Subject area

The studies are from a variety of subject areas, with Computer Science (40%), Decision Sciences (18%), Engineering (12%), Business, including Management and Accounting (12%), making up a total of 82% of the studies. Refer to Figure 21 for a visual depiction of the makeup of the relevant studies used for this research.

Computer science makes up the largest share of the studies as a digital transformation is linked with integrating the IT department with the rest of the organisation's operations and making it the central department of the organisation, and many of the studies focus on the integration challenges linked to this. Decision sciences made up the second biggest share, as many of the papers are focused on the transformation of a specific industry, with emphasis put on healthcare. Engineering is the next biggest share of the research, as organisations struggle with legacy systems and digitalising their processes. Business, management and accounting make up the same share as Engineering, as organisations in this sector are challenged financially with performing a successful digital transformation.

The numerous fields from which the relevant research stems support the notion that this topic of research is relevant for various industries, and enhance the contribution that this research makes if the research objectives are met.
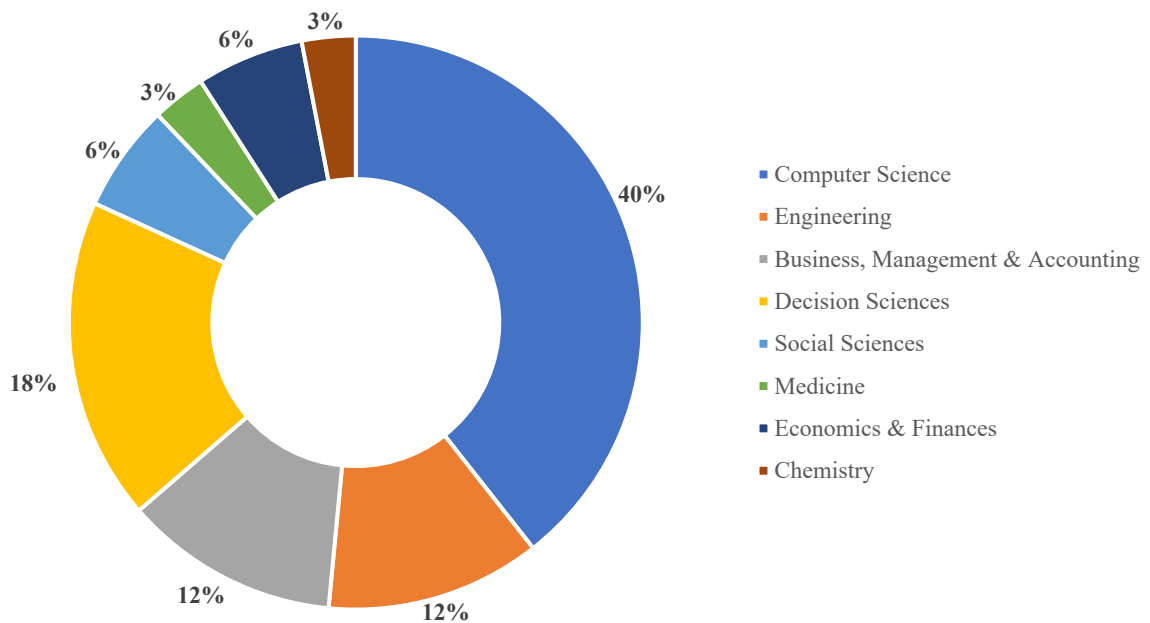
Figure 21: Document subject area

4.4.3   **Document & source type**

Refer to Figure 22 for a visual depiction of the makeup of different source types used in this research. The sources used in this study include Journals (50%), Conference Proceedings (35%), Book Series (10%) and Trade Publications (5%). Journals and conference proceedings make up the majority of the research, further supporting the notion that the research is new and relevant. New research is presented at conferences to be reviewed, after which it is published in journals.
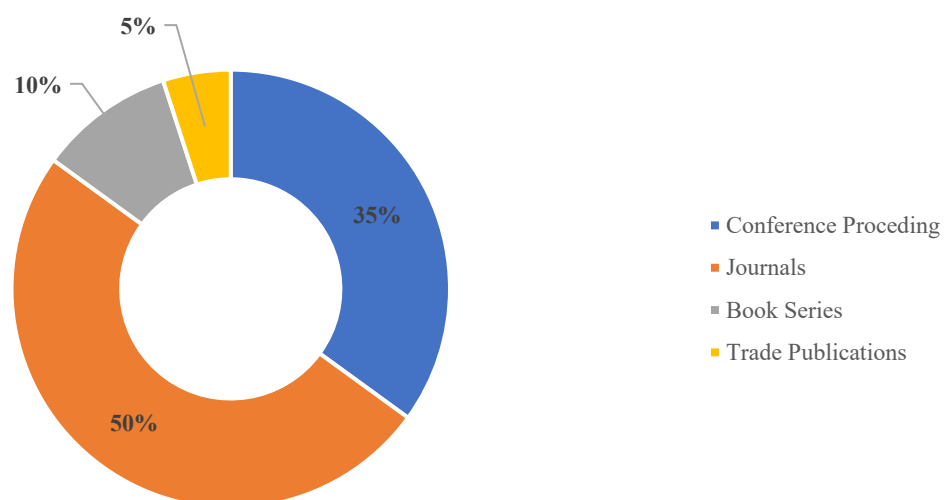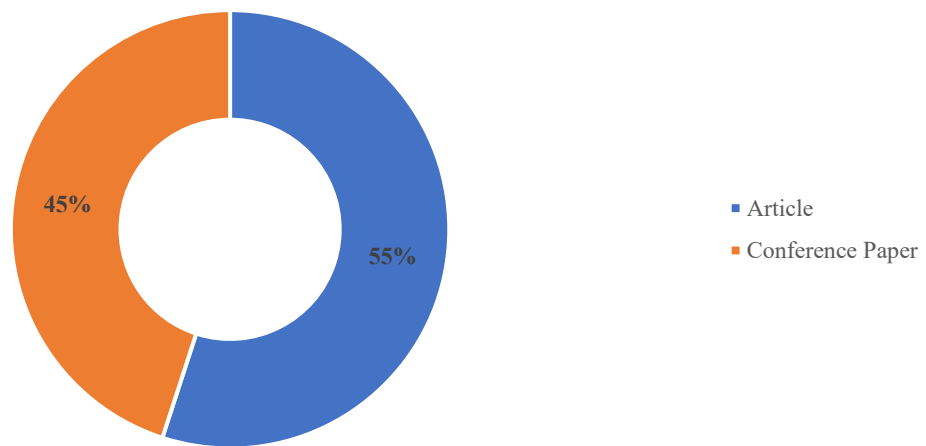
Figure 23: Document type

As can be seen in Figure 23, from the 20 relevant documents, Articles made up 55% of the studies, with Conference Papers making up 45% of the studies. The large proportion of Conference Papers indicates and further supports the notion that the study is new and relevant, as new studies are taken to conferences to test the legitimacy of the findings, after which the work is published in articles.

4.4.4 Country of publication

As can be seen in Figure 24, most of the studies were published in either the United States or Germany. Germany is the country of origin of the term 'Industry 4.0' and is thus active in the field of researching digital transformation. America is at the forefront of digital initiatives, and therefore contributed in large to the studies used in this research.
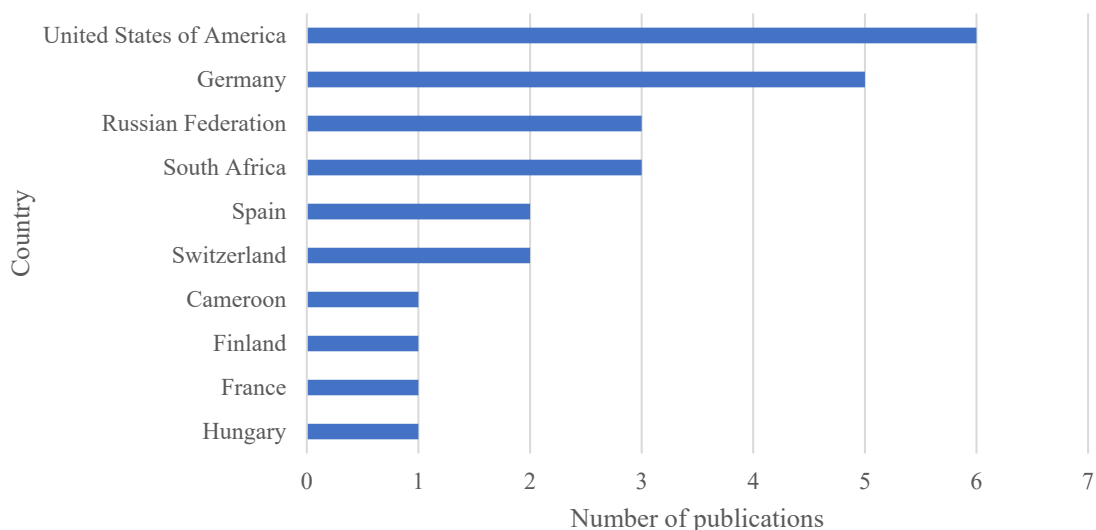
Figure 24: Country of source publication

4.4.5 Keywords used in research

Keywords are used in research to provide the reader an idea of what key concepts are addressed in the research paper. As can be seen in Figure 25, the phrase 'digital transformation' was the most used keyword, found in 14 of the relevant 20 documents, thus being present in 60% of the studies.
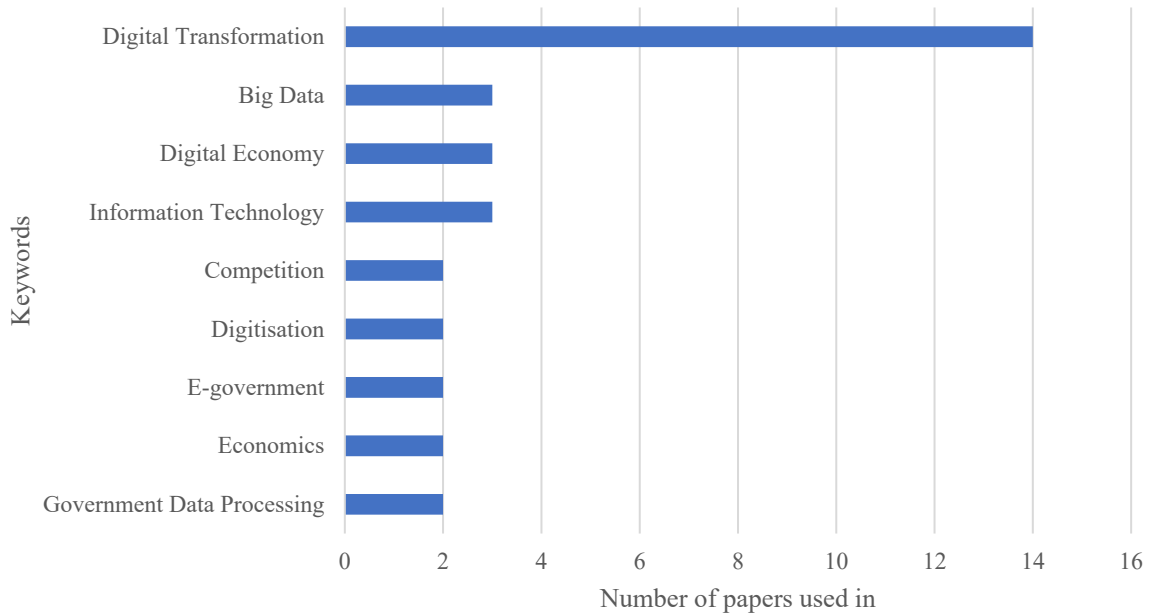
Figure 25: Keywords used in research

4.5 Challenges

The various challenges associated with digital transformations identified through the systematic literature review, along with the number of sources that highlighted each challenge, are shown in Table 11.

Table 11: Digital transformation challenges

Challenge	Sources
Legacy organisational infrastructure prevents interoperability.	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Earley, 2014; Abrahams, 2015; Piccinini, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Al-Sai and Abualigah, 2017a; von Leipzig *et al.*, 2017; Dold and Groopman, 2017; Dremel *et al.*, 2017; Haggerty, 2017; Manda, 2017)
Legacy IT infrastructure prevents the implementation of new digital initiatives	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Earley, 2014; Abrahams, 2015; Piccinini, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Hess *et al.*, 2016; Al-Sai and Abualigah, 2017a; Manda, 2017; von Leipzig *et al.*, 2017; Dold and Groopman, 2017; Dremel *et al.*, 2017; Haggerty, 2017)
Lack of access to digital skills on the market.	(Ebrahim and Irani, 2005; Arendt, 2008; Westerman *et al.*, 2011; Abrahams, 2015; Piccinini, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Heikkila *et al.*, 2016; Al-Sai and Abualigah, 2017a; Rajnai and Kocsis, 2017a; von Leipzig *et al.*, 2017; Dobrolyubova, Alexandrov and Yefremov, 2017; Khitskov *et al.*, 2017)
Lack of clarity regarding role of employees during- and after a digital transformation can lead to worker resistance.	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Gerth and Peppard, 2016; Hafsi and Assar, 2016; Henriette, Feki and Boughzala, 2016; Hess *et al.*, 2016; Al-Sai and Abualigah, 2017a; Dremel *et al.*, 2017; von Leipzig *et al.*, 2017; Khitskov *et al.*, 2017; Rajnai and Kocsis, 2017a; Rojo Abollado, Shehab and Bamforth, 2017)

Lack of collaboration between departments interoperability issues or lack of vision.	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Earley, 2014; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Hess *et al.*, 2016; Al-Sai and Abualigah, 2017a; Dold and Groopman, 2017; von Leipzig *et al.*, 2017; Dremel *et al.*, 2017; Haggerty, 2017; Manda, 2017)
Lack of digital culture (people-centric, agile) and understanding the need for it.	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Henriette, Feki and Boughzala, 2016; Al-Sai and Abualigah, 2017a; Dremel *et al.*, 2017; Khitskov *et al.*, 2017; Rojo Abollado, Shehab and Bamforth, 2017; von Leipzig *et al.*, 2017)
Lack of leadership and strategy during the process.	(Ebrahim and Irani, 2005; Arendt, 2008; Mell and Grance, 2011; Westerman *et al.*, 2011; Etoundi *et al.*, 2016; Gerth and Peppard, 2016; Hafsi and Assar, 2016; Hess *et al.*, 2016; Al-Sai and Abualigah, 2017a; Rojo Abollado, Shehab and Bamforth, 2017)
Lack of awareness of the requirement for digital skills.	(Ebrahim and Irani, 2005; Arendt, 2008; Westerman *et al.*, 2011; Piccinini, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Al-Sai and Abualigah, 2017a; Dobrolyubova, Alexandrov and Yefremov, 2017; Khitskov *et al.*, 2017; Rajnai and Kocsis, 2017a)
Lack of policy and regulatory reform.	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Abrahams, 2015; Piccinini, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Al-Sai and Abualigah, 2017a; Dobrolyubova, Alexandrov and Yefremov, 2017; Manda, 2017)
Financial challenges: a digital transformation is very resource-intensive, and the challenge is to access the required funds.	(Ebrahim and Irani, 2005; Arendt, 2008; Abrahams, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Heikkila *et al.*, 2016; Hess *et al.*, 2016; Rojo Abollado, Shehab and Bamforth, 2017; von Leipzig *et al.*, 2017)
Lack of understanding the process- requirements and benefits.	(Ebrahim and Irani, 2005; Arendt, 2008; Westerman *et al.*, 2011; Gerth and Peppard, 2016; Hafsi and Assar, 2016; Al-Sai and Abualigah, 2017a; Khitskov *et al.*, 2017; Rojo Abollado, Shehab and Bamforth, 2017; von Leipzig *et al.*, 2017)
Lack of informed drive from management to transform.	(Ebrahim and Irani, 2005; Arendt, 2008; Westerman *et al.*, 2011; Gerth and Peppard, 2016; Hafsi and Assar, 2016; Hess *et al.*, 2016; Al-Sai and Abualigah, 2017a; Rojo Abollado, Shehab and Bamforth, 2017)
Cybersecurity to protect the organisations from cyberattacks.	(Ebrahim and Irani, 2005; Westerman *et al.*, 2011; Abrahams, 2015; Piccinini, 2015; Heikkila *et al.*, 2016; Al-Sai and Abualigah, 2017a; Haggerty, 2017)
Uncertainty regarding what technology to invest in.	(Arendt, 2008; Westerman *et al.*, 2011; Earley, 2014; Piccinini, 2015; Etoundi *et al.*, 2016; Al-Sai and Abualigah, 2017a)
Lack of access to technology prevalent in third world countries.	(Ebrahim and Irani, 2005; Arendt, 2008; Abrahams, 2015; Etoundi *et al.*, 2016; Dobrolyubova, Alexandrov and Yefremov, 2017; Manda, 2017)
Job losses from automating processes leading to change-resistance.	(Westerman *et al.*, 2011; Henriette, Feki and Boughzala, 2016; Al-Sai and Abualigah, 2017a; Rojo Abollado, Shehab and Bamforth, 2017)
Disruption from external competition taking market share.	(Earley, 2014; Piccinini, 2015; Etoundi *et al.*, 2016; Dremel *et al.*, 2017)
Being agile – remaining profitable during a complete business-model transformation.	(Piccinini, 2015; Etoundi *et al.*, 2016; Hess *et al.*, 2016; Dremel *et al.*, 2017)
Increased and changing demand from customers regarding their customer experience.	(Earley, 2014; Dremel *et al.*, 2017)
External resistance to change from Unions	(Westerman *et al.*, 2011)

The challenges identified in this study were evaluated from the perspective of the organisations, with each challenge evaluated in two ways:

(i)   The root cause of the challenge(s).
(ii)   How to overcome the challenge(s).

The Root Cause Analysis (RCA) technique was used as the guiding principle to deal with the challenges (Rooney and Heuvel, 2004). The method includes identifying and addressing the factor that causes the undesired outcome, and thus the focus of the systematic literature review was the evaluation of what the root causes of the challenges are. Once an in-depth understanding of the challenges is achieved, the solution to the challenges can be researched. The first part of the evaluation is addressed in this section, with the solution discussed in the following chapter in the form of a conceptual framework.

From the 20 unique challenges identified Table 11, and after analysing the challenges, a challenges typology was created to present the various challenges organisations face during a digital transformation, thus addressing the first part of the challenges' evaluation. The classification of challenges according to the categories mentioned below does not infer mutual exclusivity – the categorisation is focused on further identifying the root cause of the challenges. Whilst evaluating the challenges, specific themes were identified – (i) the lack of understanding, or contextual challenges, (ii) technological challenges, and (iii) external challenges. Various subcategories are included in each category. It should be noted that the categorisation did not result in a binary output of challenges being assigned to one of the three categories. Several of the challenges can have origins in various categories, and thus a challenges landscape was developed to represent the origins of the various challenges.

4.5.1   Contextual challenges

From the results of the systematic literature review, it is evident that internally organisations face two major challenges – a lack of understanding the relevant concepts and having an organisational structure that is not conducive to digital organisations. The first challenge organisations face when attempting a digital transformation is the lack of understanding, which can further be divided into lack of context regarding (i) the process, (ii) the role of employees, (iii) the organisational culture, and (iv) the financial implications of a transformation.

The digital transformation process is complex, and organisations lack a clear understanding of what it entails (Khitskov *et al.*, 2017; Tiersky, 2017). This misunderstanding often leads to overmanaging processes within the organisation, and consequently wasting resources (Rojo Abollado, Shehab and Bamforth, 2017). This misconception often leads to the creation of inaccurate transformation strategies, with organisations then being likely to fail as they are working towards an objective that is misinformed and not value-adding (Arendt, 2008; Gerth and Peppard, 2016).

As organisational business models are redefined through a digital transformation, so too do the roles of employees change, and such new or changed roles, given the transformative process, are often ill-defined (Gerth and Peppard, 2016; Tiersky, 2017). The lack of leadership and not having a clear vision, strategy, and active engagement from management inhibits the successful

transformation of organisations (Piccinini, 2015; Hafsi and Assar, 2016; Rojo Abollado, Shehab and Bamforth, 2017; Tiersky, 2017). Once digital initiatives have been implemented in an organisation, there is often a misconception of how the roles of employees and requirements from them have changed (Gerth and Peppard, 2016; Hafsi and Assar, 2016). This leads to organisations employing the wrong people, as they lack the understanding of what skills employees require to effectively utilise the new digital initiatives (Arendt, 2008; Gerth and Peppard, 2016; Khitskov *et al.*, 2017; Tiersky, 2017).

Organisations are often unaware of the importance of the organisational culture and the importance of fostering a people-centric, agile culture that is conducive to doing business in a digital economy (Arendt, 2008), with organisations experiencing various challenges due to the lack of understanding the importance of having a digital culture when doing business in a digital economy. These challenges include the lack of leadership and vision which leads to a lack of urgency to transform as they believe their business model is resistant to disruption (Gerth and Peppard, 2016; Hafsi and Assar, 2016; Manda, 2017), and a regressive culture in terms of willingness to transform where employees push back against the change due to a fear of losing their jobs (Hafsi and Assar, 2016; Henriette, Feki and Boughzala, 2016; Al-Sai and Abualigah, 2017b; Frolov *et al.*, 2017; Rojo Abollado, Shehab and Bamforth, 2017; von Leipzig *et al.*, 2017). This can lead to external labour relations organisations being involved, which further inhibits a successful digital transformation (Westerman *et al.*, 2011; Hafsi and Assar, 2016).

Linked with the lack of understanding what the process entails and subsequently having an inaccurate transformation strategy, organisations are unsure what technology to invest in and often waste resources on investing in the wrong technology (Westerman *et al.*, 2011; Earley, 2014; Piccinini, 2015; Etoundi *et al.*, 2016; Al-Sai and Abualigah, 2017b).

Organisations are challenged to remain profitable whilst undergoing their digital transformations, and thus the lack of an agile business model challenges organisations to survive the transformation process (Piccinini, 2015; Etoundi *et al.*, 2016; Hess *et al.*, 2016; Dremel *et al.*, 2017).

The internal organisational-infrastructure transformation is resource-intensive for organisations, and without a clear understanding of what a digital transformation is and the financial benefits that can be realised through a successful transformation, organisations are left unconvinced about allocating resources to a transformation, (Arendt, 2008; Osterwalder and Pigneur, 2010; Earley, 2014; Rüßmann *et al.*, 2015; Turner, 2015; Hess *et al.*, 2016; von Leipzig *et al.*, 2017; Dietel, 2018). Organisations are challenged with aligning short-term technology investments with the long-term strategy of the organisation regarding digital development in times where the lifecycle of technology is short (Piccinini, 2015).

4.5.2 Technological challenges

Organisations face various challenges regarding technology when aiming to digitally transform – as technology is central to the digital business model. Organisations face three key challenges with regards to technology – (i) they are unsure what technology to invest in to create value for their organisation, a challenge that is closely linked to the previous section of not

understanding the requirements of a digital transformation, (ii) their IT departments are not conducive to a digital organisation in terms of interdepartmental collaboration, leveraging value from big data, and the ease of new technology integration, and lastly (iii) access to the required technology is limited for organisations especially in Third World countries.

Some of these challenges find their roots in both technology and the lack of understanding categories, as understanding the process, and having a clear vision will guide organisations in their technology investments and redefining their IT architecture to allow inter-departmental integration and collaboration, as well as leveraging value from the data available to them. A lack of understanding often leads to organisations investing in the wrong technology (Westerman *et al.*, 2011; Earley, 2014; Piccinini, 2015; Etoundi *et al.*, 2016; Al-Sai and Abualigah, 2017b). Organisations have to determine where the root of the challenge lies – as it directly influences the strategy to address each challenge.

As mentioned by Klaus Schwab in Section 3.7.3, interdepartmental collaboration is key to the success of a digital transformation, and traditional infrastructure often does not allow this as it usually functions around siloed departments (Earley, 2014; Hafsi and Assar, 2016; Rojo Abollado, Shehab and Bamforth, 2017; Tiersky, 2017). Organisations keep operating with their legacy business models, which impedes their ability to do business effectively in a digital economy (Tiersky, 2017). These structures hinder the implementation and integration of digital initiatives and lack the ability to leverage value from the vast amounts of data available to organisations regarding customer needs (Dold and Groopman, 2017; Frolov *et al.*, 2017; Tiersky, 2017), and the challenge organisations face is to redefine and restructure the organisational IT infrastructure to allow the effortless adoption of new digital initiatives (Piccinini, 2015; Al-Sai and Abualigah, 2017b; Haggerty, 2017). The collaboration between departments is a prerequisite for many Industry 4.0 initiatives to add value to the organisation, such as big data analytics (Hafsi and Assar, 2016; Dremel *et al.*, 2017; Manda, 2017).

In addition to the challenges discussed above, and a prominent theme when considering the challenges outlined in Table 11, are the challenges that arise from the environment within which organisations exist. Thus, linking with the following section of external challenges, organisations operating in developing countries are often also challenged with not having access to the required technology for their digital business model to work effectively, which inhibits their ability to partake in the digital economy (Ebrahim and Irani, 2005; Arendt, 2008; Abrahams, 2015; Etoundi *et al.*, 2016; Dobrolyubova, Alexandrov and Yefremov, 2017; Manda, 2017).

4.5.3 External challenges

Organisations face various challenges with origins outside of their organisational boundaries, including (i) market disruption from competition, (ii) changing demands from customers regarding their customer experience, (iii) the lack of policy and regulatory reform and support, (iv) the lack of access to digital skills and technology, and (v) cybersecurity threats.

Organisations are at risk of losing market share to competitors as they are facing competition from a wider range of rivals, and other non-industry entrants (Piccinini, 2015). This impacts the profitability of organisations, thus putting them under increased pressure to transform

(Etoundi *et al.*, 2016). As mentioned earlier, organisations are challenged to remain profitable whilst transforming their business models digitally, and they have to balance the need to transform with remaining profitable using their current business models (Hess *et al.*, 2016). Customer needs are also changing more regularly, and organisations are challenged with providing competitive customer experiences at affordable rates whilst remaining profitable (Schwab, 2015). The organisational culture is also relevant to this challenge, as the belief that organisations harbour about being disruption-resistant further contributes to the impact that this challenge may have on organisations' profitability (Hafsi and Assar, 2016).

The rate at which organisations can digitally transform is influenced by policies, regulations, and legislation. This inhibits organisations from entering markets and discourages them from spending resources to transform their business models. Organisations must comply with policies and regulations, which challenges them to fully transform (Hafsi and Assar, 2016; Dobrolyubova, Alexandrov and Yefremov, 2017; Manda, 2017).

Organisations also face regulatory and legal issues around some digital initiatives they plan to implement – especially automated activities that can affect the safety of the user, such as self-driving cars (Piccinini, 2015). Organisations feel there is a lack of policy support for them in their transformation process, and this increases the risk of a transformation (Manda, 2017). As data is central to the operation of a digitally transformed organisation, organisations must comply with certain regulations regarding the privacy and security of data (Haggerty, 2017).

As organisations are digitalising, more data is being collected and the reliance on IT systems is increasing. This has put organisations at an increased risk of cyberattacks, as these organisations have more data to lose during such an attack (Abrahams, 2015). The vast increase in data requires organisations to invest a significant amount of resources into improving their IT systems, so as to enable the organisation to leverage value from and protect the data (Heikkila *et al.*, 2016; Al-Sai and Abualigah, 2017b; Haggerty, 2017).

As mentioned in Chapter 4, Section 4.1 speaking to the changing roles of employees in digital organisations, organisations are challenged with access to the required digital skills on the market – as the demand is greater than the supply of these skills (Westerman *et al.*, 2011; Abrahams, 2015; Piccinini, 2015; Etoundi *et al.*, 2016; Hafsi and Assar, 2016; Heikkila *et al.*, 2016; Al-Sai and Abualigah, 2017b; Dobrolyubova, Alexandrov and Yefremov, 2017; Khitskov *et al.*, 2017; Rajnai and Kocsis, 2017b; von Leipzig *et al.*, 2017). Linked with the technology category, organisations, especially in Third World countries, are challenged with access to the technology they require to operate their digital business model successfully (Ebrahim and Irani, 2005; Abrahams, 2015; Etoundi *et al.*, 2016; Dobrolyubova, Alexandrov and Yefremov, 2017; Manda, 2017).

Based on the challenges identified and the findings from the literature indicating that organisations struggle with enacting value-adding digital transformations, the need was identified to develop a model or framework to assist organisations in enabling a value-adding digital transformation. This framework will serve as the second part of the challenges' evaluation – the solution to overcoming and preventing the challenges. The requirement

specification, and subsequent conceptual framework will be discussed in the following chapters.

4.6 Challenges evaluation

As discussed in Section 3.6, there are various ways that organisations can approach a digital transformation. The challenges identified in this section were specifically linked to an enterprise-wide transformation of the entire organisation into a digital organisation, but as the literature research and interviews with subject matter experts found, organisations struggle with enacting value-adding digital transformations due to the challenges identified in this section. An approach focused on enabling organisations to participate in the digital economy that was found in literature and interviews to be more practical, was through the implementation of digital initiatives built on the relevant digital capabilities.

This method of transformation is elaborated on in Section 3.6, and it was concluded that organisations manage to mitigate some of the identified challenges through this method, compared with trying to transform the entire organisation in one digital transformation project. It should be noted that this method is also aiming to digitally transform the organisation enterprise-wide, but the approach is through launching the digital initiatives and integrating them incrementally into the organisation to ultimately transform the entire business, as opposed to launching an all-encompassing digital transformation project to transform the entire organisation at once.

This section considers the challenges identified in the previous section and identify specific challenges that can be mitigated through using this method.

The challenges are presented in Table 12 below with an indication of what challenges are experienced with each of the approaches. An 'X' indicates the challenge will be experienced, where a '-' indicates experiencing the challenge at a lesser degree.

Table 12: Transformation challenges evaluation

Challenge	Enterprise-wide	Initiative
Legacy organisational infrastructure prevents interoperability.	X	-
Legacy IT infrastructure prevents the implementation of new digital initiatives	X	X
Lack of access to digital skills on the market.	X	X
Lack of clarity regarding role of employees during and after a digital transformation can lead to worker resistance.	X	-
Lack of collaboration between departments interoperability issues or lack of vision.	X	-
Lack of digital culture (people-centric, agile) and understanding the need for it.	X	-
Lack of leadership and strategy during the process.	X	X
Lack of awareness of the requirement for digital skills.	X	-
Lack of policy and regulatory reform.	X	X
Financial challenges: a digital transformation is very resource-intensive, and the challenge is to access the required funds.	X	-
Lack of understanding the process- requirements and benefits.	X	X
Lack of informed drive from management to transform.	X	X
Cybersecurity to protect the organisations from cyberattacks.	X	X
Uncertainty regarding what technology to invest in.	X	-
Lack of access to technology prevalent in third world countries.	X	X

Job losses from automating processes leading to change-resistance.	X	-
Disruption from external competition taking market share.	X	X
Being agile – remaining profitable during a complete business-model transformation.	X	-
Increased and changing demand from customers regarding their customer experience.	X	X
External resistance to change from Unions	X	-

It should be noted that the challenges that were indicated to be less prevalent through the launching of digital initiatives were not completely prevented but were rather mitigated to some extent. These challenges that were identified to be mitigated through taking the digital initiative approach are discussed below and the argument is made as to why the digital initiative approach mitigates these challenges to some extent.

Legacy organisational infrastructure prevents interoperability – Due to the digital initiative being launched as an independent enterprise from the organisation, interoperability is not a requirement for the working of the digital initiative. This may become an issue as the initiative is being integrated into the organisation, but it is very dependent on the nature of the digital initiative.

Lack of clarity regarding role of employees during and after a digital transformation can lead to worker resistance – Due to the initiative running parallel to the current operations of the organisation, the current employees' roles are not changed significantly, and the new roles of employees within the digital initiative are clearly defined during the acquisition of employees phase. The new employees are thus aware of their roles when they start.

Lack of collaboration between departments, interoperability issues, or lack of vision – Transforming the entire organisation to share the same vision is challenging and ensuring the collaboration of the various departments requires a large-scale transformation effort that is resource-intensive. Focusing your efforts on specific digital initiatives is more manageable for organisations, and less resource intensive. The vision for specific initiatives is easier to define, as the objectives are more directly related to the specific initiative. Collaboration between departments is also not a requirement for the successful implementation of a digital initiative.

Lack of digital culture (people-centric, agile) and understanding the need for it – Based on Edgar Schein's definition of cultures as sharing beliefs and assumptions that influence peoples' behaviour, changing organisational cultures is significantly more difficult than defining a culture for a new initiative, as nobody from the new initiative shares any assumptions and beliefs that influence their behaviour. Changing a culture requires of the leaders to redefine the shared assumptions and beliefs, which requires time and effort – whereas defining a new culture only requires the buy-in from the new employees, who do not expect anything else.

Lack of awareness of the requirement for digital skills – The fact that the new digital initiative is launched infers that the organisation is aware of the need for new digitally relevant skills. Although the challenge is not completely mitigated through the digital initiative approach, the impact of the challenge is not as relevant to the initiative approach.

Financial challenges: a digital transformation is very resource-intensive, and the challenge is to access the required funds – As mentioned in some of the previous challenges, an enterprise-wide digital transformation is resource-intensive, as opposed to launching specific digital initiatives requiring less resources due to the size of the initiative.

Uncertainty regarding what technology to invest in – The specific focus of digital initiatives makes it clearer for the organisation what technology is required to successfully implement the digital initiative, compared to launching an entire transformation project enterprise-wide where each department has to be considered.

Job losses from automating processes leading to change-resistance – The digital initiatives are executed parallel to the current operation of the organisation, and thus leads to less job losses from the outset.

Being agile – remaining profitable during a complete business-model transformation – Similar to previous challenges, the parallel nature of digital initiatives means the organisation does not immediately change their traditional business model, and even though the profitability of the legacy part may decrease as time passes and disruption increases, the revenue burden will be shared by the old and new parts of the organisation. As the transformation is also less resource-intensive, the profitability of the organisation might be higher.

External resistance to change from unions – Less jobs will be lost during the launching of the digital initiative, and thus less involvement from the unions can be expected as fewer of their members will have lost their jobs during the process.

This assessment shows that several of the challenges are mitigated in part by approaching the digital transformation through the implementation of digital initiatives. By experiencing less challenges in the transformation process, organisations stand a greater chance of successfully reaching their objectives and adding value to the organisation, and thus the selection of this approach is validated.

The second part of the evaluation of the challenges regarding how to solve them and enact a value-adding digital transformation is thus based on the digital initiative approach for enacting digital transformations. The following section considers all of the previously mentioned literature and subsequent conclusions to generate a set of design requirements that will address the challenges that the research has identified, and achieve the objectives identified through literary research and exploratory semi-structured interviews with subject matter experts.

4.7   **Design Requirements**

Based on the literature review regarding Industry 4.0, digital organisations and digital transformations in Chapter 3, the systematic literature review regarding the challenges organisations face whilst undergoing a digital transformation in Chapter 4, and the semi-structured interviews which further explored the concepts that the author considered, conclusions are drawn regarding the requirements of a framework that would address all the required areas. It should be noted that, in line with the research strategy that is visually represented in FIGURE 1, conclusions from Chapters 5 and 7 are incorporated in the design of the framework. Reference is made in the following sections as to where the conclusions from

following chapters are included, and where to find the literature that led to the mentioned conclusion(s).

The following conclusions drawn from the research were central to the generation of the design requirements of the conceptual framework, can be seen visually represented in Figure 26:

- Industry 4.0 has impacted organisations is various domains, and changed their customer value proposition;
- Customers and their demands are at the centre of a digital organisation, and subsequently this should be the focus of every digital initiative; and
- The structure of digital organisations is different from traditional organisations – various new technologies have developed which enabled new capabilities that were previously not possible – and these capabilities can be used to increase the operational effectivity and efficiency of organisations and enhance their offered customer experience. Chapter 5 concluded that various existing models/frameworks make use of Capability Maturity Models (CMM's) to contextualise the various new capabilities, and subsequently this method is used within the framework. Section 6.4.2.1 elaborates on the use and application of CMM's;
- Most capabilities have a varying value-creation potential for organisations from different industries – and organisations must determine which capabilities they require to create value in their digital initiative(s).
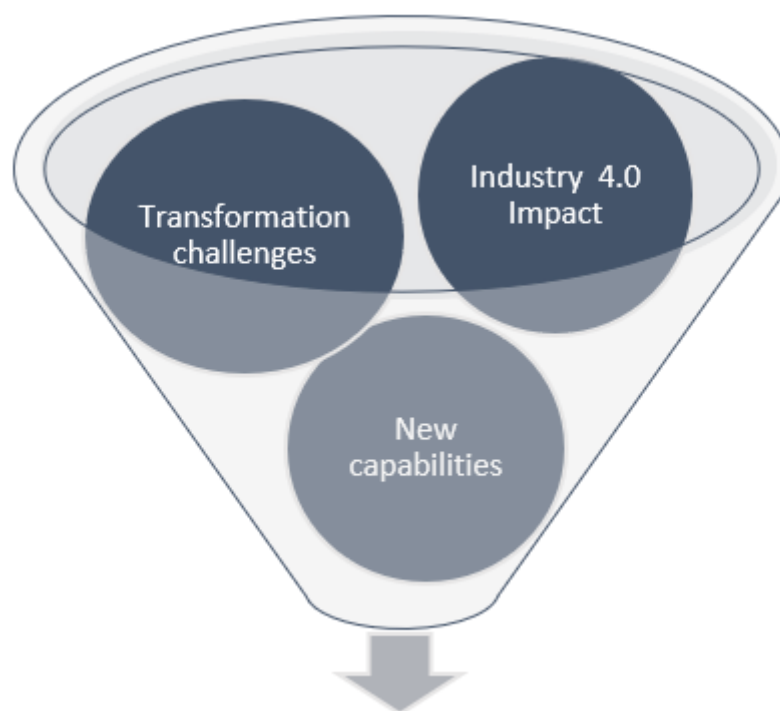
Framework design requirements

These conclusions were further deconstructed into various design requirements, found below, that when adhered to would support organisations in the digital initiative initiation process.

Design Requirement 1.   The framework must allow organisations to determine how disrupted the industry is in which they find themselves, and subsequently how urgent the implementation of the digital initiative is.

Design Requirement 2.   The framework must enable organisations to assess what customer need(s) should be addressed by the digital initiative.

Design Requirement 3.   The framework must enable organisations to map the customer journeys within the digital initiative.

Design Requirement 4.   The framework must assist organisations to determine how effectively they can design desirable customer journeys.

Design Requirement 5.   The framework must contextualise a digital organisation for the organisation to understand what digital dimensions and capabilities are relevant.

Design Requirement 6.   The framework must clearly state and explain the different capability maturity levels for each digital dimension, and each digital capability within the separate digital dimensions.

Design Requirement 7.   The framework must allow organisations to assess their perception of their maturity within each of the identified digital dimensions.

Design Requirement 8.   The framework must allow organisations to determine how accurate their perception of their digital capability maturity is.

Design Requirement 9.   The framework must allow organisations to assess to what extent they have encountered digital transformation challenges.

Design Requirement 10.   The framework must enable organisations to determine how far they are in their transformation journey.

Design Requirement 11.   The framework must present the results of the assessments in a clear and concise manner that contextualises each assessment's output to ensure that the relevant stakeholders can easily use the framework for decision support.

Design Requirement 12.   The framework must guide the organisations to critically evaluate the value creation potential of the different digital capabilities to support their decision as to which capabilities to invest in.

Design Requirement 13.   The framework must allow organisations to identify the challenges that they are most likely to face based on the digital capabilities that they are going to include in the digital initiative.

Design Requirement 14.   The framework must allow organisations to assess and evaluate their digital transformation progression.

4.8   Chapter 4: Conclusion

This chapter was used to further explore the phenomenon that organisations struggle with enacting value-adding digital transformations identified in Chapter 3 by looking at the challenges organisations face whilst undergoing a digital transformation. The research was conducted through using a systematic literature review, which is a rigorous research method to ensure the scientific legitimacy of the findings.

Various challenges were identified through the research, and 20 unique challenges were presented in a challenges landscape which categorised the challenges as either (i) contextual, (ii) technological, or (iii) external challenges. The categorisation was not mutually exclusive, and various challenges found their roots in more than one category.

The extent to which the identified challenges are experienced was then evaluated based on the approach that organisations take to enact a digital transformation. The conclusion was drawn that a digital transformation through the launching of digital initiatives experiences some of the identified challenges at a lower intensity, and thus the chance of enact a value-adding digital transformation is greater. As this is the objective of the research, this further supported the selection of this method, and subsequently addresses the second objective mentioned in Section 4.5 – a solution that mitigates the identified problems.

The following chapter introduces the development of the conceptual framework to assist organisations in enacting value-adding digital transformations, by using the digital initiative perspective. Chapter 5 thus serves as the solution as to how the problem statement, mentioned in Section 1.3 and contextualised in Chapters 3 and 4, will be addressed.

CHAPTER 5. EXISTING TRANSFORMATION FRAMEWORK REVIEW

5.1 Introduction

Upon the completion of the requirement specification in Chapter 4, 14 design requirements were identified. A conceptual framework was subsequently developed that aims to address the design requirements and thus achieve the objective of supporting organisations in the process of enacting a value-adding digital transformation through initiating digital initiatives.

Based on these requirements, a study was done to identify existing digital transformation frameworks or models through a systematic literature review, and to evaluate them based on their ability to meet the design requirements identified in Chapter 4. It was found that no model/framework adhered to all the specified design requirements.

The study of existing frameworks or models was also used as resource in the development of the conceptual framework presented in Chapter 6, where the list of existing frameworks or models is presented to organisations to use for Phase 1.2.1 in the conceptual framework. The use of the findings of this chapter will be discussed in Section 7.3.1.

The same methodology for performing a systematic literature review used in Chapter 4 was used in this chapter, and therefore the background information will not be discussed again. Reference will be made to the research done on systematic literature reviews in Chapter 4.

At the end of the chapter a conclusion will be drawn on to what extent existing frameworks or models are meeting the design requirements identified in this research, and as none do – the decision is made to further develop the framework. Figure 27 indicates how Chapter 5 fits into the thesis.
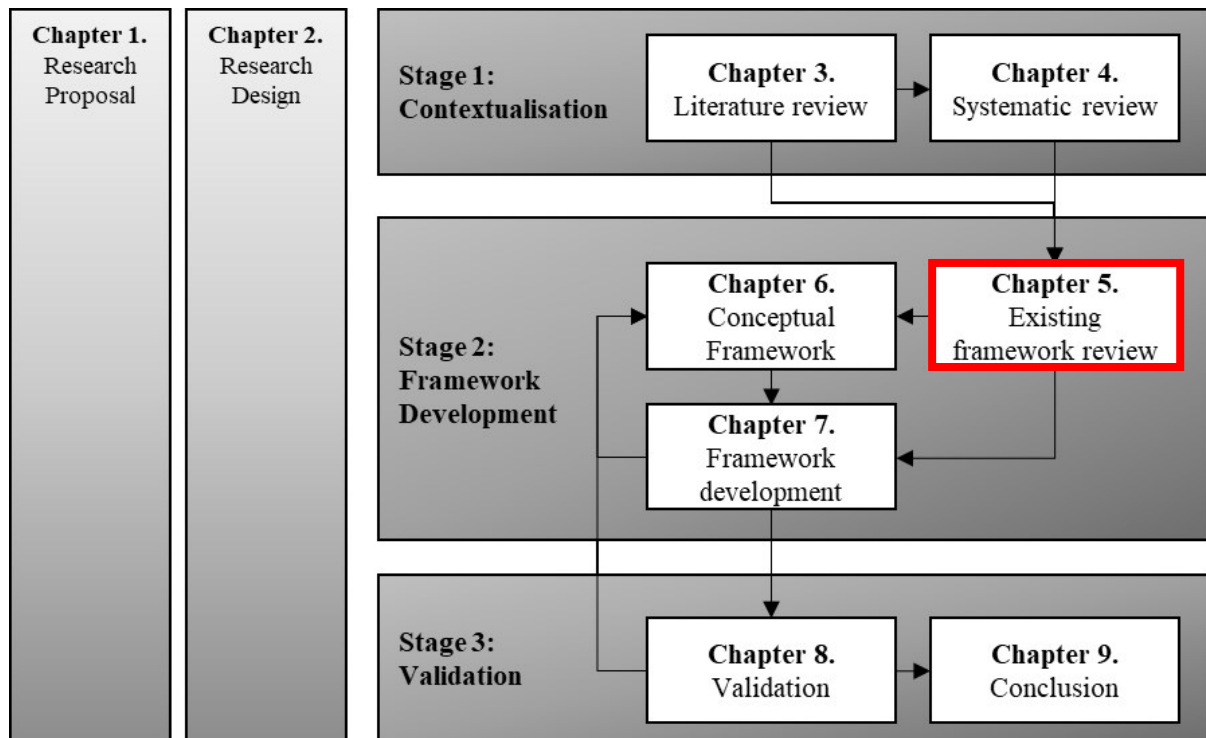
Figure 27: Research design: Chapter 5

5.2   Methodology

This section will describe the methodology followed to identify the relevant digital maturity models or frameworks. As with Chapter 4, Kitchenham's (2004) methodology will be used to guide the structure of the systematic literature review. The research method includes five stages – research identification, selection of studies, quality review, data extraction, and data synthesis. Each stage is contextualised in the following sections.

5.2.1   Research identification

Kitchenham's (2004) PCO framework was used to guide the creation of the research question, which led to the following research question: *What existing digital transformation models or frameworks are there that support organisations in a digital transformation?* The population was identified to be organisations undergoing a digital transformation, the context was the digital transformation process, and the outcome the model of framework that the organisations use.

The purpose of researching this question is to research the existing models in depth, to measure their ability to meet the design requirements identified in Chapter 4.

5.2.1.1   Research strategy

Keywords were generated based on the research question mentioned in Section 5.2.1. The population, context, and outcome were used as keywords, with synonyms then identified for each term. These were then used in SCOPUS, a scientific database, as a search algorithm to identify relevant research. Table 13 shows the different search terms.

Table 13: Systematic review keywords

Search Terms	
Keywords	**Synonyms**
Digital Transformation	Digitisation, Digitalisation
Transformation framework	Assessment model, assessment tool, transformation model, maturity model

5.2.2   Selection of studies

Inclusion and exclusion criteria were then identified to further ensure the relevance of the identified research. These criteria can be seen in Table 14.

Table 14: Study selection criteria

Criteria	Justification
Research published between 2000 and 2018	Digital transformation has been an active discussion since computers entered the societal frame around 30 years ago, but the term 'digital transformation' as defined in this thesis is looking specifically at the implementation of Industry 4.0 concepts. Papers before 2000 are therefore not included.

Papers published in English	Only papers available in English are included in the paper collection
Model/framework used by organisations, governments, and societies.	Any organisation – organisations, governments, or companies, forms part of the study - as the model will have to cater for any organisation wanting to digitally transform and must therefore include all entities. The search was therefore not limited to a specific type of organisation.
Journal articles, research articles, conference proceedings.	Research to be used in this systematic literature review includes peer-reviewed articles sourced from SCOPUS, as well as grey literature, such as reports compiled by governmental institutions or companies who are experienced in digital transformation.
Keywords must include: 'digital transformation', 'Industry 4.0', 'maturity model', 'Assessment', 'Framework'	This criterion was executed as a second iteration to further ensure the relevance of the identified research. It is used to limit the included literature to research that is strongly aligned to the research question.

5.2.3 Quality review

Once the search algorithm was executed, the abstracts were reviewed to further ensure the relevance of the research to the posed research question. In order for the paper to be selected as relevant, the content had to explicitly describe a digital transformation model or framework. Some of the papers addressed the review of other maturity models, and these papers were excluded. Refer to Figure 28 for a visual depiction of the iteration process.
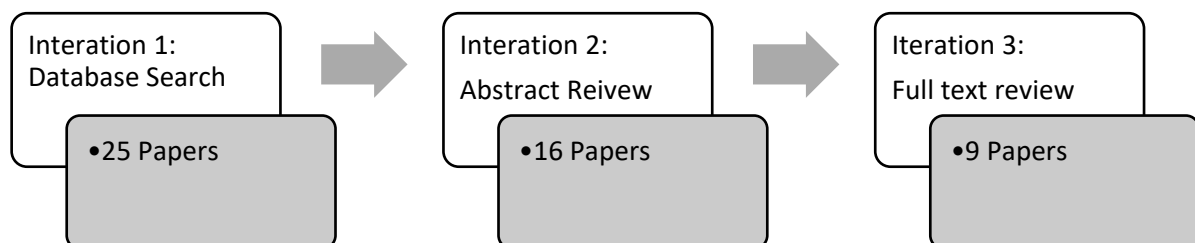
Figure 28: Quality review

5.2.4 Data extraction and synthesis

The relevant papers were researched, and the models were evaluated based on the requirements set out in Chapter 4. Each model was evaluated in such a manner that if the model addressed the design requirement in part, it was indicated as meeting the requirement. Each design requirement was individually assessed and looked for in each model. The results from this rigorous reviewing process can be found in summation in Section 5.5.

5.3 Bibliometric analysis

This section is dedicated to analysing the relevant papers that were identified to be used in this systematic literature review. Attention will be given to the publications per year and document and source type to validify the relevance of the work, as well as the keywords used and their respective occurrence rate within the relevant research.

5.3.1 Publications per year

Figure 29: Documents published per year

As can be seen from Figure 29, the number of papers in 2016 and 2017 are one each, with 7 being published in 2018. This indicates that the area of research is very relevant, as 78% of the work has been published in the first year of this research (2018).

5.3.2 Document and source type

As can be seen in the Figure 30, 88% of the relevant research is Conference Papers, further supporting the idea that the research is relevant and new. This also indicates that the research has not been scientifically reviewed sufficiently, as is the case with very new research.
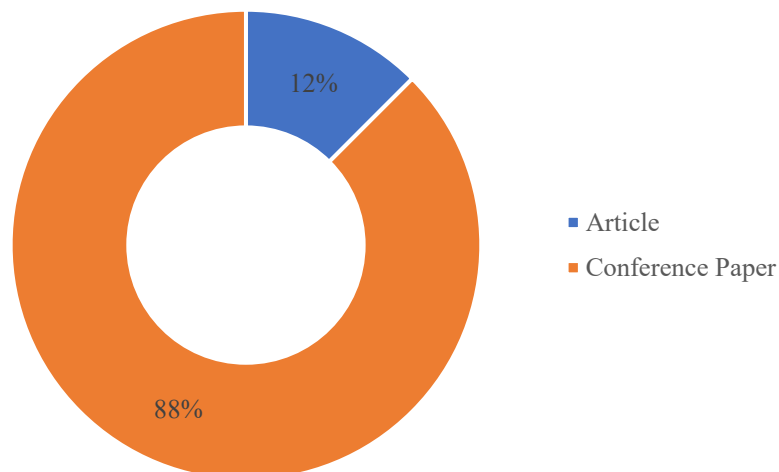
Figure 30: Document type

5.3.3 Keywords

Figure 31 below indicates the various keywords that were found throughout the relevant research, with 'Maturity Model' the most frequently used. 'Digital transformation' was next with six mentions, followed by 'Industry 4.0' and 'Maturity Assessments' with five and three mentions respectively. It can thus be concluded that capability maturity models are a very popular method to assist organisations in their digital transformations, and further validates the use of an interpretation thereof in Phase 1.2.1 of the framework.
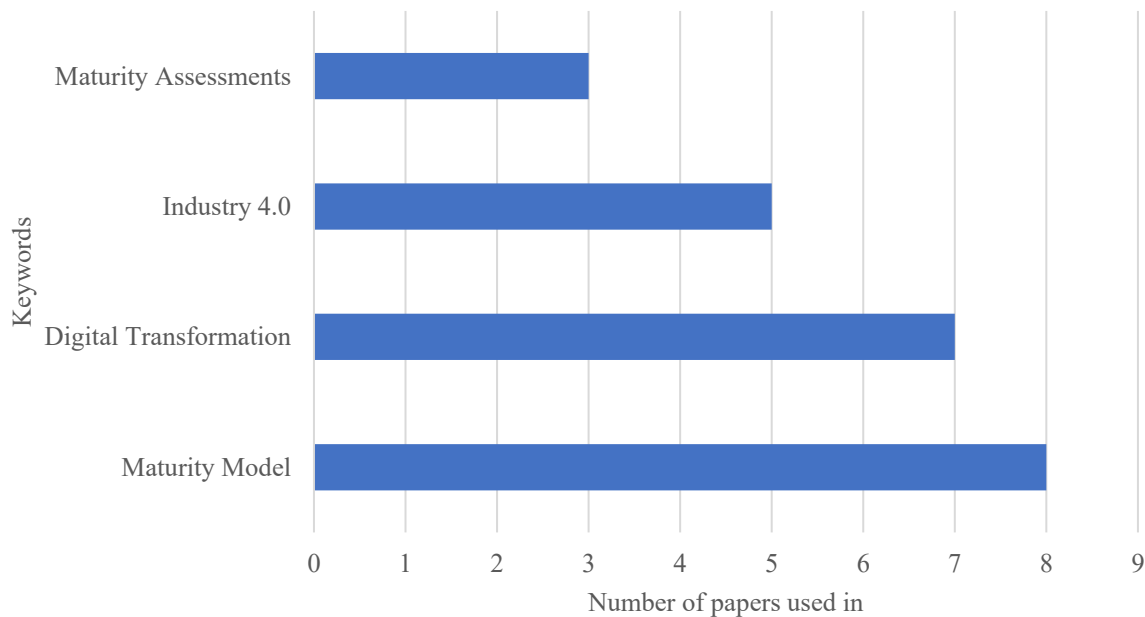
Figure 31: Keywords used in documents

5.4 Digital transformation frameworks or models

After reviewing all the relevant papers, nine models/frameworks were identified from literature. This section will elaborate on each of these models/frameworks to contextualise them, and then look at the extent to which the models/frameworks are meeting the design requirements.

5.4.1 SIMMI model

The System Integration Maturity Model Industry 4.0, or SIMMI 4.0, was developed to asses organisations' IT system landscape in the context of Industry 4.0. The authors identified the rapid development of technology in Industry 4.0, and the increased digitisation of products, services, and systems. This interconnectedness between the physical and virtual world poses various challenges for organisations (Leyh *et al.*, 2016).

Leyh *et al.* (2016) identified three key characteristics of Industry 4.0 that address: (1) the horizontal integration across value networks, (2) the strong vertical integration within the organisation's departments to allow for easy data flow up and down the organisation's hierarchy, and (3) a digital transparency in the value chain regarding the engineering facet.

SIMMI 4.0 looks to address the challenge of Industry 4.0 through the transformation of the organisation's IT department, as they identified the IT infrastructure as being central to a digital organisation. The model enables organisations to classify their own IT requirements within the needs of an Industry 4.0 system landscape (Leyh *et al.*, 2016).

The dimensions of SIMMI 4.0 identified in literature enable the model to assess an organisation's IT landscape. These dimensions include: (1) *Vertical integration* – the ability of dataflow up and down the organisation's hierarchy, (2) *Horizontal integration* – the interconnectedness of value networks within and beyond the boundaries of the organisation, (3) *Digital product development* – the digital representation of each process step in the product development stage, and (4) *Cross-sectional technology criteria* – the assessment of the extent to which Industry 4.0 technologies, such as Cloud computing, Cyber security, and Big data are used across the organisation.

SIMMI 4.0 consists of five stages – with each stage speaking to the level of digitisation that the organisation has achieved in its pursuit of a digital transformation. Activities required to achieve a higher stage are also incorporated. They include: (1) B*asic digitisation level* – the organisation has not addressed the Industry 4.0 needs, with the activities focused around shifting the organisation's focus to Industry 4.0, (2) *Cross-departmental digitisation* – digitisation has been implemented across departments, and the organisation is actively engaging over Industry 4.0 topics. Activities include developing cybersecurity and achieving departmental integration, (3) *Horizontal and vertical integration* – Industry 4.0's requirements have been implemented in the organisation and information flow between departments has been achieved. The improvement activities are focused around moving beyond the boundaries of the organisation and collaborating with other organisations, (4) *Full digitisation* – the organisation is completely digitised and integrated into value networks. The activities revolve around furthering the collaboration with different organisations to supply end-to-end solutions, and (5) *Optimised full digitisation* – the organisation is a flagship for Industry 4.0 concepts. The business model is digitised, information flow is easy, and cross-organisational collaboration is the norm.

5.4.2 DREAMY

DREAMY, or the Digital REadiness Assessment MaturitY model, was created using a framework that the authors validated through literature consisting of five stages – inception, elaboration, construction, deployment, and maintenance. This was used to design the model, with the architecture created within a manufacturing context, but as broadly as possible (Carolis *et al.*, 2018).

The model groups certain processes that the authors identified as being important for a digital organisation to function in a digital economy, with the five key areas being: (1) Design and Engineering, (2) Production Management, (3) Quality Management, (4) Maintenance Management, and (5) Logistics Management. The process areas are completely independent, thus allowing organisations to add or remove specific areas based on their importance for a specific organisation without affecting the overarching structure of the model. The model refers

to these process areas as being the *Digital Backbone* of manufacturing organisations transforming digitally (Carolis *et al.*, 2018)

The DREAMY model makes use of maturity levels to address the capabilities of each of the above-mentioned process areas. The maturity levels were inspired by the CMMI, with the definitions provided used as a baseline, after which certain adaptations were made to better fit the model. The model specifies five different maturity levels, with each distinct and encompassing all the preceding levels. These levels are: (1) Initial, (2) Managed, (3) Defined, (4) Integrated and interoperable, and (5) Digital-oriented. The model also emphasises the importance of integration within departments, as well as various organisations (Carolis *et al.*, 2018)

The model identified that the use and implementation of technology is not enough to ensure a successful digital transformation, and the subsequently identified four analysis dimensions to evaluate the digital readiness of the organisations. These include: (1) Process, (2) Monitoring & Control, (3) Technology, and (4) Organisation. These dimensions are applied to the processes within the organisation. The model uses a digital readiness questionnaire with normative answers of increasing maturity to assist organisations to gauge where they are in terms of digital maturity in each of the dimensions. (Carolis *et al.*, 2018).

5.4.3   Industry 4.0-MM

The Industry 4.0-MM was developed based on generally accepted software capability maturity models, such as ISO/IEC 15504 which named it the Software Process Improvement & Capability determination model, or SPICE model, and the Developmental Capability Maturity Model Integration. The purpose for this model was to develop a reliable framework for assessing the implementation of Industry 4.0 concepts in organisations, to improve their maturity levels so as to enable the increased value creation through the use of these technologies (Gokalp, 2017).

The SPICE model was used to ensure a baseline for assessing process capabilities in organisations, and to present the results on a common rating scale. The Industry 4.0-MM varies slightly from the SPICE model in the arrangement of Industry 4.0 dimensions – termed 'aspects' in this model. These aspects include: (1) Asset Management, (2) Data Governance, (3) Application Management, (4) Process Transformation, and (5) Organisational Alignment (Gokalp, 2017).

The Industry 4.0-MM makes use of the same maturity scale as the SPICE model, which used the CMMI as baseline, with the levels ranging from Level 0: Incomplete to Level 5: Optimising. The model's method is based on the succession of maturity levels, ranging from addressing the basic needs of Industry 4.0 to the full implementation of Industry 4.0 concepts. Each capability dimension consists of various generic aspect practices – activities when performed contribute to the achievement of the attributes of the relevant aspect (Gokalp, 2017).

The model aims to present organisations with a roadmap to implement Industry 4.0 concepts. Furthermore, it aims to benefit organisations in the following ways: development standardisation, increased quality, more flexibility, consistent benchmarking, enhancement,

increased competitive business advantage globally, creation of new, Industry 4.0-relevant jobs, and new products, services, and business models. The model has not been validated by experts as of yet (Gokalp, 2017).

5.4.4 360 Digital maturity assessment

The 360 Digital Maturity Assessment (DMA) is a maturity model that is based on the Problem Based Learning (PBL) model. The need was identified to guide organisations towards becoming digital organisations – with the 360 DMA model focused on providing guidelines for a diverse group of organisations. The composition of the model is similar to previous models, with organisations broken up into several digital dimensions, measured in maturity with various maturity levels. The assessment process is also discussed (Colli *et al.*, 2018).

The digital dimensions incorporated in 360 DMA model are as follows: (1) Governance, (2) Technology, (3) Connectivity, (4) Value creation, and (5) Competence. These digital dimensions were compiled using various other maturity models as resources (Colli *et al.*, 2018).

The capability maturity of each of these dimensions is then assessed and categorised according to six sequential maturity levels, namely: (1) None, (2) Basic, (3) Transparent, (4) Aware, (5) Autonomous, and (6) Integrated. Each of these stages follows the previous stage, as well as encompassing everything of all the latter stages (Colli *et al.*, 2018).

The assessment to determine the level of maturity of each digital dimension is based on the PBL model, with five sequential steps used for the data collection. These steps are: (1) Creation of awareness, (2) Definition of scope, (3) Data collection, (4) Evaluation and solution selection, and (5) Debriefing. These steps ensure that an organisation-specific outcome is reached, and it enables organisations to iteratively adapt their transformation plan to adjust to new technology and changing organisational goals and objectives (Colli *et al.*, 2018).

The assessment is questionnaire-based, with executives and various members of the organisation tasked with completing the questionnaire. The model was tested and validated in a large manufacturing organisation in Denmark (Colli *et al.*, 2018).

5.4.5 PSS model

The PSS maturity self-assessment tool was developed to help organisations overcome the challenges of a digital transformation. The digital state of the organisation is measured according to four digital dimensions, with the level of capability categorised according to five maturity stages (Exner, Balder and Stark, 2018).

The four dimensions of the PSS Model are: (1) Value proposition, (2) Business processes, (3) Customer, and (4) Sustainability. Each of the dimensions is further divided into (1.1) Degree of individualisation, (1.2) Service degree, (2.1) PSS management, (2.2) PSS orientation, (3.1) Customer demands, (3.2) Customer integration, (4.1) Sustainable management, and (4.2) End-of-life responsibility (Exner, Balder and Stark, 2018).

The eight dimensions are measured according to a set of five maturity levels, which include: (0) Novice, (1) Beginner, (2) Advanced, (3) Experienced, and (4) Expert. Each of these levels

describes a different level of digital capability maturity in each identified dimension, with each next level encompassing the previous levels (Exner, Balder and Stark, 2018).

Once the digital dimensions have been evaluated in terms of their digital maturity, the model presents organisations with generic actions to attain specific levels of maturity for each digital dimension, which are used to guide the digital transformation strategy of the organisation (Exner, Balder and Stark, 2018).

Organisations answer normative questions related to the different digital dimensions which guides them to assess what level of capability maturity they exhibit in each digital dimension. This assessment tool is available online, with focus put on the comprehensibility of the tool. The model was validated through a case study on a manufacturing SME (Exner, Balder and Stark, 2018).

5.4.6 IMPULS model

The IMPULS model was developed to assist Malaysian SMEs in their pursuit of a digital transformation. The model consists of six digital dimensions – each with a relative, different rating of importance. The digital maturity of each dimension is measured according to six different maturity levels. The key objectives of using this model for a digital transformation according are to increase competitiveness, utilise opportunities, and adjust talent and IT resources (Hamidi *et al.*, 2018).

The IMPULS model consists of six dimensions, namely: (1) Employees, (2) Strategy and organisation, (3) Smart factory, (4) Smart operations, (5) Smart products, and (6) Data-driven services. Each of these dimensions was ranked relatively in terms of its importance in a digital organisation (Hamidi *et al.*, 2018). Organisations were asked to rate the relative importance of each dimension, and the outcome according to Hamidi *et al.*, (2018) is as follows:

1. Employees – 18%
2. Strategy and organisation – 25%
3. Smart factory – 14%
4. Smart operations – 10%
5. Smart products – 19%
6. Data-driven services – 14%

The digital maturity of each digital dimension was then qualitatively calculated through questionnaires being sent to organisations and based on the level of maturity and the relative importance of the dimension, organisations are guided in creating a digital transformation strategy for their organisation (Hamidi *et al.*, 2018).

5.4.7 SM^{3}E

This model is aimed at providing SMEs with a Smart Manufacturing Maturity Model, referred to as SM^{3}E. The model enables and assists SMEs during their digital transformations and does so through three axes: (1) Organisational dimensions, (2) Toolboxes, and (3) Maturity levels. It was developed through a combination of literature reviews and expert interviews with personnel from SMEs. Holistically, this model is aimed at guiding SMEs to smart

manufacturing and Industry 4.0 (Mittal, Romero and Wuest, 2018). The model identified various digital dimensions and sub-dimensions, as can be seen in Table 15:

Table 15: SM3E organisational dimensions (Mittal, Romero and Wuest, 2018)

Dim.	Finance	People	Strategy	Process	Product
Sub-dim.	• Cost-benefit analysis • Budgeting and cost control • Investments risk & return management	• Leadership • Customer feedback • Safety & ergonomics • Training & education	• Knowledge management • Decision-making & support • Standards • Legal/tax policies • Sustainability guidelines • Government regulations	• Quality control • Job scheduling • Repair & maintenance • Machines operation • flexibility	• Logistics • New product development • Packaging • Modularity • Time to market

Each of these digital dimension's digital maturity is rated according to a maturity scale, which includes the following maturity levels: (1) Novice, (2) Beginner, (3) Learner, (4) Intermediate, and (5) Expert (Mittal, Romero and Wuest, 2018).

The model also provides organisations with several toolkits – defined as "[…] a set of methods, tools, and practices that can lead towards a final goal." These toolkits include: (1) Manufacturing and fabrication, (2) Design and simulation, (3) Robotics & automation, (4) Sensors & connectivity, (5) Cloud/storage, (6) Data analytics, and (7) Business management. Each of these toolboxes is applied in every digital dimension to assist the organisation in increasing its maturity in said digital dimension. It suggests actions that can be taken in the digital dimensions for each maturity level to ensure that maturity level is reached. Together these toolboxes create digital capabilities in each digital dimension (Mittal, Romero and Wuest, 2018).

By using the model, organisations will be able to find their maturity level for each digital dimension, and the toolboxes will enable them to identify what is required from them to increase the maturity of each of the digital dimensions (Mittal, Romero and Wuest, 2018).

5.4.8 **Digital value creation model**

The purpose of this model is to critically analyse the digital value creation within organisations. Literature research was conducted in conjunction with industry-expert interviews, and 22 digital initiatives were identified, categorised according to four digital categories. Each of these categories' digital maturity is evaluated according to a maturity scale and compared to the value creation evaluation of each dimension. Based on this, guidance is given to organisations in terms of where they should be looking to invest resources to create significant value for their organisation (Burosch, 2018).

The model categorised the various digital initiatives into the following four categories: (1) Digital business models, (2) Digital business operations, (3) Digital marketing & sales, and (4)

Digital mindset. Each of the latter digital categories consists of between five and six different dimensions which are all aimed at value creation according to profit, revenue, and enterprise value growth. Each of these categories is then viewed from two perspectives – digital maturity, and value creation potential (Burosch, 2018).

The digital maturity evaluation and value creation assessment is done according to a maturity scale consisting of five levels. These levels are: (1) Non-existent, (2) Low, (3) Rather low, (4) Rather high, and (5) high. Organisations were tasked with completing questionnaires that guided them to determine their level of maturity and value creation potential in each digital category (Burosch, 2018).

From this assessment, organisations can determine what digital categories should be invested in to create value for the organisation. The model also sees the current level of digital maturity as a measure of how far the organisation is in its transformation journey, and the combined result of the value creation potential and digital maturity as the recommendations for action (Burosch, 2018).

5.4.9 Digital transformation through information society development framework

Ershova & Hohlov (2018) developed a digital transformation framework through the implementation of the information society development framework. They argue that the success of a digital transformation is the creation of an ecosystem between digital transformation and its management. At the centre of the framework is a set of overarching objectives to ensure all the relevant stakeholders understand the process and all the accompanying components.

They listed eight key concepts that must be considered in a digital transformation (Ershova and Hohlov, 2018b):

1. Strategies and policies that lay out the digital development.
2. A regulatory framework that speaks to the legislative requirements of the process.
3. The relevant organisational structures.
4. The human capital involved in the process (leadership, digital skills, managerial capacity, etc.)
5. Relevant sector of the economy pertaining to the organisation.
6. Digital technologies – relevance, accessibility- and affordability-wise.
7. Financial support of the process through sponsors, partnerships, investments.
8. Regional and/or sectoral policies.

These concepts must be integrated in a coherent way to form a digital ecosystem that will contribute towards the successful digital transformation. They propose seven stages of executing the process (Ershova and Hohlov, 2018b).

Stage 1 includes the analysis of existing policies and strategies that pertains to the digital transformation process, and further includes the contextualisation of the process to all the relevant stakeholders to ensure their buy-in. This stage also includes an analysis of the as-is state of the organisation's digital capabilities and how enabled the organisation is in the digital economy (Ershova and Hohlov, 2018b).

Stage 2 focuses on (i) developing a strategic vision that lays out how the process will be executed and what the relevant roles of the different stakeholders are, (ii) the creation of a working coalition of partners who represent all the various stakeholders, and (iii) the forming of a structure that will manage the digital transformation process (Ershova and Hohlov, 2018b).

Stage 3 focuses on getting the approval of the proposed strategy at all relevant levels – internally and externally. Stage 4 includes the development and approval of action plans to execute the strategy on all relevant levels. Stage 5 evaluates existing digital initiatives in the organisation's context and guides the organisation to determine priority initiatives. Stage 6 mobilises the required resources to execute the transformation process, and Stage 8 develops a feedback function to measure the progress of the process (Ershova and Hohlov, 2018b).

5.5 Design requirement evaluation

Table 16: Existing model/framework evaluation

	Model/Framework	Design requirements													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	SIMMI 4.0					x	x	x				x			
2	DREAMY					x	x	x				x			x
3	Industry 4.0-MM					x	x	x				x			
4	360 Digital Maturity Assessment		x			x	x	x		-		x	x		x
5	PSS Model		x			x	x	x				x	x		
6	IMPULS Model		-			x	x	x				x	-		
7	SM^{3}E					x	x	x				x			x
8	Digital Value Creation Model	-	x			x	x	x			-	x	x		
9	Information society framework		x			x	x	x				x	x		x

Source: (Leyh *et al.*, 2016; Gokalp, 2017; Burosch, 2018; Carolis *et al.*, 2018; Colli *et al.*, 2018; Ershova and Hohlov, 2018a; Exner, Balder and Stark, 2018; Hamidi *et al.*, 2018; Mittal, Romero and Wuest, 2018)

As can be seen in Table 16, not one of the identified models/frameworks adheres to all the design requirements from the requirement specification. An 'x' indicates the design requirement was met, a '-' indicates it was partially met, and an open block indicates it was not met at all. Models/frameworks 4, 5, 8, and 9 are the closest, with focus in those models/frameworks also put on value creation, whereas the other models/frameworks are simply used for digital maturity assessments. All of the models/frameworks contextualise a digital organisation, use various digital dimensions to describe a digital organisation, and enable organisations to assess their digital maturity within the identified digital dimensions on some sort of maturity scale. Some of the models/frameworks use normative methods to assess the maturity, where others use a Likert-scale to determine the digital maturity of the dimensions.

None of the models/frameworks speaks to the challenges that organisations face when undergoing a digital transformation, and subsequently do not address the difference between the perception of digital maturity and the actual maturity of the identified dimensions. All of

the models/frameworks assume that the qualitative assessment methods they propose, all through questionnaires, will provide organisations with an accurate representation of their digital maturity. The models/frameworks which use normative descriptions for each maturity level in the assessments exclude most of the personal bias accompanied with using a Likert-scale, as identified in the requirement specification, but do not adequately eliminate the subjectivity of such assessments. The models/frameworks do not specify who should answer the various parts of the questionnaires, thus further increasing the discrepancy between the perception of digital maturity and the actual digital maturity.

Only model 8 and framework 9 adequately addresses value equations in the model/framework – with an equal amount of emphasis put on the digital maturity assessment and the value creation potential of different capabilities and initiatives. This guides organisations to effectively use their resources to invest it into initiatives that will create value for them.

Most of the models/frameworks are specifically aimed at manufacturing organisations, with only models/frameworks 4, 5, 8, and 9 fully able to be applied in different organisations, and even these are limited to SMEs. It was also found that every model/framework identified in this non-exhaustive list of existing models/frameworks included a Capability Maturity Model (CMM) element, which indicates that this method is preferred when identifying the digital As-Is state of the organisation.

Based on these findings, it can be concluded that no existing model/framework adequately addresses all the design requirements presented in Chapter 4, and the decision was thus made to develop a conceptual framework to address all the design requirements.

5.6   Chapter 5: Conclusion

This chapter aims to systematically review existing models and frameworks to determine the novelty of a framework which would address all of the mentioned design requirements. It was found that no existing framework or model addresses all of the generated design requirements, and subsequently validated the novelty of the proposed framework.

The conclusions drawn from the chapters up to and including Chapter 5 are that (i) there is significant value to be created through digital transformations, (ii) organisations find it difficult to enact value-adding digital transformations, (iii) there are various relevant concepts that are value-adding when considered in the process of a digital transformation, and (iv) no existing framework addresses all of these concepts.

The next chapter will be dedicated to the development of the digital transformation framework on a conceptual level. The various concepts that were identified in the preceding chapters are integrated into a framework that addresses the design requirements presented in Section 4.7. Each phase will be contextualised, and reference will be made to the design requirements that it is addressing.

CHAPTER 6. CONCEPTUAL FRAMEWORK DEVELOPMENT

6.1 Introduction

Through the preceding literature-based chapters it became evident that organisations struggle to enact value-adding digital transformations. The conclusion was drawn from literature and discussions with subject matter experts that there are various ways of enacting a digital transformation, and Section 3.6 contextualises the method proposed in this research – through the implementation of digital initiatives. In Chapter 4 the challenges that organisations face whilst undergoing a digital transformation are discussed, and a comparison was made between transforming the entire organisation and doing so incrementally through digital initiatives, and how the challenges are experienced in the respective approaches. Subsequently the conclusion was drawn that a digital transformation through digital initiatives from within the organisation, that incorporates some of the digital capabilities elaborated on in Section 7.3.1, mitigates and/or reduces the severity of several of the challenges, and thus increases the chance of enacting a value-adding digital transformation (refer to Section 4.6 for an evaluation of the digital transformation challenges).

This chapter is concerned with the development of a digital transformation framework in order to address the design requirements mentioned in Section 4.7. Background is provided on the rationale for such a framework.

The framework consists of two phases – each phase within the framework is contextualised and linked back to literature discussed in Chapters 3 and 4. The framework is further elaborated on in Chapter 7, where attention is given to the expansion of the various tools proposed in Chapter 6. Figure 32 indicates how Chapter 6 fits into the thesis.
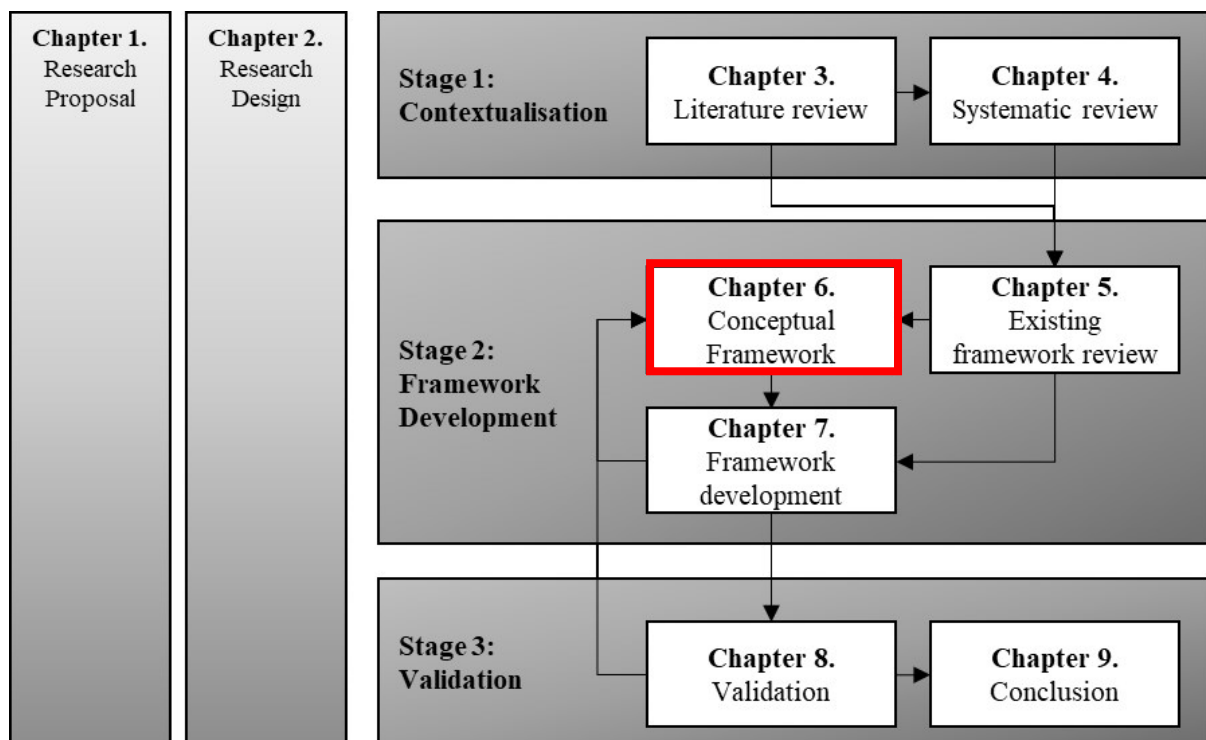
Figure 32: Research design: Chapter 6

6.2   Overview

The previous literature-based chapters came to two significant conclusions regarding digital organisations and digital transformations – (i) there is significant value to be created in Industry 4.0, and (ii) organisations find it difficult to enact a value-adding digital transformation. These conclusions were further validated through semi-structured interviews with multiple subject matter experts, with the results presented in Section 8.4.1. Based on these conclusions, it was established that there exists a need for resources that will aid organisations in enacting value-adding digital transformations through the implementation of digital initiatives.

As mentioned in Sections 3.3.2 and 3.3.3, digital transformations are driven by customer satisfaction, speed-to-market, and profitability (Babar and Yu, 2015), and subsequently their transformation objectives are (i) the offering of a desirable and profitable customer experience through their products and services, and (ii) effective and efficient operational business processes (Westerman *et al.*, 2011). From these drivers and objectives, it became evident that for organisations to successfully transform and be profitable, they must understand how their value proposition to customers will change in order to provide them with the best possible customer experience, and how their business operations and model will change to facilitate the customer experience transformation. The need to understand how the customer value proposition will change and how that is linked to the sustainable success of organisations was validated through semi-structured interviews with subject matter experts (refer to Section 8.4 for the results of the validation).

The digital initiatives will need to give effect to the adapted customer value proposition mentioned above. Organisations experience various challenges whilst undergoing a digital transformation, and Chapter 4 was dedicated to determining these challenges through a systematic literature review. Through undergoing a digital transformation through the launching of digital initiatives, some of these challenges can be mitigated – as discussed in Section 4.6.

As the scope of this framework focuses on firm/organisational level and not on any specific industry, the framework developed here is applicable to organisations from all industries. The purpose of this framework is not to present organisations with step-by-step instructions of how to initiate digital initiatives, as organisations vary too much, but rather to guide executives of organisations to consider concepts that are relevant within the context of Industry 4.0, and to support them in making decisions regarding these concepts that will lead to the initiation of a value-adding digital transformation through the implementation of digital initiatives. The research efforts thus culminated in the development of the: ***Digital Initiative Initiation Decision-Support (DIIDS) framework.***

It should be noted that the application of the framework is not linear – rather the framework should be applied in an iterative manner where the user can periodically re-evaluate the various phases and sub-phases to (i) ensure the decision-support remains relevant to the digital initiative(s) and the organisation(s), and (ii) allow the organisation(s) to apply an agile, failing-forward approach to the initiation of the digital initiative(s). This approach is supported through (i) literature discussed in Section 3.7 that speaks to agile business models, and (ii) semi structured interviews with subject matter experts.

6.3 Framework development approach

This section elaborates on the approach followed to develop the ***DIIDS framework***. The conceptual framework is developed with a combination between Jabareen's (2009) conceptual framework methodology, and Du Preez *et al's.* (2015) enterprise design methodology, as discussed in Section 2.4. Phases 3 through 6 from Jabareen's methodology led to the developed framework presented in this chapter, with this section elaborating on the process followed to develop the final framework. The Enterprise Engineering methodology (Du Preez *et al.*, 2015) was applied as a supporting method during phase 6 of Jabareen's methodology to guarantee the digital initiative(s) are underpinned by a methodology that would ensure its ability to function separately from the parent organisation as an independent enterprise.

Jabareen (2009) defines a conceptual framework as "[…] *a network, or 'a plane', of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena.*" This was further developed into various phases that, when completed in succession, facilitates the development of a conceptual framework. Phases 3 through 6 speak to the identification of relevant concepts, the categorisation and integration of said concepts, and finally the development of a conceptual framework. The process followed for the development of this conceptual framework was done accordingly. The relevant concepts were identified through literature in Chapters 3 and 4, supported by exploratory semi-structured interviews with subject matter experts. The identified concepts (phases 3 & 4) are:

- **Digital disruption** – Effect caused by Industry 4.0 on various interlinked sectors relevant to the organisation – (Section 3.3).
- **Customer- needs and experiences** – The required focus of organisations on customers and their needs and experiences (Sections 3.2.3.2; 3.3.3.4; 3.4.2.1; 3.5.3.2; 3.8.6).
- **Digital capabilities** – The organisational structure of digital organisations and how that differs from traditional organisational capabilities (Section 3.8).
- **Value equation –** Prioritisation of specific capabilities/initiatives that creates value for the organisation (Section 3.5).
- **Digital transformation challenges –** Organisations face various challenges that inhibit value-adding digital transformations (Chapter 4).

These concepts were then integrated (phase 5) and developed into a conceptual framework (phase 6) using a combination of Jabareen's (2009) methodology and Du Preez *et al's.*, (2015) methodology of designing enterprises, which is elaborated on below.

Due the digital transformation framework aiding executives in the initiation of digital initiatives and subsequently their decision-making process, the *deployment* phase from the enterprise engineering process is excluded from the scope of this research. The DIIDS Framework is thus focused on the *initiation* and *master planning* phases, and the layout of the DIIDS Framework was designed based on these phases. The enterprise engineering process was used as a guideline to design the structure of the DIIDS Framework to ensure the integration of the various concepts identified earlier in this section, as required from phase 6 in Jabareen's methodology. The layout of the DIIDS Framework and the integration between the two methodologies is shown below.

Based on the enterprise engineering process and the five concepts that the DIIDS Framework should address, the DIIDS Framework consists of two phases:

Phase 1 – *Digital contextualisation* – the overarching phase that addresses all of the enterprise engineering phases except the transition planning phase.

Phase 1.1 – *Customer value design* – which serves as the definition and identification and To-Be concept design.

Phase 1.2 – *Digital organisational profile* – which serves as the As-Is analysis and To-Be concept design.

Phase 2 – *Assessment integration and value equation* – which serves as transition planning.

The various phases, concepts, and design requirements were combined and integrated to design and develop the DIIDS Framework. Figure 33 shows a diagrammatic representation of the developed framework, with focus put on the phase, the process, and the outcome of each phase. Each phase is elaborated on in the following sections.
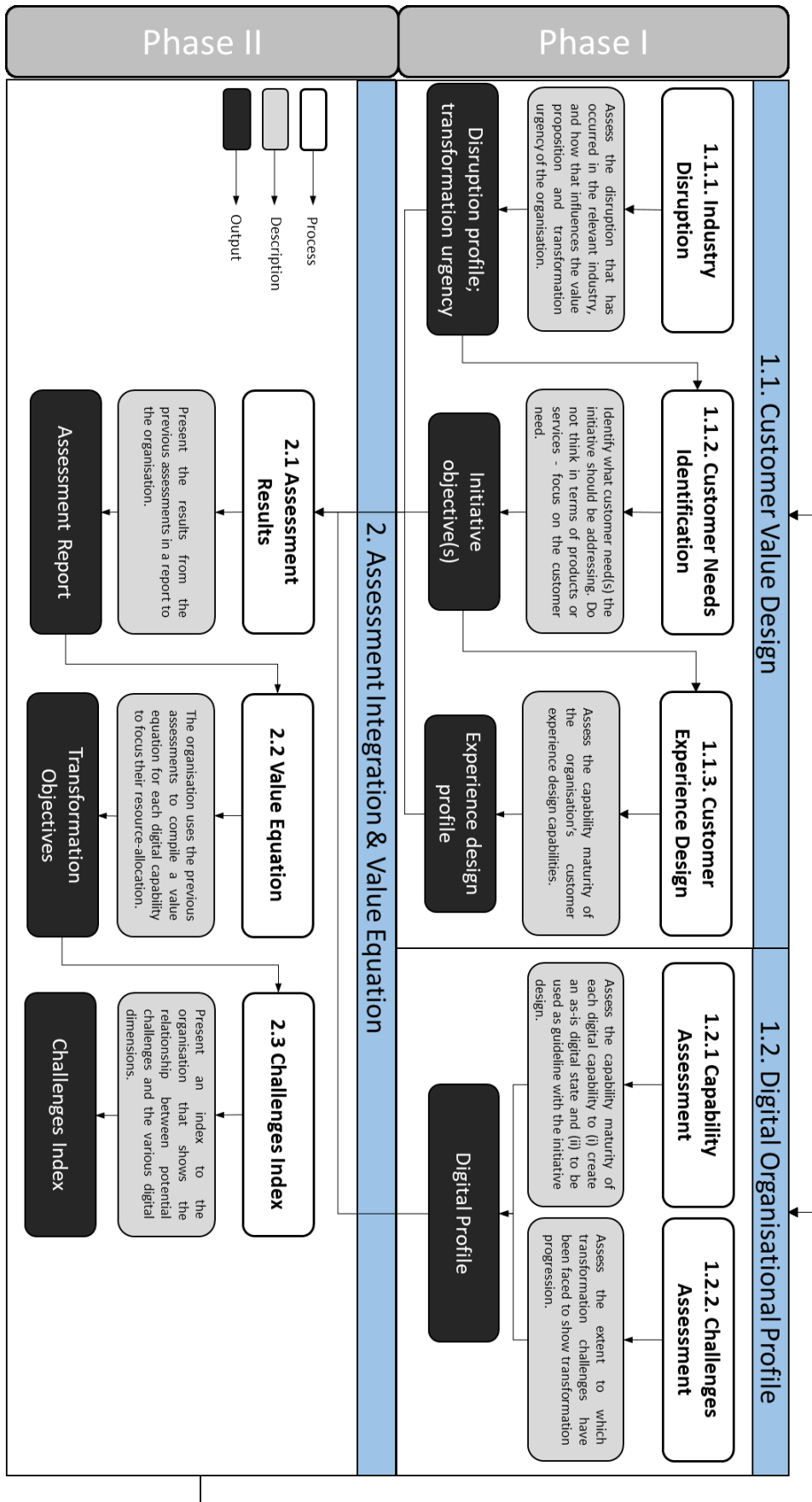
Figure 33: DIIDS framework

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6.4 Framework development

This section contextualises the various phases included in this conceptual framework. This section seeks to conceptually explain what the phase aims to achieve, with the expansion of the tools proposed in each phase addressed in Chapter 7.

The framework is divided into two phases. Phase 1, which is further divided into five sub-phases related to the customer value design (Phase 1.1), and digital organisational profile (Phase 1.2), comprises of the concepts that the author identified to be relevant to a digital transformation, and aims to conceptually elaborate on the role that each sub-phase plays in the framework. Each sub-phase in Phase 1 aims to guide the user to consider the relevant concept, and conceptually develops a process that the user could undertake (i) to undergo an educational process to learn about the concept and its role and impact in Industry 4.0, and (ii) to gather relevant information to aid in their decision-making process pertaining to the relevant concept.

Phase 2, which is further divided into three sub-phases, aims to integrate the outputs of Phase 1 into a useable, decision-support resource. The following sections elaborates on each phase and the relevant sub-phases.

6.4.1 Phase 1.1 – Customer value design

Established organisations often fail because they try to satisfy changing customer needs with traditional methods (Straker, Wrigley and Bucolo, 2013). Their lack of progression and transformation has allowed digital innovations to absorb parts of their market share and caused systemic effects in markets and industries. These digital innovations and the effects they cause for established organisations are referred to as *digital disruption,* and are defined by Skog, Wimelius & Sandberg (2018) as follows, "*The rapidly unfolding processes through which digital innovation comes to fundamentally alter historically sustainable logics for value creation and capture by unbundling and recombining linkages among resources or generating new ones."*

This phase of the framework looks at the disruption Industry 4.0 has caused, and how that has influenced the value proposition of organisations. Organisations create value through addressing specific customer needs and using their business operations to give effect to the solution to the customer needs in the form of a product or service (Ernst & Young, 2013). The framework must thus look at what needs customers are willing to pay for, and how the digital initiatives will address the new customer needs.

Phase 1.1 is divided into three sub-phases: (1.1.1) *industry disruption*, (1.1.2) *customer needs identification,* and (1.1.3) *customer experience design*. Phase 1.1.1, industry disruption, considers the disruption that is relevant to the specific industry and creates a disruption profile based on four disruption domains that were identified through literature: (i) the market, (ii) competition, (iii) technology, and (iv) customer demands. Phase 1.1.2 considers identifying what customer needs the organisation is and should be addressing, without looking at its product or service offering. The customer demand disruption is used to guide this phase. Phase 1.1.3 guides the organisation to (i) map the existing and potential customer journeys that the initiative will address, and (ii) assess their customer experience design capabilities.

6.4.1.1 Phase 1.1.1 – Industry disruption

Digital initiatives in this context can be considered as digital innovations, as discussed in Section 3.3.4. The technologies mentioned in Section 3.2.2 are impacting organisations, society, and the economy, as discussed in Section 3.2.3. This widespread impact has changed how organisations do business with their customers, and also what the value proposition of an organisation is.

As mentioned in Section 3.2.3.2, organisations face disruptive threats from established organisations crossing industry boundaries with new digital capabilities that Industry 4.0 offers, along with start-up organisations who are building their organisations on digital platforms (Schwab, 2016). The disruption organisations face varies between different industries and can be measured according to two metrics: the size of the impact of the disruption, and the time it takes before it makes an impact. These metrics play a role in the strategy organisations adopt for their digital initiatives. If the organisation finds itself in a heavily disrupted industry, the digital initiative must be planned urgently and must be executed rapidly. If the industry is less disrupted, the digital initiatives may be implemented over a longer time period with less urgency. Based on the level of disruption experienced within the relevant industry, the digital transformation strategy organisations follow differ (Brinkley, 2012; Bughin, 2017).

Disruption was researched and conclusions were drawn on the various domains that disruption can occur in. These domains include:

(i) **The legislative environment** – Regulations and policy changes could inhibit progression (for example, governments introducing new regulations to meet the COP21 agreement) or allow competitors to progress without being subject to regulations.

(ii) **Technology** – New technology is being developed to increase operational effectiveness and efficiency and subsequently enables organisations to cut expenditure and become more profitable, as well as create new business avenues (for example, developing mobile applications was not a source of revenue 20 years ago) which can also increase profitability.

(iii) **Changing customer demands** – Due to the customer-centricity of many of the Industry 4.0 concepts customer demands keep changing and this disrupts an organisation's value proposition. Customers want better products and services, an overall enjoyable customer experience, for less money, and in less time.

(iv) **Competitors** – Established organisations enter new industries (for example, Discovery entering the banking industry) and start-ups are taking market share and threatening incumbents' sustainability.

(Porter, 1980; Accenture, 2017; Schwieters *et al.*, 2017; Schreiber, Forer and De Yonge, 2018).

The disruption domains are elaborated on in Section 3.3.3.

Phase 1.1.1 guides organisations to consider the disruption that the relevant organisation has experienced within the various disruption domains mentioned in the previous paragraph. The level of disruption will indicate to the organisations (i) whether they are a digital leader or a

fast follower, and subsequently (ii) what their transformation urgency, and thus their digital initiative strategy, should look like, and (iii) how the disruption has influenced the organisation's customer value proposition.

This phase can be used by the organisation to determine if the organisation is in need of a digital transformation – if the four disruption domains exhibit low levels of disruption, the organisation could consider not undergoing a digital transformation. This decision would determine whether the user would continue using the framework.

6.4.1.2   Phase 1.1.2 – Customer needs identification

For the organisation to understand why a digital transformation is required, the organisation must first understand where it is creating value for its customers. Value creation is defined as follows, "[…] *value is created through an organisation's business model, which takes inputs from the capitals and transforms them through business activities and interactions to produce outputs and outcomes that, over the short, medium and long term, create or destroy value for the organisation, its stakeholders, society and the environment*" (Ernst & Young, 2013). This phase will thus be used to assist the organisation to identify where they are and should be creating value for their customers.

Although it became evident from Section 3.4.2.1 that focusing on the customer experiences yields strong returns, the challenge organisations experience is understanding what the customer needs are, as indicated in a study by the Altimeter group, where 53% of interviewed organisations indicated that they find it 'extremely difficult' to understand customer behaviour (Solis, 2014).

Based on the above definition of what value is and how it is created through business processes, and the fact that organisations struggle with understanding customer needs, the framework will guide the organisation to consider a tool that will enable them to gain a better idea of the specific customer needs they are, and should be, addressing through the digital initiative. At this stage the product or service that is giving effect to the solution should not be considered. This phase lays the foundation for the entire digital initiative as it positions the initiative in the correct industry and market.

The disruption that the organisation has experienced with regards to changing customer demands is considered in this phase. The development of this phase can be found in Section 0.

6.4.1.3   Phase 1.1.3 – Customer experience design

Through focusing on the customer experience, organisations stand to gain a significant advantage over their competitors (Accenture Interactive, 2013). As mentioned in the previous section, Section 3.4.2.1 addresses the stock market performance of organisations who focus on customer satisfaction, compared to those who do not. Accenture Interactive (2013) studied organisations over a six-year period and found that organisations who focused on the customer experience made cumulative gains of 43%, compared to the S&P Index of 14.5% cumulative gains. Organisations who failed to prioritise the customer experience achieved cumulative returns of -33.9%.

The focus on customer experience is moving from providing a customer with a desirable product or service to providing them with a desirable end-to-end customer experience. Organisations are starting to consider the multiple interactions that customers have with their organisation, and what the accumulated effect is on the customer's perception of the organisation. These various interaction-platforms between the customer and the organisation are referred to as touchpoints (Maechler, Neher & Park, 2016; Rawson, Duncan & Jones, 2013).

Organisations realise that each touchpoint contributes to the experience of the customer, and instead of taking a siloed approach and looking at each touchpoint individually, organisations should be looking at how customers perceive the entire journey. McKinsey & Company (2017) explored the effect of focusing on customer journeys rather than the individual touchpoints, and found that in the health insurance industry, organisations achieve 73% more customer satisfaction than organisations who focus on individual touchpoints. In the hotel industry customers are 61% more willing to recommend a hotel service if the hotel is focused on their customer journey (Duncan *et al.*, 2017).

Satisfying your customers' needs translates into creating value for your organisation, supported by a London School of Economics study that found that an average increase in Net Promotor Score[4] of 7% correlates with an average 1% growth in revenue (Forhez and Evans, 2018). A Harvard Business Review study found that satisfied customers spent 140% more than those who had bad past experiences at an organisation. McKinsey & Company argue that organisations who manage to improve the customer journey can see revenue increases of as much as 15%, whilst cutting expenditures by up to 20% (Forhez and Evans, 2018).

Due to the changing nature of organisations' understanding of what constitutes a good customer experience through focusing on customer journeys, and the financial benefits of increasing the focus on customer experience, the DIIDS Framework will focus on customer experience design – it will use the customer needs identified in the *Customer Needs Identification* as guide, and customer journeys will be designed around these specific customer needs for the digital initiatives.

This phase includes two parts: (i) the mapping of existing customer journeys, and the customer journey that the digital initiative will propose, and (ii) analysing the customer experience design capabilities of the organisation. Thus, this phase will assist organisations in (i) realising the importance of customer journeys, (ii) understanding what their customer journeys are going to look like and should look like, and (iii) determining how effective the organisation is in designing and creating customer journeys.

6.4.2 Phase 1.2 – Digital organisational profile

As discussed in Section 3.8, digital organisations comprise of various digital dimensions. Within each of these dimensions there exist multiple digital capabilities that, when present, support the operations of a digital organisation. The digital dimensions are divided into three categories. Guiding dimensions, which includes strategy and leadership, focus on aligning the

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[4] The Net Promoter Score (NPS) measures customer experience and predicts business growth (*What Is Net Promoter?*, no date).

digital initiative(s) with the overall vision of the organisation, and ensuring the strategy and leadership structures are in place to drive the implementation of the digital initiative(s), as a successful digital transformation is driven from the top down (Westerman *et al.*, 2011).

The second category is the enabling digital dimensions – which includes (i) Business operations, (ii) Organisational culture and people, (iii) Product and service offering, and (iv) Technology. The digital capabilities within these digital dimensions give effect to the digital transformation strategy and are used as the building blocks of the digital initiative(s).

The last category is the objective category – customer experience. The objective of digital organisations is to increase operational efficiency and effectiveness (Westerman *et al.*, 2011) to ultimately be more customer-centric, and to prioritise the customer experience throughout the organisation (Schwab, 2017). Thus, the digital dimensions work together as follows: the *guiding dimensions* stipulate how the *enabling dimensions* must operate to ensure a value-adding *customer experience*, through aligning the various aspects of the organisation to become more customer-focused and increase its operational effectiveness and efficiency. The focus of this framework is thus designing digital initiatives with a desirable customer experience (Phase 1.1) and ensuring that through the enabling digital capabilities (Phase 1.2), the organisation manages to provide customers with a desirable experience through their digital initiatives.

This phase guides the organisation to create an accurate As-Is digital state of the organisation. It was concluded from the literature research and semi-structured interviews with industry experts that the framework must allow the organisation to do two evaluations to accurately determine their digital profile: an assessment of the maturity of the organisation's digital capabilities (Phase 1.2.1), and an assessment of the extent to which transformation challenges have been experienced and dealt with (Phase 1.2.2), to determine where the organisation is in its digital transformation journey, and thus how accurate the perception of their own maturity is.

Based on the results of these assessments, the organisation should get an accurate idea of where it is in the transformation process and what the actual maturity of the different digital capabilities are, and not their perception of them.

6.4.2.1   *Phase 1.2.1 – Digital capability maturity*

Phase 1.2.1 must guide organisations to undergo a process that will assist them in determining the performance levels of their digital capabilities. The different digital dimensions describe various Industry 4.0-relevant capabilities, and the different levels of maturity describe increasing levels of performance for each digital capability within that dimension. Phase 1.2.1 is used to determine the organisation's As-Is digital state of the different capabilities.

The measure of digital capability maturity will be done by using the structure of a Capability Maturity Model. Capability Maturity Models measure the maturity of organisational aspects based on the number of specified best practices that are evident within an organisational process (Paulk, Curtis, *et al.*, 1993). Process maturity is defined as "[…] the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective" (Paulk, Curtis, *et al.*, 1993). Maturity itself is defined as "[…] the state of being complete, ready, or perfect" (De Carolis *et al.*, 2017).

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Various digital capabilities are identified through literature and subject matter expert interviews. The capabilities' maturity statements will be used to guide organisations in determining what their existing state is in terms of digital capability maturity, as well as contextualising the performance abilities of various digital capabilities, thus guiding them to (i) determine their As-Is state regarding the digital capabilities, and (ii) consider the various digital capabilities for use within their digital initiative(s).

It should be noted that the author does not claim that the digital dimensions and subsequent capabilities are fully representative of digital organisations – the included dimensions and capabilities were found to be relevant within digital organisations through literature but are not considered an exhaustive list of all relevant digital capabilities. The organisations are thus guided to consider these digital capabilities, but the framework's application is not limited to the use of those digital capabilities.

Each dimension should be evaluated by the relevant stakeholder/stakeholder group that is relevant to the specific dimension, to ensure an accurate representation of the maturity of each dimension within the organisation.

The output of this phase is thus (i) an As-Is state of the existing organisation in terms of digital enablement, and (ii) an educational process to show organisations what capabilities they could consider for use in their digital initiatives to achieve the two overarching objectives mentioned in Section 1.3.

6.4.2.2   *Phase 1.2.2 – Transformation challenges*

Through exploratory interviews it was found that the actual digital maturity and level of understanding the relevant concepts influences the accuracy of the organisation's perception of their digital capability maturity. There was thus a need to incorporate some measure to determine the accuracy of the digital capability maturity assessment from Phase 1.2.1.

The extent to which organisations experience transformation challenges was identified as the most suitable assessment to use in conjunction with the capability self-assessment to evaluate actual digital capability maturity versus the perception of maturity. This negates to an extent the effect actual organisational maturity has on the subjective evaluation of digital maturity.

A separate assessment will be done regarding the challenges identified in the systematic literature review, to determine to what degree the organisation has experienced each challenge. The results of this evaluation will be used to determine where the organisation finds itself in the process of a digital transformation. Based on the interviews with industry experts, organisations exhibit high levels of optimism when undertaking a digital transformation, and as they progress and experience resistance to the changes, their optimism decreases. The turning point, referred to as the point of disillusionment, is where the optimism is at its lowest and organisations understand what the full extent of a digital transformation is, whereafter the changes start yielding value, and the levels of optimism increase again. This cycle repeats itself as technology, the market, and customer demands shift over time.

This assessment is thus used to determine how their progression has influenced the results from Phase 1.2.1 and is subsequently used as a measure of accuracy of the digital capability maturity

self-assessments. This phase does not infer that the perception of digital maturity will exclusively be inaccurate if an organisation has not experienced the transformation challenges – it guides the organisation to consider the effect that transformation progression might have on their optimism regarding their maturity, and subsequently their perception of digital capability maturity.

6.4.3   Phase 2 – Assessment integration and value equation

This phase compiles the results of the assessments from Phase 1.2 and integrates them with the results from Phase 1.1 to guide organisations to create transformation objectives for the relevant digital capabilities used in the design of the digital initiative(s).

Each digital initiative comprises of various customer journeys, and the digital capabilities are seen as the tools that can be used as the enablers for these customer journeys that were mapped in Phase 1.1.2. The digital capabilities will be categorised according to its value-creation potential on a spectrum ranging from low value-creation potential to high value-creation potential.

Based on the digital initiative and subsequent digital capabilities that will be recommended for investment, a challenges landscape will be created to indicate to the organisation what transformation challenges, identified in Chapter 4, they will be most likely to encounter on their journey. This will further aid the organisation in their preparation for the digital initiative implementation journey as they will be more prepared to mitigate the challenges before they manifest.

6.4.3.1   *Phase 2.1 – Assessment Results*

For an organisation to determine how to digitally transform, a combination of the above assessments is required. The organisation will be made aware of its position in all five categories, which will be used in the value equation phase.

The framework must present the results of the self-evaluations in a manner that is easy to understand, allowing organisations to (Phase 1.1.1) identify where they are disrupted and how that influences their value proposition, (Phase 1.1.2) determine what customer need(s) the initiative should be addressing, (Phase 1.1.3) identify the customer journeys of the digital initiative and how effective they are in designing desirable customer journeys, (Phase 1.2.1) determine how digitally enabled the organisation is at their current point of existence, and (Phase 1.2.2) to what extent they have faced the transformation challenges, and subsequently how that might have influenced their perception of the digital maturity of the identified digital capabilities.

This phase looks to integrate the assessments into a report that can be used as a decision support resource – thus the report must clearly and concisely contextualise each phase, and explain the reasons why the organisation should consider the topic, and what the impact is of the phase in the initiation process of a digital initiative.

6.4.3.2   *Phase 2.2 – Transformation value equation*

Building on the definition of the different capability maturity levels of each digital capability – organisations will gain insight into, based on the results of their self-evaluations, their

organisation's current state with regards to digital maturity in each digital dimension. When comparing this with the results of the Customer value design phase, the organisation will be aided in determining where value can be created for the customer within the organisation and will allow the organisation to design the digital initiative with the help of the digital capabilities that the organisation already possesses. As mentioned in Section 5.3.3, each digital capability's value creation potential will be assessed according to its ability to contribute to the designed customer journeys.

Emphasis should be put on the fact that not all digital initiatives should aspire to reach the same level of maturity for each digital capability, as the customer need(s) and subsequent customer journey(s) are unique in different organisations and industries, and digital capabilities carry different value creation weightings for different digital initiatives. This is supported by a study conducted by (Deakin, LaBerge and O'Beirne, 2019). They investigated the capability-objective focus of organisations from different industries, and their findings can be seen in Figure 34, which is an interactive tool[5] that indicates the key objectives of various organisations' digital transformations. The bigger circles indicate a greater number of respondents (n=1733) indicating that the relevant capability was a focus for them in their digital transformation.
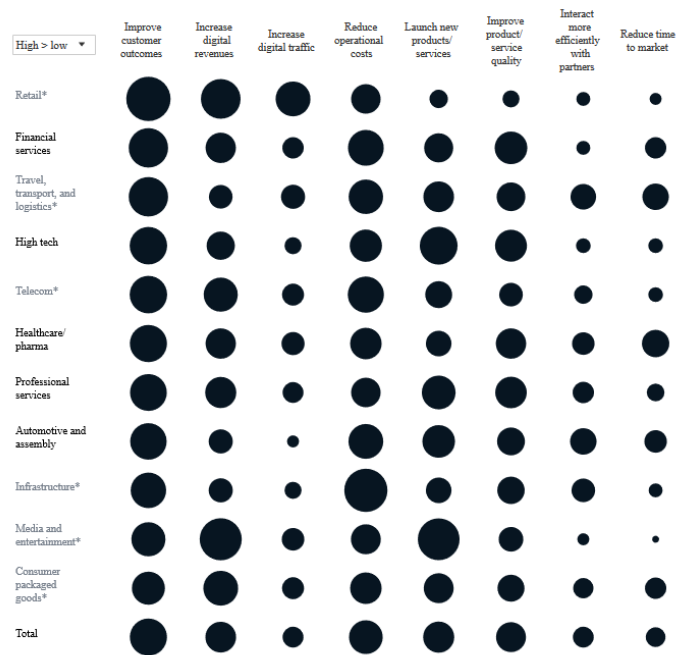
Figure 34: Transformation focus (Deakin, LaBerge and O'Beirne, 2019)

This phase supports organisations to prioritise investing resources in developing certain digital capabilities within the digital initiatives where the greatest amount of value for the customer can be created. The output of this phase is thus a categorisation of each digital capability based on its ability to create value for the customer and subsequently for the organisation, and its capability maturity. This will assist the organisation in its design of the digital initiative to

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[5] Find the interactive tool at: https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/five-moves-to-make-during-a-digital-transformation

understand what digital capabilities are required for the digital initiative to support the organisation in its objective of enacting a value-adding digital transformation.

6.4.3.3   Phase 2.3 – Potential transformation challenges index

Chapter 4 identified various challenges that organisations face whilst undergoing digital transformations. Through the categorisation of digital capabilities, it became evident that certain challenges are more related to specific digital dimensions than others.

A digital transformation challenges index will be presented to the organisation to indicate what challenges they are likely to face, based on the digital capabilities that they are going to invest in for the digital initiative(s). This should assist organisations in their preparation for the launching of their digital initiatives.

6.4.4   **Progression evaluation**

As the framework aims to assist organisations in the initiation of digital initiatives, the progression evaluation is not a key consideration for organisations at the time of using the framework. The framework aims to educate and inform the user as to the key concepts that require their consideration during a digital transformation through the initiation of digital initiatives, and allows the user to reconsider any of the concepts at all times. Certain phases can however be re-evaluated to measure the progression of the transformation. This re-evaluation can be done by re-evaluating the disruption the organisation has experienced in Phase 1.1.1 to consider how the transformation urgency has changed, reassessing the designed customer journeys from Phase 1.1.3 and if they are still relevant, and completing the digital capability maturity assessment and challenges assessment from Phase 1.2, where the results of the assessments will be compared with the original assessments. This comparison could serve as the transformation progression indicator.

6.5   **Chapter 6: Conclusion**

This chapter was dedicated to developing a conceptual framework that would adequately address the design requirements that were proposed in Section 4.7. The framework was conceptually developed based on these requirements.

The conceptual framework aims to meet the research objectives set out in the project proposal, based on background information regarding Industry 4.0, digital organisations and digital transformations from Chapter 3, the digital transformation approach from Chapter 3, and digital transformation challenges identified in Chapter 4. It was developed following the research methodology described in Chapter 2. To ensure the novelty of the framework, the design requirements were used in Chapter 5 to identify to what extent existing digital transformation models or frameworks are addressing the requirements generated from the research. The comparison with existing frameworks indicated where this research is adding value.

Chapter 7 considers the development of the various phases that will give effect to the identified design requirements. Once the set of tools is developed, the framework is validated using the methods proposed in Section 2.5 and 0. The validation results are used to amend the framework

to include the findings from the validation, and the amendments are mentioned in Chapter 8. The framework presented in this chapter is the final framework.

CHAPTER 7. DIIDS FRAMEWORK TOOL EXPANSION

7.1 Introduction

This chapter looks to build on Chapter 6 where the DIIDS Framework was developed on a conceptual level. This chapter will further expand on each phase within the DIIDS Framework to further contextualise each phase, and to provide users with guidance as to how the framework must be applied on a practical level.

Each section addresses a phase within the framework that correlates with the layout of the framework presented in Figure 33. Each phase is explained, and the development of a tool that may be used when executing the phase is reported on. This chapter serves as the last part of stage 2 of this research, which concludes the development of the framework. It should be noted that the intention is not to provide an exhaustive list of tools to use within each phase, rather the focus is on highlighting the analysis processes supported by examples of tools. In the application to empirical cases, tool selection should be dealt with on case-by-case basis.

For each phase, and sub-phases, the analytical/evaluation process is discussed at the hand of (i) the design requirements that prompted the development of the phase, (ii) the inputs that is required for the execution of each phase/sub-phase, and (iii) the output – which entails the result of executing the phase, and the outcome that, achieved through the process and the inputs, addresses the relevant design requirement. Figure 35 indicates how Chapter 7 fits into the thesis.
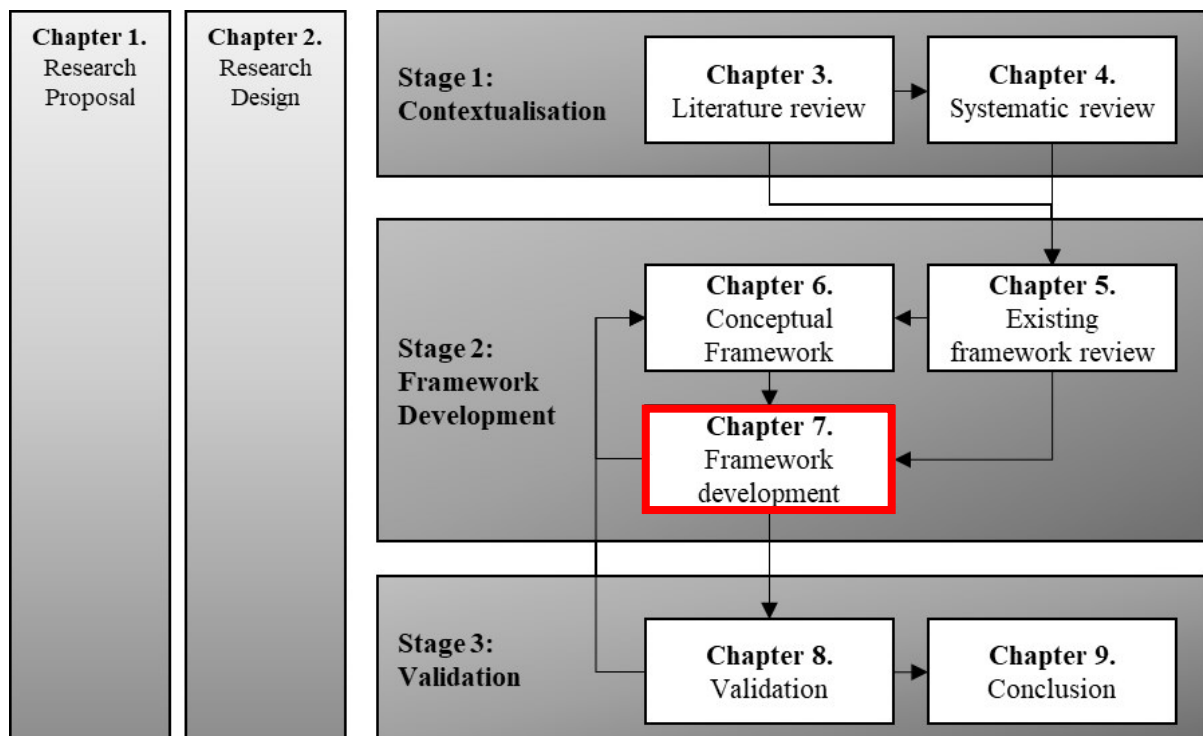
Figure 35: Research design: Chapter 7

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7.2 Phase 1.1 – Customer value design

Before the digital transformation of an organisation through the initiation of initiatives can start, the organisation has to determine what specific customer need(s) the envisaged or planned initiative(s) will address. This need must be critically evaluated based on various factors – as Industry 4.0 has caused disruption in various areas, elaborated on in Phase 1.1.1, and subsequently how the disruption has changed the way in which value is created for customers. This phase is executed in three sub-phases – (1.1.1) the disruption assessment through internal and external disruption assessments, (1.1.2) the Customer Needs Identification, and (1.1.3) Customer Experience Design. Each phase will be further contextualised in the following sections.

Phase 1.1.2 (Customer Needs Identification) and Phase 1.1.3 (Customer Experience Design) work closely together to translate the customer requirements into quantifiable business processes. The Quality Function Deployment (QFD) method was developed in 1966 by Yoji Akao to provide a framework for organisations to determine what customer need(s) they are addressing, and how to translate that need into a product or service that will effectively address this need (Mizuno, Akao and Ishihara, 1994). The literature concluded that the focus of digital organisations and thus digital initiatives should be on the end-to-end customer experience instead of the individual touchpoints in Section 6.4.1.3, and subsequently the QFD framework should be applied to design *customer experiences*, and not just *products and services*.

This method was selected due to the (i) the specific focus that the framework puts on starting at what customer-need the organisation is addressing, (ii) the ranking of importance of the identified customer needs, (iii) the correlation that the framework draws between the customer needs and specific engineering characteristics and processes, and (iv) the flexibility of the framework – as it can be applied at any system composition level (Mizuno, Akao and Ishihara, 1994).

However, alternative methods to identify customer needs and translating them into business processes exist, and the user will have to select a method that will work best for them. Other examples of existing methods include the Theory of Inventive Problem Solving (TRIZ), which aims to come up with innovative solutions to identified customer needs (Ekmekci and Koksal, 2015), Process mapping tools such as the Sig Sigma method, which aims to increase profitability through improving customer satisfaction through business process improvement (Beemaraj and Theni, 2018), Total Quality Management (TQM) models, which aims to ensure the sustained customer satisfaction through ensuring quality business processes (Arikkök, 2017), or a Systems Engineering approach, which enables the realisation of successful systems that addresses customer needs (Fraser and Gosavi, 2010).

7.2.1 Phase 1.1.1 – Disruption assessment
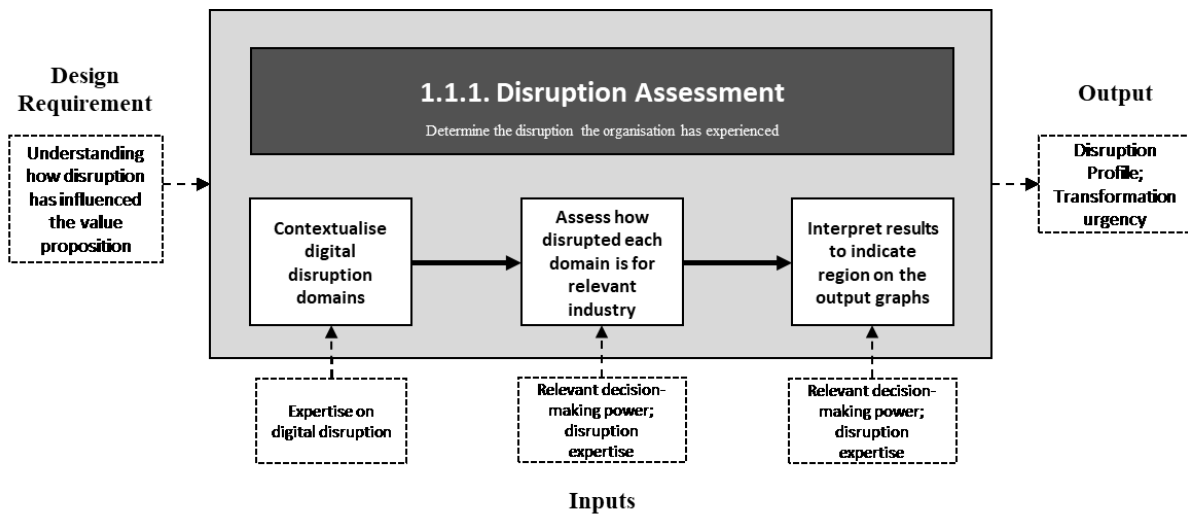
Figure 36: Disruption assessment

As described in Section 3.3, digital disruption is a key driver of digital transformations. Subsequently, the first tool that the DIIDS Framework presents to organisations is angled towards establishing how the disruption caused by Industry 4.0 has influenced the disruption domains elaborated on in Section 3.3.3. The layout of the tool can be seen in Figure 36. The argument is made in Section 3.3 that the disruption experienced due to Industry 4.0 has changed how value is created for customers, and in order to successfully transform digitally, the organisation must launch initiatives that will effectively address customer needs in the digital economy.

As mentioned in Section 6.4.1.1, the level of disruption within the various disruption domains will indicate to the organisations (i) whether they are a digital leader or a fast follower, and subsequently (ii) what their transformation urgency is, and thus what their digital initiative strategy should look like based on the stage that the organisation finds itself in from Figure 11, and (iii) how the disruption has influenced the organisation's customer value proposition.

The output of this phase is for organisations to understand in which region their organisation and industry is on Figures 3, 4, and 5 – which are a visual representation of the effect of disruption on incumbent organisations. Using the graphs will further contextualise the impact disruption has on the organisation and provide organisations with a sense of transformation urgency.

7.2.1.1   Application

The disruption assessment is completed in two parts – (i) internally through a disruption profile assessment, and (ii) externally through using an existing disruption readiness/assessment tool. The internal assessment aims to establish how the organisation perceives disruption and how disrupted they think the four disruption domains are, where the external assessment looks to utilise disruption expertise, internally or externally, that will assist them to objectively determine the disruption risk of the organisation.

Internal disruption profile assessment

The disruption profile assessment is completed by the relevant personnel within the organisation which investigates the likelihood of the organisation experiencing disruption within the four identified disruption domains – (i) *the legislative environment, (ii) the new technology*, (iii) *changing customer demands*, and (iv) *competitors* – elaborated on in Section 3.3.3. This self-assessment will indicate what the organisation's perception is of existing- and potential digital disruption. The objective with this assessment is twofold: (i) to test the organisation's perception of their disruption, and (ii) to inform and educate the organisation of potential sources of disruption, and to guide them to determine the disruption experienced in the identified disruption domains if they don't know. The questions can be found in Addendum A3 – Disruption profile

The questions from the assessment were created by the author through literature research and existing digital disruption profiles (PwC Global, 2017). The questions were posed in such a way where the answers ranged from 'very unlikely' to 'very likely' on a Likert-scale. The organisation would thus have to indicate how likely certain disruptive concepts have and were to impact their industry. The results from the questionnaire will be presented on a radar chart, to visually indicate to the organisation what their perception is of how disrupted the various domains are within their industry. The questionnaire can be found in Addendum A3 – Disruption profile.

External disruption assessment

The second part of the disruption assessment entails involving digital disruption expertise to further contextualise the impact Industry 4.0 has had on the identified disruption domains. The organisation must thus find a disruption assessment tool(s), such as DeltaHedron's technology disruption assessment tool that assesses which technologies could disrupt your organisation, and how new technology could assist organisations in achieving their objectives ('DeltaHedron ® Executive Innovation Insight', 2019), for each of the disruption domains that will further contextualise the disruption that the organisation has experienced. The outcomes of this tool is further contextualisation of the organisation's position on Figure 11 on page 42, and thus the stage of disruption that the industry finds itself in, and identifying potential areas where the organisation might be prone to disruption. The various disruption stages are elaborated on in Section 3.3.2.

The tool must assist the organisation to determine the accuracy of the organisation's disruption self-assessment, and how this will influence their digital initiative initiation strategy. The organisation will subsequently gain insight into the following after using this tool: (i) how disrupted they perceive their industry to be, (ii) how technologies and innovation have disrupted the industry, (iii) how accurate their disruption perception is, (iv) which stage of disruption their industry is in, and (v) what their transformation urgency should be.

By understanding the disruption that the industry has experienced will assist organisations in the decision-making process of initiating digital initiative(s) through contextualising how Industry 4.0 has changed the organisation's value proposition to their customers. By understanding the five outcomes mentioned in the previous paragraph, it will contribute

towards enabling organisations to develop a relevant, informed, and effective strategy for the initiation of their digital initiative(s).

7.2.2 Phase 1.1.2 – Customer needs identification
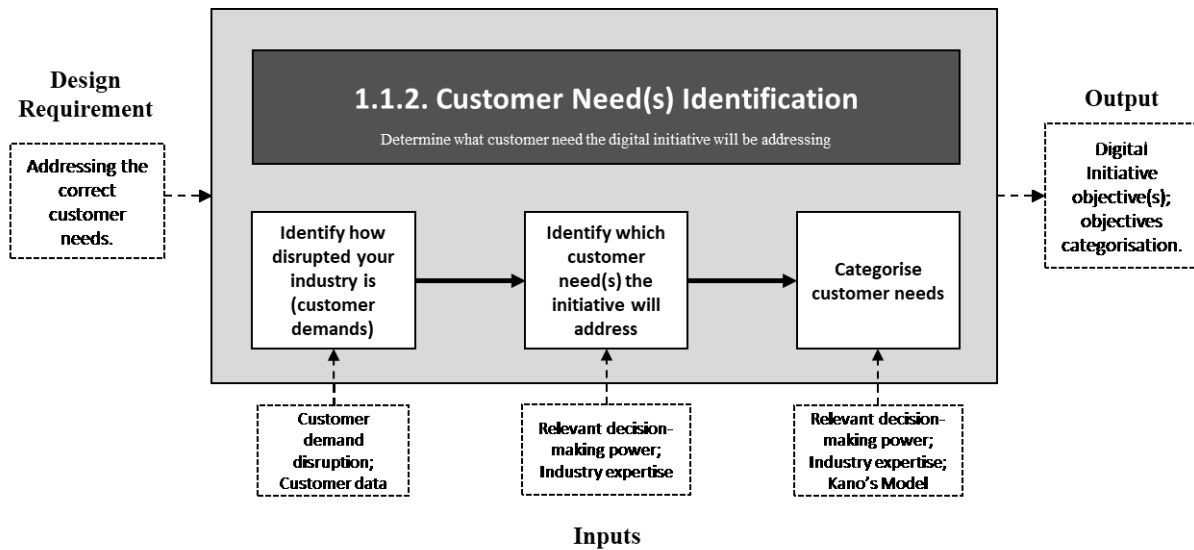
Figure 37: Customer need(s) identification

The organisation must determine what customer needs they are, and should be, addressing, using the context created from the disruption assessment. The fundamental question to be asked during this phase, presented in Figure 37, is "what ***customer need*** is the digital initiative going to address?", and focus should intentionally not be put on the means that the organisation currently uses to address that need. Phase 1.1.2's output, as is visually represented in Figure 37, will be the first step to determining how the digital initiative will create value for their customers, as defined in Section 6.4.1.1.

Identifying customer needs is a concept that is found in most initiative implementation strategies, and various tools exist that organisations can use to identify the customer needs. Various existing tools were researched, and this framework, as a decision-support and not a prescriptive methodology, does not provide organisations with a specific customer needs identification tool, but rather support the interpretation of the tool's output. The user of the framework must however use some method to identify customer needs in order to progress with the framework.

An important distinction must be made between internal and external customers – internal customers can be seen as all the various stakeholders who are involved in the operation of the business, where external customers are those that use the product or service from the organisation (Gomez, 2017). The internal customer needs are, amongst other methods, addressed through the creation of a positive corporate culture, where this tool specifically addresses the external customer demands, as the framework is aimed at the initiation of a digital initiative, and the internal customers become a focus area in the implementation of the initiative.

Phase 1.1.2 must thus (i) guide organisations to determine a set of customer needs for the digital initiative, (ii) support organisations to interpret the customer needs, and (iii) make a clear link

between satisfying the customer needs to attain customer satisfaction, and understanding how value is created for both the customer and the organisation.

The Quality Function Deployment (QFD) tool is recommended for the interpretation of the identified customer demands and is thus the tool that the author proposes for use in Phase 1.1.2. The QFD has been adapted over the years, and this adaptation process has led to the creation of the Kano Model – a model that specifically focuses on the customer needs.

7.2.2.1 Background

The Kano model was originally developed in 1984 by Professor Noriaki Kano to analyse customer needs, and how different customer needs influence the product or service design to attain customer satisfaction (Qiting, Uno and Kubota, 2005). The intentional focus on customer needs and customer satisfaction contributed to the recommendation of this tool, as Schwab, (2016) mentions that to be successful in the digital economy, the focus of organisations should be on customer satisfaction.

The Kano model classifies customer requirements into three categories:

i. *Basic needs* –Customer needs that must be met but do not cause the customer particular satisfaction. If these needs are not met, the customer is left dissatisfied (Rotar and Kozar, 2017).

ii. *Performance needs* – These are customer needs that customers can quantify and discuss, that would, if present, provide the organisation the competitive advantage over their competitors (Rotar and Kozar, 2017).

iii. *Attractive needs* – Needs that the customer cannot describe or quantify, but that provide them with a great amount of satisfaction if present, and due to their lack of expectation, no real dissatisfaction when these needs are not present (Rotar and Kozar, 2017).

The model further evaluates these customer needs based on two metrics – the extent to which the customer requirement is fulfilled on the x-axis, and the customer satisfaction achieved on the y-axis (Qiting, Uno and Kubota, 2005). The Kano model is presented visually in Figure 38 below.
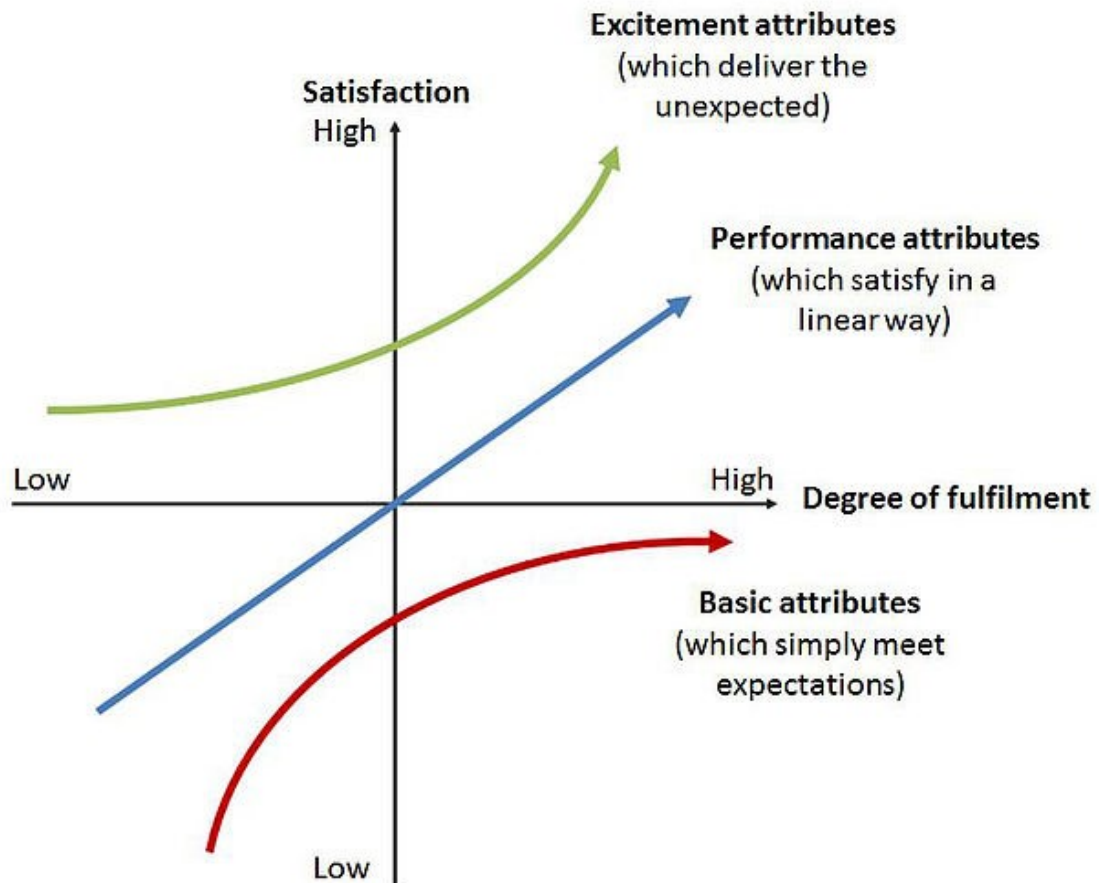
*Figure 38: Kano model requirement categorisation (*Kano Model: A business model to identify purchase motivations*, 2018)*

7.2.2.2   *Application*

The structure of the Kano model is questionnaire-based, to generate an in-depth understanding of how your current or potential customers perceive the customer requirements that the organisation wants to meet through their digital initiative. The execution of this phase happens in two parts: (i) The organisations are tasked with identifying customer needs that they believe the digital initiative should address using a method of their choice, and (ii) using the Kano model to determine the nature of these requirements, and whether value will be created for the organisation and its customers through meeting these requirements.

The first phase of identifying customer needs will happen within the organisation, and they will decide how this process takes place. Industry and digital expertise should contribute to this process, as they will provide the organisation with expert advice regarding what is possible with the new capabilities enabled by Industry 4.0 technologies and business models. Once the list of requirements is set up, the execution of the Kano model can take place. As the framework is defined as a decision-support framework, the focus is on helping the organisation decide which customer needs are relevant and important, and not the generation of these requirements.

Once the list of requirements is completed, the execution of the Kano model can commence. Four steps were identified to form part of the application of this model – (i) setting up the questions and accompanying grid, (ii) identifying the customers, (iii) executing the survey, and (iv) interpreting the results.

Questionnaire Preparation

The customers are asked two types of questions: functional and dysfunctional. Functional questions are asked in a positive way focusing on if the feature were to exist, and dysfunctional questions are put in a negative way, with focus put on if the feature did not exist. Examples of both questions are found below (Qiting, Uno and Kubota, 2005).

1. *Functional* – How do you feel about a particular feature?
2. *Dysfunctional* – How would you feel if did not have this feature?

Each question is posed in both a functional and dysfunctional way, and the combination of answers is used as an indication of the group to which the particular feature belongs. Each question is answered on a Kano table, which can be in Table 17 (Qiting, Uno and Kubota, 2005).

Table 17: Kano model requirement assessment (Qiting, Uno and Kubota, 2005)

Customer Requirements →		Dysfunctional				
		1. like	2. must-be	3. neutral	4. live with	5. Dislike
Functional	1. like	Q	A	A	A	O
	2. must-be	R	I	I	I	M
	3. neutral	R	I	I	I	M
	4. live with	R	I	I	I	M
	5. dislike	R	R	R	R	Q

The specific customer requirement is positioned in the top left corner, with the functional question posed in the left-hand column, and the dysfunctional question posed in the top right row. Each customer will answer both questions for each customer requirement, and the requirement is classified based on where the dysfunctional column and functional row cross. The list of answers include (1) I like it that way, (2) It must be that way, (3) I am neutral about it, (4) I can live with it that way, and (5) I dislike it that way (Shahin, 2003)

The one-dimensional requirements (O) are representative of performance customer needs, attractive needs (A) are needs that customers would like but would not be disappointed by not having it, must-be requirements (M) are the basic needs that customers have and will be dissatisfied it these aren't present, indifferent needs (I) are needs that the customer is neither satisfied nor dissatisfied with, regardless of the functionality of the requirement, questionable requirements (Q) are results that are inherently contradicting, and reverse requirements (R) are requirements where customers expect the opposite of what the organisation has identified as a customer need (Qiting, Uno and Kubota, 2005).

Due to the unexplored nature of Industry 4.0, and the increased capabilities that organisations can exhibit enabled by new technologies, the focus of the DIIDS Framework will primarily be

on ensuring the high functionality of the requirements classified as (M) and (O), and the increased functionality of the requirements classified as (A).

Identifying existing and potential customers

Once the questions are set up and the accompanying grids are ready, the organisation must find existing and potential customers to answer the questionnaires. It is recommended that the organisation has a diverse group of people fill in the questionnaires, so to gain a better understanding of how different people perceive the requirements (Shahin, 2003; Rotar and Kozar, 2017).

Once everyone has filled in the various Kano grids, the general trend can be determined from the answer sheets, and the organisation will be able to identify how customers perceive each requirement.

Results interpretation

Interpreting the results will guide the organisation to focus their resources on solving specific customer requirements and prevents them from adding capabilities to their product or service that will not increase their customer satisfaction. Each customer requirement can be plotted on Figure 38, with quadrants one to four representing *Attractive requirements*, *Indifferent requirements, Basic requirements, and Performance requirements* respectively. Based on this plot, the organisation will be able to determine what their digital initiative will have to do, and this introduces the second part of Phase 1.2 – Customer Experience Design, which will be discussed in the following section.

7.2.3   Phase 1.1.3 – Customer experience design
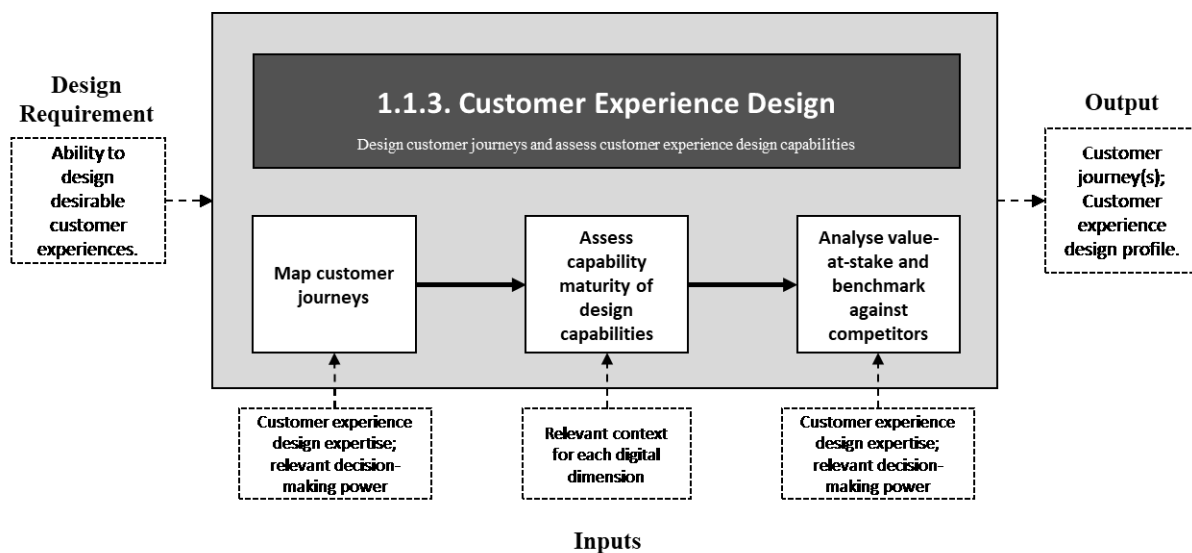
Organisations who focus on the customer experience, as supported by studies mentioned in Section 3.4.2.1, achieve significantly higher profitability levels compared to those that do not. This phase is thus specifically focused on guiding organisations to design customer journeys that will address the customer need(s) identified in Phase 1.1.2, and is visually represented in Figure 39. It will be executed in two parts – (i) translating the identified customer needs from

Phase 1.1.2 into customer journeys where the focus is put on the end-to-end customer experience, and (ii) assess how effectively the organisation is enabled to design customer experiences through a customer experience design capabilities evaluation.

The first part of this phase is guiding the organisation to map the customer journeys that will address the customer needs identified in Phase 1.1.2 on a conceptual level. This is a collaborative process between various stakeholders within the organisation, and the output is a detailed analysis of every point where the customer will interact with the organisation. The integration of these touchpoints forms the basis of the customer experience that the digital initiative will offer its clients. The organisation is now aware of *where* the customers will interact with the organisation.

The process of mapping the customer journeys must be executed by combining expertise surrounding customer experience design, and the relevant decision-making power within the organisation. The organisation is free to decide how this will take place.

Once the customer journeys are mapped – the second part of Phase 1.1.3 commences. This entails assessing the customer experience design capabilities of the digital initiative. The approach that is proposed to facilitate the process of achieving the desired outcome mentioned in this section is McKinsey's Design Index assessment, elaborated on below.

Design index assessment
McKinsey's Design Index will be used to evaluate the design capabilities' maturity[6] within the organisation, and it will be completed as an online assessment. McKinsey identified four design capabilities that organisations need to effectively design customer journeys, and these are:

i. *Analytical leadership* – Organisations should drive design focus from the executive level and should apply the same sort of analytical rigour to the design performance as they do to the finances of the organisation.

ii. *User experience* – Focus should be put on integrating physical, digital, and service design to provide customers with a cross-functional product or service.

iii. *Cross-functional talent* – Organisations must break away from making design performance the responsibility of one department – all of the departments should focus on customer-centric design.

iv. *Continuous iteration* – Decrease the risk of product or service development by continuously listening to, testing-, and iterating with end users.

The authors designed different levels of maturity for each design capability and validated the value creation potential of these capabilities through an extensive 5-year study (Sheppard *et al.*, 2018).

McKinsey & Company studied 300 publicly listed companies over the 5-year period, recorded more than 100 000 design actions, and collected more than 2 million pieces of financial data. When comparing the companies who scored in the top quartile of each design capability to their industry peers, they found that revenue growth was on average 10% per annum (p.a.)

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[6] The concept of maturity is defined in the preamble of this document and elaborated on in Section 7.3.1.

compared to 3% to 6% p.a. for the industry benchmarks. The Total Shareholders Return Growth was 21% p.a. over the 5-year period, compared to the 12% to 16% p.a. achieved by the industry benchmarks. The top quartile companies thus generated 32% and 56% more revenue and total return to shareholders respectively over the 5-year period. This trend was true throughout various industries, and thus validated the correlation McKinsey & Company drew between design capabilities and value creation for the organisation and their customers (Sheppard *et al.*, 2018).

McKinsey's Design Index was is proposed to assist in the designing of desirable customer experiences due to the intentional focus on the value that customer experience-design has on the value creation potential of the organisation. It allows the leaders of the organisation to determine their design capabilities' maturity, benchmark it with 300 other publicly listed companies, and estimate the value-at-stake through improvement (*Design Index*, 2019). Other tools exist to design customer experiences, and the users of this framework are encouraged to research other tools and make a selection based on the needs of their organisation.

The questionnaire was set up in such a way that the questions and results contextualise the four design capabilities. The executive team is responsible for answering the questions, as the tool makes the argument that design should be an executive-level priority for organisations (Sheppard *et al.*, 2018). The organisation will now understand *how* they should design the customer journeys presented in the first part of Phase 1.1.3 that will address the customer needs that were identified in Phase 1.1.2. Organisations should consistently revisit the customer journeys they designed to ensure the relevance of the designed customer journeys. Phase 1.1.3 thus supports the design decisions that the organisation will need to make when designing their digital initiative.

7.3   Phase 1.2 – Digital organisational profile

Phase 1.1 focused on determining how disruption has altered the value proposition that the organisation offers to their customers and guides the organisation to consider relevant concepts that will aid in the design of their value proposition to their customers, whereas Phase 1.2 focuses internally on the current digital state of the organisation – and to what extent they are equipped to address the new customer need(s). This part strives to create an As-Is digital state of the organisation, and both phases 1.2.1 (capability assessment) and 1.2.2 (challenges assessment) focus on presenting the organisation with an accurate As-Is digital organisational state. Phases 1.2.1 and 1.2.2 are elaborated on in the following sections.

7.3.1 Phase 1.2.1 – Capability assessment
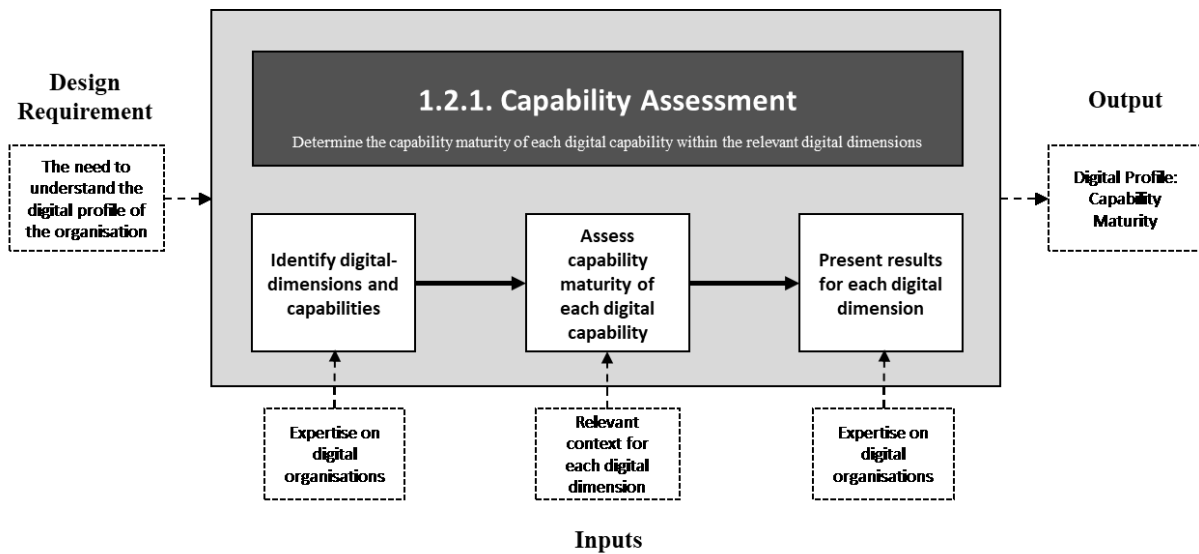
Figure 40: Capability maturity assessment

As identified by the design requirements specified in Chapter 4, a framework is required that can assist organisations in increasing their digital capabilities, elaborated on in Chapter 3. Should organisations decide to undergo a digital transformation, assessing the maturity of said digital capabilities within an organisation was determined to be a valuable outcome for executives to support them in their decision-making to understand to what extent the organisation is digitally enabled, and what potential capabilities can be introduced in the digital initiative. Phase 1.2.1 is visually represented in Figure 40.

This section considers how the structure of a CMM was amended to be used in the DIIDS Framework to determine what the digital capability maturity is of the various digital capabilities identified in the research. Due to its representation of increasing process maturity, an interpretation of the CMM was selected as a tool to guide the organisation to (i) determine their As-Is state of their digital capabilities, and (ii) contextualise the possible To-Be state of the digital capabilities so as to assist the organisation in making decisions that will aid them in achieving the overarching objectives of enhancing the customer experience and increasing operational efficiency and effectivity.

It should be noted that the list of digital capabilities is a non-exhaustive list of digital capabilities that were identified through (i) literature research through the literature review in Chapter 3, (ii) the systematic literature review conducted on the challenges organisations experience in Chapter 4, and (iii) interviews with subject matter experts. There exist various digital capability maturity models that were developed for specific organisations – whereas this framework is applied on a high level and is thus not organisation-specific. Organisations are thus encouraged not only to evaluate themselves against the digital capabilities that are presented in this research, but also to research which other digital capabilities would further support them in realising the proposed customer experiences.

Chapter 5 is dedicated to the study of existing models/framework, which includes CMM's, and the findings of this chapter will be presented to the organisation during Phase 1.2.1 to support

them in finding existing CMM's that is applicable to their organisation. Each of these existing CMM's include various digital capabilities, and this will guide the organisation to consider more digital capabilities that is not mentioned in the developed CMM for this research. Refer to Section 5.4 for an elaborate discussion of the structure of each CMM.

The structure of the tool will be elaborated on in this section, and how it is applied to satisfy some of the design requirements set out in Chapter 4. The various capability statements can be found in Addendum A1 – Capability statements.

7.3.1.1 *Background*

Originating from the field of software development, the CMM is a model that describes the effectivity of a process through the definition of key elements that are present in processes. It describes the path to evolving a process from being immature and ad hoc, to being a mature, disciplined process (Paulk, Weber, *et al.*, 1993; Carnegie-Mellon-SEI, 2010).

Various definitions exist for maturity, as different authors view the term from different perspectives. The definition of process maturity for this research is "[…] the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective" (Paulk, Curtis, *et al.*, 1993). Maturity itself can be defined as "[…] the state of being complete, ready, or perfect" (De Carolis *et al.*, 2017). As the purpose of a digital transformation is to increase the digital maturity of an organisation, the process of increasing capability maturity is of relevance to the framework.

Gottschalk (2009) elaborated on the different stages of maturity and classified them as (i) of a successive nature, (ii) transpires in a hierarchical manner that is not easily inverted, and (iii) includes a wide range of organisations and their activities or processes. Maturity is thus defined in this research as a combination of the work of Paulk, Curtis, *et al.*, (1993) and (De Carolis *et al.*, (2017), with the stages of maturity adopted from the work of Gottschalk (2009).

7.3.1.2 *Application*

The CMM is not a prescriptive model – it does not provide the organisation with instructions regarding the improvement in process capabilities to move from one level of maturity to the next. A CMM contextualises organisational processes and allows organisations to understand what their process capabilities are, which enables them to determine what they want it to be, using the capability statements of the various maturity levels. The improvement of process capabilities is addressed in the transformation strategy of the organisation and will vary for each organisation (Paulk, Curtis, *et al.*, 1993).

The above-mentioned supports the design requirements of supplying the organisation with decision support during their digital transformation process – as this will support (i) their design of the digital initiative that will address the customer needs identified in Phase 1.1.2, (ii) their resource allocation process when investing in specific digital capabilities for their digital initiatives.

The application of this tool within the DIIDS Framework was an interpretation of the CMM to fit the requirements of the DIIDS Framework. The digital dimensions identified and elaborated on in Section 3.8 were further deconstructed into various relevant capabilities, which were used

as the capabilities for the CMM. The five maturity levels were redefined as, in increasing order from one to five, (i) digitally ignorant, (ii) digitally stagnant, (iii) digital followers, (iv) digital collaborators, and (v) digital leaders. Five capability statements were created for each digital capability that match the five maturity levels mentioned in this paragraph, and the successive and hierarchical nature of capability maturity levels. The six digital dimensions with their accompanying digital capabilities are shown in Addendum A1 – Capability statements in Tables 23, 24, 25, 26, 27, and 28 respectively.

Organisations will receive the capability statements in the form of a matrix, where they will have to select which capability maturity statement most closely represents the current maturity of their organisation. The maturity levels range from not having the digital capability in the organisation at all (digitally ignorant), to being a leader in the industry regarding the specific digital capability (digital leader). This method was selected above using a Likert-scale ranging from immature to mature, as the lack of understanding the digital capability could play a role in the organisation, misrepresenting their organisational digital capabilities, and the various capability statements serve as an educational tool to contextualise different digital capabilities for the organisation. This assessment will be accompanied with a presentation of the findings of the Systematic Review conducted in Chapter 5 regarding existing digital CMM's, to further present organisations with CMM's and digital capabilities that could be more applicable to their organisation.

The different capabilities will be evaluated by the relevant individuals within the organisation to further ensure that the capability maturity representation is as accurate as possible. Once the digital capability maturity has been evaluated by all of the relevant personnel, the results will be presented on radar charts to the organisation. This will provide the organisation with an overall idea of how digitally-enabled their current organisation is, and where they lack digital maturity. This representation will serve as the As-Is state of the organisation.

7.3.2 Phase 1.2.2 – Challenges assessment
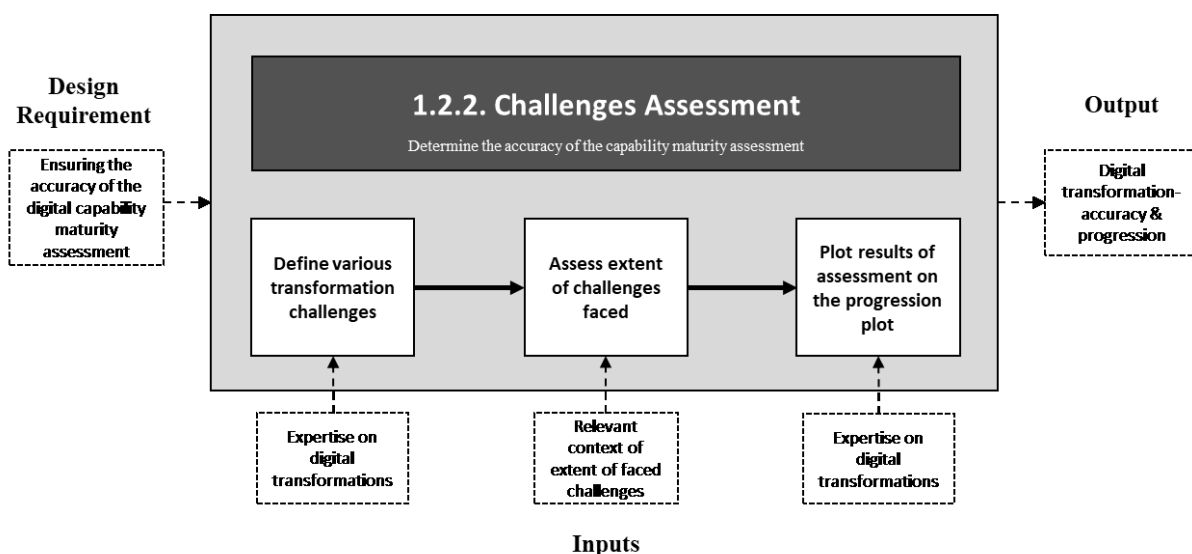
Figure 41: Transformation challenges assessment

As mentioned in Chapter 4 and Section 6.4.2.2, organisations experience various challenges whilst undergoing a digital transformation, and these challenges are experienced at varying levels within different industries. It was found through semi-structured interviews with subject matter experts that the extent to which these challenges have been experienced is a relatively accurate indication of how far the organisation is in its digital transformation journey – and the link was made between the transformation progression and the accuracy of the digital capability assessment from Phase 1.2.1. Due to the qualitative nature of assessment and the degree of subjectivity of it, it is argued that the organisation's optimism could be influenced by the extent to which the challenges have been faced and dealt with, and their optimism could influence their perception of their digital capabilities' maturity. This assumption was tested and validated through semi-structured interviews with subject matter experts. Phase 1.2.2 is visually depicted in Figure 41.

Figure 42 visually indicates how the transformation optimism changes as the transformation progression changes. The optimism that the organisation exhibits towards the digital transformation process was concluded, through the interviews, to potentially impact the accuracy of the digital capability maturity assessment, and thus the challenges assessment was included in the DIIDS Framework to ensure the accuracy of the As-Is state of the digital organisation. Referring to the figure above, this tool will indicate in which region the organisation is on the graph. By indicating to the organisation where they are on this graph, the organisation will be guided to reconsider their digital capability maturity assessment – due to the fact that they now know the accuracy could be influenced by how far they have progressed.

It should be noted that not all organisations will experience this trend whilst undergoing a digital transformation – it was however concluded from semi-structured interviews with subject matter experts that this trend is common for organisations undergoing digital transformations.
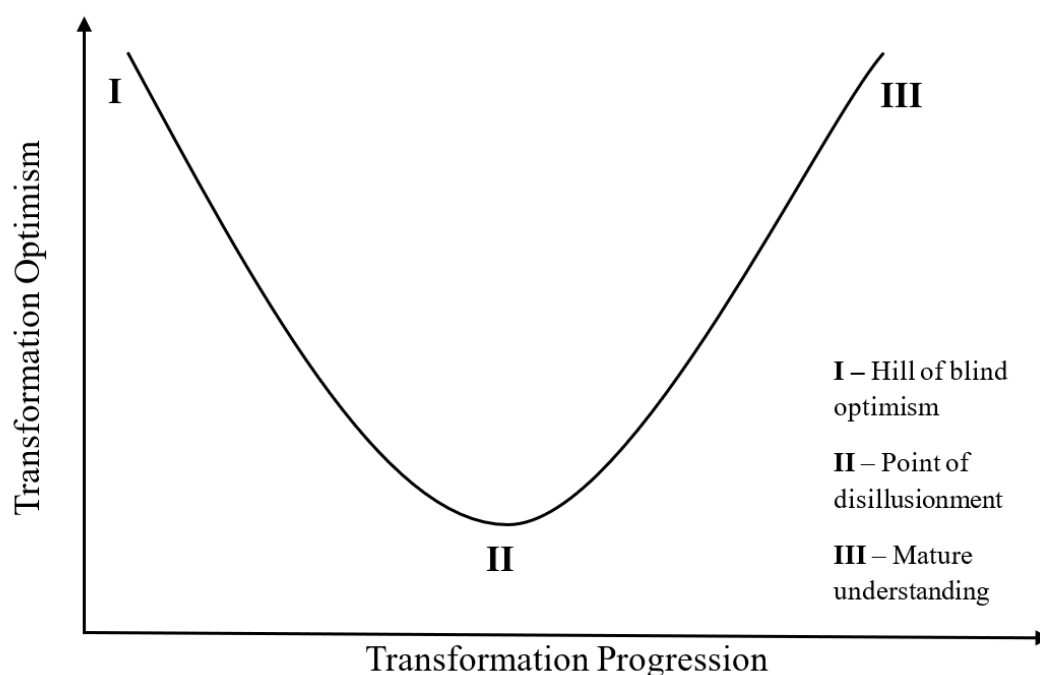
Figure 42: Transformation optimism vs progression

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The structure of the challenges' assessment will be based on a Likert-scale, where the challenge will be posed as a question, and the relevant stakeholder can then answer to what extent they have experienced the challenge. The assessment is structured in such a way where the answers range from not having experienced it, having experienced it and not yet dealt with it, and lastly having experienced it and dealt with it. Not having experienced it relates to the *hill of blind optimism,* having experienced it and not having dealt with it links to the *point of disillusionment,* and having experienced and dealt with it provides organisations with the *value of maturity of understanding*. It should be noted that the extent to which challenges have been faced was not concluded as an absolute indication of digital transformation progression, transformation optimism, and subsequently capability maturity assessment accuracy, but rather as an indicator of the possible influence of actual process immaturity on the perception of process maturity.

If the organisation finds itself in the first region of the graph, their digital capability maturity has a high probability of being skewed positively, thus their perception could be overly optimistic and the actual maturity is probably lower than their assessment. If the organisation is in the second region of the graph, they potentially have experienced the full extent of the challenges without having fully overcome it, which could have a negative impact on their digital transformation optimism, which in turn could negatively influence their perception of digital maturity, and their actual maturity could be higher than their perception thereof. If they are in the third region of the graph, they probably have experienced and dealt with the challenges, and thus their digital capability maturity perception is most likely accurate. It should be noted that this tool does not infer that the perception is always skewed based on the region of the graph that the organisation finds itself in – the tool's purpose is to make organisations aware of the possibility that it could be skewed, and thus prompts them to re-evaluate and further investigate their perception of their digital capabilities' maturity.

The challenges will be compared to the digital dimensions mentioned in Section 3.8, to ensure the accurate assessment of different sectors within the organisation – different facets of the transformation could be more mature than others, and subsequently their capability maturity perception could be more accurate. This led to the creation of a digital transformation challenges assessment matrix – that can be found in Addendum A2 – Digital transformation challenges, Table 28. This matrix is used to assess to what extent the organisation has experienced and dealt with the challenges. This was done to mitigate the effect that the extent to which challenges that are not related to specific digital dimensions have been faced has on the result of the challenges assessment.

The results from the challenges assessment, which is described in the following paragraph, will be used to populate the following matrix, called the Digital transformation challenges influence matrix, which will further contextualise the As-Is digital state of the organisation, and provide organisations with an accurate assessment of their digital transformation progression. This matrix is used to compare the relevance of each challenge to the various digital dimensions, and subsequently the relevance weighting, ranging from zero to a hundred with zero indicating no influence and 100 indicating strong influence of the challenge on the digital dimension, determines the influence each challenge has on the determination of the region in which the

organisation is on the progression vs optimism plot for each digital dimension. This matrix can be found in Addendum A2 – Digital transformation challenges, Table 29.

The challenges assessment (Table 28) is executed over two phases: (i) the executives will evaluate the challenges to determine how top management has experienced the challenges, and (ii) the personnel relevant to the challenge within the organisation will complete the same assessment. The outcomes will be compared to determine how the different parts of the organisation views their transformation journey, and will provide the stakeholders with a clear indicator of the potential gap of understanding between them and the rest of the organisation. The results of both assessments will then be used to populate two separate digital transformation challenges influence matrices, and the region on the progression vs optimism graph (figure 42) will be indicated from each perception – from executives and personnel.

This will further support organisations in their decision-making process as it will extend the contextualisation of the organisation's As-Is state with relation to their digital maturity.

Phase 1.2.2 concludes Phase 1.2 and subsequently Phase 1, and is followed by the start of Phase 2, which is elaborated on in the following sections.

7.4   Phase 2 – Results integration and value equation

Phase 2's over-arching objective is to use the various outputs from Phase 1, and to integrate them to present the organisation with information regarding these outputs that is (i) easy to understand, (ii) ensures the correct assumptions are drawn from the outputs of Phase 1 by the organisation, and (iii) to guide the organisation to invest their resources in areas where value can be created for the organisation. Phase 2.1 focuses on the presentation of the results of Phase 1, Phase 2.2 guides the organisation to prioritise value-creating capabilities and initiatives, and Phase 2.3 present organisations with a challenges index that will create awareness surrounding the potential challenges they might encounter during their digital transformation journey.

It should be noted that Phase 2 is described on a lower level of detail as Phase 1, as this phase is used as a transition phase between the initiation and the implementation of the digital initiative. Phase 2 is thus aimed at guiding the user(s) to use the results of Phase 1 to create an informed implementation strategy focused on creating value for the organisation, whereas Phase 1 was concerned with the development and expansion of the relevant concepts pertaining to the initiation of the digital initiative.

7.4.1 Phase 2.1 – Assessment report
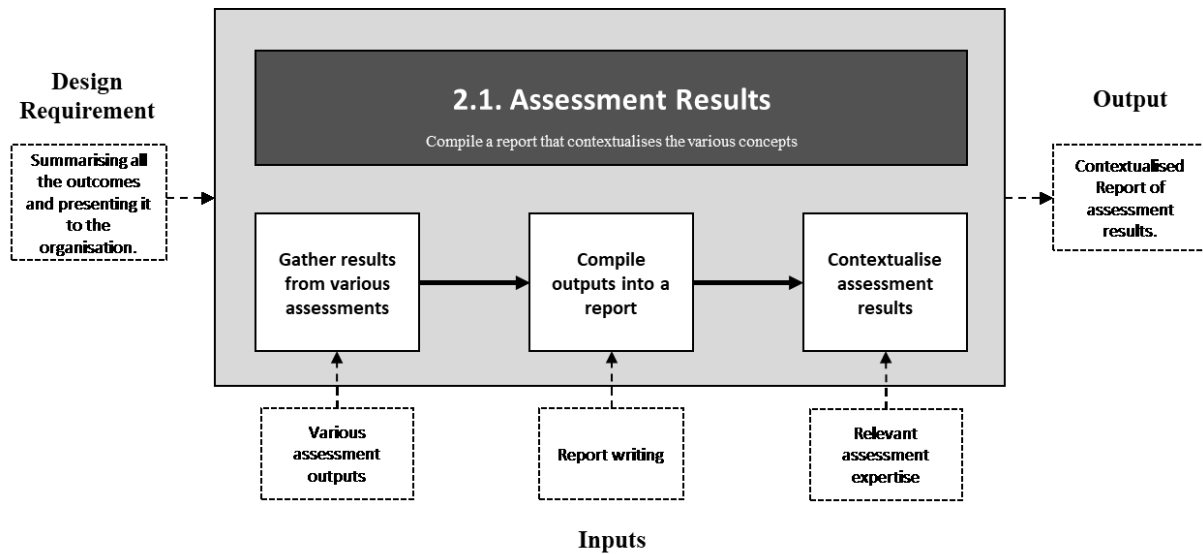
Figure 43: Assessment Report

The assessment report aims to summarise the findings from the five concepts that were applied during Phase 1. The report must be clear and concise and must be compiled through a collaboration between digital expertise and the relevant decision-making responsibility within the organisation. Phase 2.1 is presented in Figure 43.

Securing commitment from top management regarding a digital transformation process is a challenge that must be overcome in order to successfully initiate a value-adding digital transformation. In order to mitigate this challenge, this phase of the framework will specifically aim to summarise the findings of the previous concepts to make an argument for why the initiation of digital initiatives is necessary, to convince the management of the organisation of the value that can be added, and subsequently to start the initiation of the digital initiative.

Phase 1's sub-phases refers to the outputs of the various phases, and as the organisations have the freedom to decide which tools they use, the report will be heavily dependent on the selected tools and the structure of their outputs. The report is thus, regardless of the selected tools from Phase 1, required to (i) practicable, and enable the relevant decision-making responsibility to deduct conclusions as to why the initiation of digital initiative(s) could be necessary, and (ii) contextualise the various phases and their outputs to facilitate an educational process for the management regarding Industry 4.0, and the effects thereof on their organisation.

7.4.2 Phase 2.2 – Value equation

Design Requirement

The need to invest resources where the most value can be created.

2.2. Value Equation

Categorise digital capabilities according to value creation potential and digital capability maturity

Evaluate value creation potential of digital capabilities

Compare to each capability's digital maturity

Plot on the value creation vs maturity plot

Output

Value creation vs maturity plot.

Industry expertise, relevant decision-making power

Digital Capability Maturity assessment results; value creation potential

Industry expertise, relevant decision-making power

Inputs

Figure 44: Value equation

Building on the definition of the different capability maturity levels of each digital capability, organisations will gain insight into, based on the results of their self-evaluations, what their organisation's current state with regards to digital maturity is for each digital dimension. When comparing this to the results of the *customer value design* phase, the organisation will be aided in determining where value can be created for the customer within the organisation and will allow the organisation to design the digital initiative with the help of the digital capabilities that the organisation already possesses. As mentioned in Section 6.4.3.2, each digital capability's value creation potential will be assessed according to its ability to contribute to the designed customer journeys.

Phase 2.2, as presented in Figure 44, supports organisations to prioritise investing resources in developing certain digital capabilities where the greatest amount of value for the customer can be created. The output of this phase is thus a categorisation of each digital capability based on (i) its ability to create value for the customer and subsequently for the organisation, and (ii) its capability maturity. This will assist the organisation in its design of the digital initiative to understand what digital capabilities are required for the digital initiative to support the organisation in its objective of enacting a value-adding digital transformation.

The evaluation of value-creation potential will be done by combining the organisation's relevant digital initiative design responsibility, along with digital and industry expertise that can assist the organisation in categorising the digital capabilities according to its value creation potential and subsequently support the organisation in capability-investment and prioritisation decisions.

As the objective of a digital transformation is to (i) enhance the customer experience and to (ii) increase operational efficiency and effectivity, the value-creation potential will be measured against its contribution to achieving these two overarching objectives. This assessment is done through evaluating what capabilities are required to initiate a digital initiative effectively that

will give effect to the customer journeys mapped in Phase 1.1.3, to subsequently address the customer needs identified in Phase 1.1.2. The over-arching objective of Phase 2.2 is creating awareness with the user that the value creation potential of investments should be a key consideration, and the matrix below is used to create awareness in the user(s) that not all mature capabilities create value, and not all value creating capabilities are mature. This guides the user to rethink the structure of the organisation, and to critically evaluate the contribution of each capability in the organisation's objective of creating value for their stakeholders.

Figure 45 will be used as a visual aid to guide organisations to plot their various capabilities, which is used as a framework for organisations to critically evaluate the value creation potential of their capabilities.
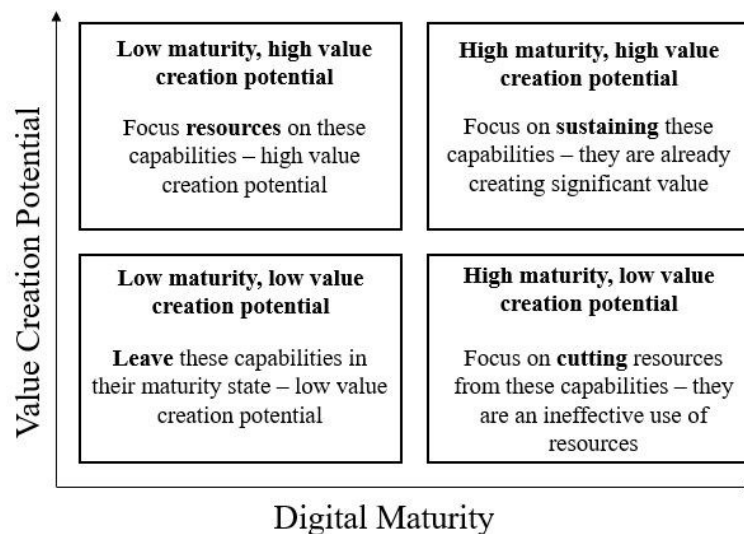
Figure 45: Value creation vs digital maturity

7.4.3 Phase 2.3 – Challenges index
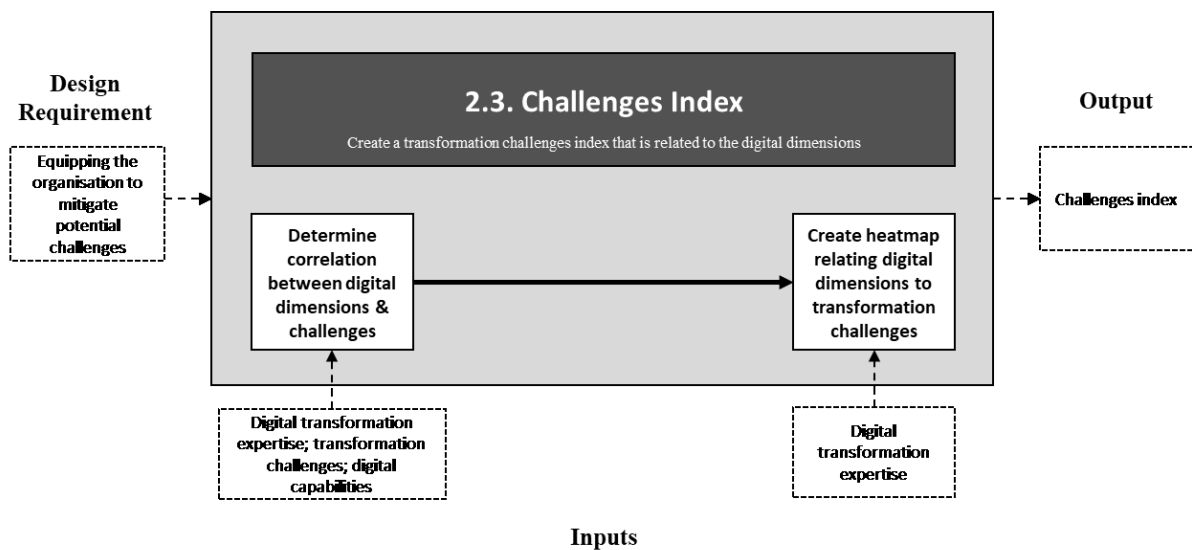
Figure 46: Challenges index

Organisations experience various challenges in their digital transformation journey, as was extensively researched in Chapter 4. Conclusions were drawn from literature and supported

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through interviews with subject matter experts that organisations find it difficult to enact value-adding digital transformations, due to the various transformation-challenges that they face. Phase 2.3, visually represented in Figure 46, was thus developed to incorporate the findings from Chapter 4, and integrate the challenges with the digital dimensions to create an index of potential challenges that organisations might face as they strive to transform their organisations.

The challenges index was created through using a heatmap, which indicates the relation between the non-exhaustive list of transformation challenges and the digital dimensions. Each challenge was critically evaluated against its relation to the various challenges – and was used in the challenges' assessment in Phase 1.2.2. Phase 2.3 refers back to the challenges' matrix and guides the organisation to reconsider the challenges based on the capabilities they want to invest in, and the various challenges' relation to these digital capabilities. The evaluation can be found in the digital transformation assessment in Addendum A2 – Digital transformation challenges.

This index will provide organisations with a tool that they can use to increase their understanding of the potential challenges to support them in preventing and mitigating them.

7.5   Tool expansion reflection

Through the execution of the various phases that was elaborated on in this chapter, the design requirements presented in Section 4.7 were all addressed. Although each phase made suggestions as to what tool to use to achieve the outcome, the users of this framework are encouraged to focus more on achieving the outcomes proposed in each phase than the use of the specific tool itself. The proposed tools were selected based on its ability to meet certain criteria for each phase, but the framework allows organisations to further refine the selection criteria to reach the desired outcomes.

As discussed in Section 6.4.4, as the objective of this framework is providing decision-support to organisations regarding the initiation of digital initiatives, the educational nature of the framework permits and encourages the user to re-evaluate various phases continuously to ensure its relevancy. Therefore, a specific tool was not developed to measure the progression of the initiation – it was concluded that this would become a requirement during the implementation of the digital initiative(s), which falls outside the scope of this thesis. Rather, Phase 1 and its sub-phases can be re-evaluated at any stage during the initiation and implementation of the digital initiative(s) to ensure the value proposition of the digital initiative is correctly aligned with the needs of the customer (Phase 1.1), and that the organisation is progressing in its digital transformation journey (Phase 1.2)

Table 18 summarises the various phases from the DIIDS Framework, with specific focus put on (i) which tool is proposed for each phase, (ii) what the desired outcome is of each phase, and (iii) which design requirement each phase addresses.

Table 18: DIIDS Framework summary

Phase	Tool	Outcome	Design Req.
Phase 1.1.1	Disruption assessment tool.	Contextualisation of various disruption domains relevant to the organisation.	1
Phase 1.1.2	Customer needs identification tool; QFD (Kano Model).	Customer needs; categorisation of identified customer needs.	2
Phase 1.1.3	Customer experience mapping tool; McKinsey Design Index	Mapping customer journeys; measuring of customer experience design capabilities.	3, 4
Phase 1.2.1	CMM	Maturity rating of various digital capabilities to create a 'As-Is' state of the organisation.	5, 6, 7
Phase 1.2.2	Challenges assessment tool	Identify the potential influence of actual digital capability maturity on the perception of digital capability maturity.	8, 9, 10
Phase 2.1	Report writing	Summarise the findings from the preceding five phases in a report that easily conveys the findings of each phase.	11
Phase 2.2	Value prioritisation	Guide the organisation to prioritise capabilities/initiatives that will create value for the organisation.	12
Phase 2.3	Challenges index	Make organisations aware of the potential challenges they might encounter to assist them in the proactive dealing with said challenges.	13

7.6 Chapter 7: Conclusion

This chapter reported on the elaboration of the conceptual framework that was presented in Chapter 6. Each phase was further contextualised through defining the inputs and outputs of the phase and explaining how the tool would be applied within the framework. This chapter concludes stage 2 of the research and introduces stage 3 – the validation of the research.

The following chapter outlines the validation process and present the results from the validation to determine the legitimacy of the framework. The validation was done according to the process presented in Sections 2.6 and 2.7 and seeks to support the literature-validation that the author discussed in Chapters 3 through 6. The findings from the following chapter was used to amend the framework to include the inputs from subject matter experts to further increase the legitimacy and feasibility of the framework. The final framework, including the aforementioned inputs, is presented in Chapters 6 and 7.

CHAPTER 8. VALIDATION

8.1 Introduction

As mentioned in Section 2.5, the validation of this research is done by using the triangulation method – with the three parts consisting of literature research, interviews with subject matter experts, and a case study where the framework is applied.

This chapter will discuss the application of the validation process and will report and discuss the findings of the (i) research rational, (ii) concept, and (iii) user validation. The case study design and application will be discussed. The chapter concludes with a discussion on the findings of the case study. Figure 47 indicates how Chapter 8 fits into the thesis.
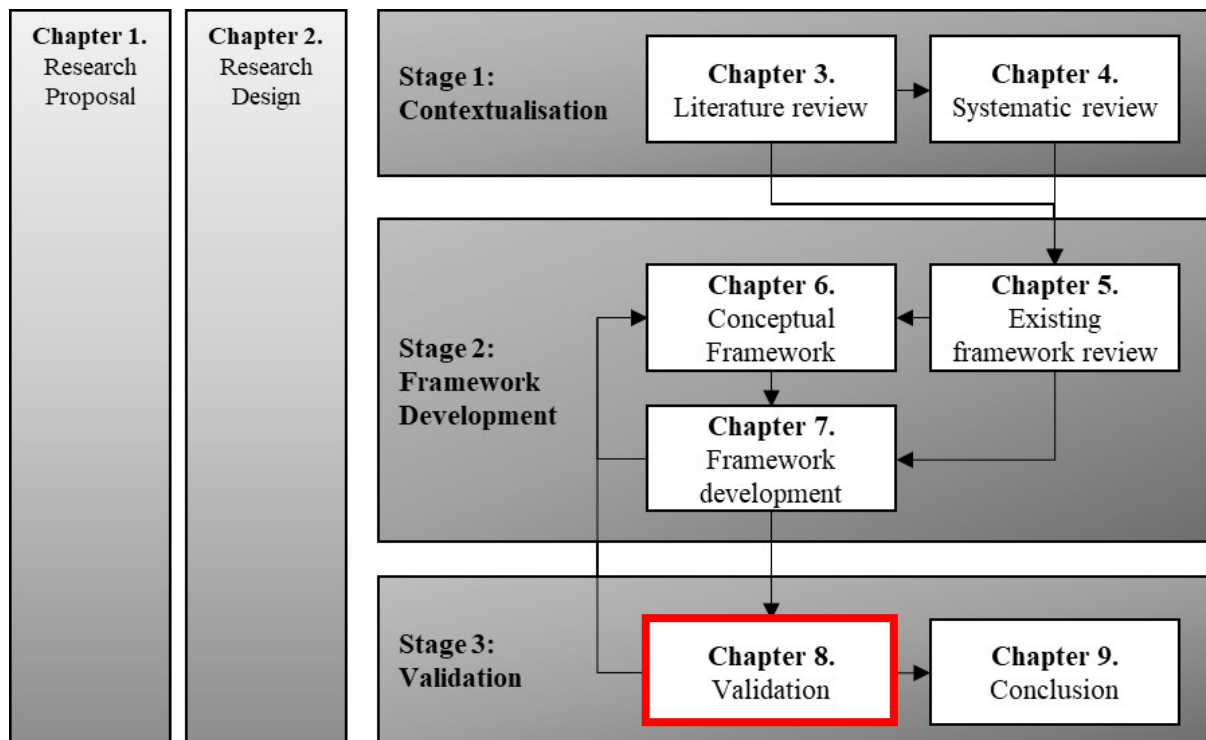
Figure 47: Research design: Chapter 8

8.2 Validation overview

The development of the digital transformation conceptual framework is an iterative process, with internal and external validation aspects. The following figure depicts how the triangulation method was used as internal and external validation, and which methods were used for each part.

The first iteration is based on the literature research component. This was done through a literature review in Chapter 3, and a systematic literature review in Chapter 4, and was used as the internal validation of the conceptual framework. The research requirements identified through the literature were then confirmed with subject matter experts and validated through semi-structured interviews. The literature and interview findings were combined in the creation of the conceptual framework found in Chapter 5. The interview component of the validation

process was executed in two parts – firstly in the validation of the design requirements for the framework, and secondly in the validation process of the completed framework.

The external validation of the conceptual framework was done through an adaptation of Borenstein's (1998) method of DSS models validation. This method is discussed and elaborated on in 2.5.2. The validation method is completed in four steps and was amended to fit the validation needs of this research. The five phases are (i) face validation, (ii) concept verification and validation, (iii) predictive validation, and (iv) user assessment. These steps are elaborated on in Section 2.5.2.

8.3 Validation design

The following sections contextualise the application of the validation strategy described in Section 2.5. The design of both the internal- and external validation approaches is elaborated on in Sections 8.3.1 and 8.3.2 respectively. The visual representation of the validation method is shown in Figure 48.
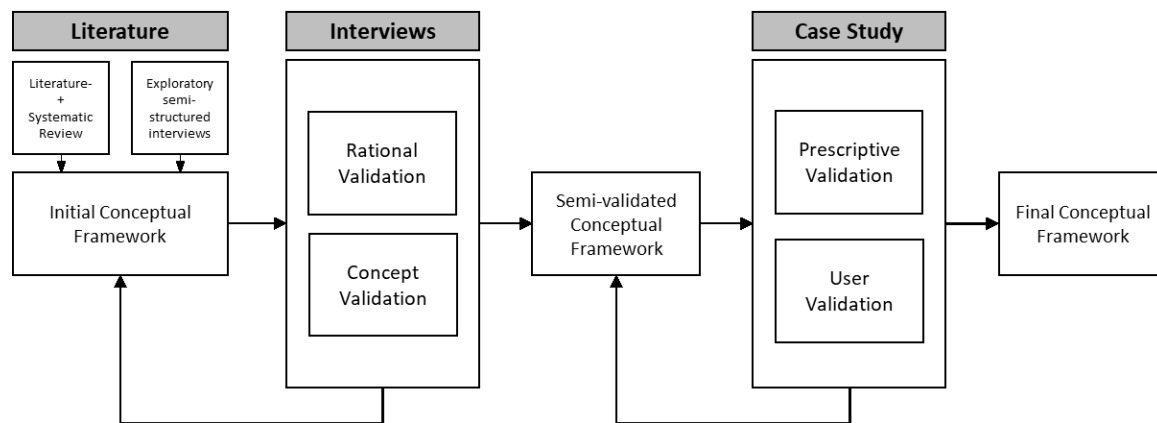
Figure 48: Validation design

8.3.1 Literature validation

The first part of the triangulation method is literature-based, and as mentioned in Section 8.2, the design requirements for the conceptual framework were developed through a literature review conducted in Chapter 3 regarding Industry 4.0, digital organisations and transformations, and a systematic literature review in Chapter 4 regarding the challenges organisations face during a digital transformation. Through these literature-based chapters it became evident that there is significant value to be created through implementing Industry 4.0 concepts through a digital organisation, but that organisations have a low success rate in enacting value-adding digital transformations.

The literature was used to generate design requirements for the conceptual framework, and this served as the input to Figure 48, which represents the adapted method from Borenstein (1998) to validate conceptual frameworks.

8.3.2 Interview validation

The second and third parts of the validation was guided by Borenstein's (1998) method, and the application thereof is contextualised in Section 2.5.2.2. The following sections will elaborate on how it was applied in this research.

The profile of the individuals who were interviewed has to comply with two requirements: (i) they must have strong Industry 4.0 knowledge to ensure their answers add legitimacy to the validation process, and (ii) they must come from a diverse set of industries to ensure the applicability to all industries.

Based on these requirements six individuals were interviewed. One is employed at a prominent management consulting company, two are from academia where their academic focus areas are related to Industry 4.0, one started a company looking at the disruptive effect of Industry 4.0 technologies, one was involved in the founding of a digital bank, and one works for an energy company that incorporates various Industry 4.0 technologies. Their profiles were compared and deemed to meet the two requirements presented earlier in this section.

The following sections elaborate on the methodology presented in Section 2.5.2.2and contextualise the application of the interview process.

1. Interview selection

Qualitative data is generally gathered in three ways – (1) unstructured interviews, (2) structured interviews, and (3) semi-structured interviews. Unstructured interviews are open-ended with no specific guide as to what questions should be asked. These interviews are used when little is known about the topic at hand to allow for exploration that will contextualise the topic, but certain disadvantages exist – such as difficulty in the analysis of the data, and inexperienced interviewers may find it challenging to guide the interviewee to present them with relevant information (Gill *et al.*, 2008).

Structured interviews are used to gather precise data within predetermined categories and are used when more context exists around the relevant topic. Advantages include that the data is easily analysed, the skill level of the interviewer does not influence the outcome of the interview, and the interview is generally completed in a short time. When uncertainty exists surrounding the topic, structured interviews may limit the deeper exploration of certain concepts within the relevant topic (Gill *et al.*, 2008).

Semi-structured interviews are more structured than unstructured interviews and are used when more context exists regarding the research topic, but they allow the interviewer to probe the interviewee to explore concepts that come up throughout the interview more deeply. Advantages include the allowance for the aforementioned exploration that could lead the interviewer to new insights, but the interviewer's level of skill could be a limiting factor in the effectivity of gathering relevant information from the interviewee (Gill *et al.*, 2008).

Based on the literature review conducted on the topic of digital transformations, and the finding that the lack of context surrounding a digital transformation is a significant transformation challenge, *semi-structured interviews* were selected as the interview method. The existing literature research was judged to provide sufficient context to not make use of unstructured interviews, but the novelty of the topic prompted the author to select an interview method that would allow for the exploration of concepts where sufficient context was not created in the literature review. As mentioned in Section 2.4, the development of the conceptual framework was based on the Grounded Theory methodology, a qualitative research technique with a systematic approach to enquiry, which strives to find relationships within data. The method

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allows for remaining open to all possibilities within the research (De Hoyos and Barnes, 2012), which further supports the selection of an interview method with enough structure to allow the comparison of various interviews, but with the openness to further explore concepts that weren't considered prior to the interview.

2. Interview protocol

The interview protocol was designed in two parts: (i) how the interviewer would conduct himself in the interview – with the decision made that respect would be the key attribute of the process – arriving on time, being friendly, respecting the interviewees wishes, etc., and (ii) the questionnaires that were given to the interviewees. These questionnaires can be found in Addendum A4 – Validation design.

3. Data analysis

The analysis of the interview data was done according to De Hoyos & Barnes (2012) methodology, who suggest that the analysis should be done by the following steps presented in Figure 49:
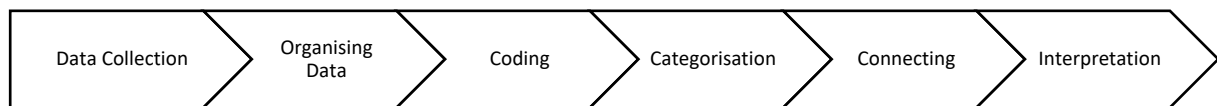
Figure 49: Data analysis process (De Hoyos and Barnes, 2012)

Data collection was done through the execution of the interviews. The interviews were transcribed, and the data organised and coded in order to use it for analysis. Coding the data includes identifying certain concepts and labelling them. The next step focused on categorising the data accordingly. The second-to-last step includes connecting the data to find related concepts, as the Grounded Theory technique strives to find relationships between data, with the last step being the interpretation of the findings – which serves to determine whether the data supports the concepts identified in the research (De Hoyos and Barnes, 2012).

4. Reporting the findings

The findings of the interviews and subsequent conclusions can be found in Section 8.4.

8.3.2.1   *Interview application in validation*

The following sections contextualise the different stages of the validation process followed in this research, with specific focus put on how Borenstein's method was interpreted to fit the needs of a conceptual framework.

Research rational validation

These two steps were completed together, as the literature-validated conceptual framework was taken to six independent subject matter experts. The semi-structured interviews were used to introduce the conceptual framework and validate the problem statement that the conceptual framework aims to solve. The various concepts present within the conceptual framework were presented to the subject matter experts, their comments and remarks were noted, and the framework was amended to incorporate their ideas and advice.

The amendments that were made to the framework were validated through literature to ensure their validity, and the development of the final conceptual framework commenced. The

amendments are mentioned in Section 8.6. This iteration of the conceptual framework was used in the *prescriptive validation* step and is discussed in the following section.

8.3.3 Case study validation

The methodology followed to design the case study was elaborated on in Section 0 – whereas this section will discuss the case study selected for this research, the design selections made for the case study design, and how this links in with the overall validation strategy followed for this research.

8.3.3.1 Case selection

The case selected for this research was a direct insurance initiative that found its origin from within an existing financial services group. This selection was made based on the following selection criteria:

- The financial services group's car insurance component was not working effectively, and they decided that an external initiative based on new digital technologies was required that would increase the effectivity and efficiency of their operations, and increase their customers' experience.
- The initiative was launched in 2008 – and thus enough time has passed to evaluate the long-term success of the initiative, and the integration between the parent organisation and the initiative.

The reasoning behind the launch of the initiative is thus aligned with the argument that this research makes for enacting a digital transformation through launching digital initiatives, and the focus areas of the initiative are aligned with the argument that the research makes for what the focus areas of a digital transformation is – operational effectivity and efficiency, and increased customer experience.

8.3.3.2 Case study application in validation

Prescriptive validation

As described in Section 2.5.2, this step was amended from Borenstein's method to compare the conceptual framework to an existing, successful solution to the same problem the conceptual framework aims to solve, to identify similarities and possible areas that the conceptual framework is not addressing. This was done in two parts – (i) the design requirements for the conceptual framework were compared to existing digital transformation frameworks in Chapter 6, and an analysis was done to determine to what extent the existing frameworks are meeting the design requirements set out for this conceptual framework, and (ii) the conceptual framework was applied to a scenario where an organisation successfully launched a value-adding digital initiative from within their organisation, and the conceptual framework was compared to the process to identify correlating principles and identify areas that the conceptual framework is not addressing. Once this commenced, the insights gathered from this step were incorporated into the conceptual framework, and the final iteration of the conceptual framework was completed.

The prescriptive case study can be found in Section 8.5.

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User validation

This phase was used to test the collective applicability of the conceptual framework within various industries – to test whether the end users would find value in applying the conceptual framework. The validation was specifically focused on the tools – with focus put on two areas: the effectivity of the tool itself, and the relevance of the tool within the greater context of the conceptual framework.

Questionnaires were set up that validated each tool from the framework in three areas – (i) whether the input for the process is correct, (ii) whether the process itself is correct, and (iii) whether the output is value-adding to the digital transformation process and thus the conceptual framework. Each tool was separately evaluated using this method through structured interviews with subject matter experts – and the findings can be found in Section 8.4. The questions were answered on a Likert-scale to allow the comparing of the answers from various sources.

The relevance of each tool pertaining to the overarching objective of the conceptual framework was also evaluated based on two metrics – (i) requirement of the tool – evaluated based on the relevance of the output of the specific tool to the objective of the framework, and (ii) whether the tool would effectively attain the desired output.

8.4   Expert validation results

The following sections elaborate on the various expert validation interviews that were conducted and discusses the results of the validation process.

8.4.1   Research rational validation

The research was based on various assumptions – and the first validation was done to test the accuracy of said assumptions. The questionnaire that was used during the validation can be found in Addendum A4 – Validation design, Section 0. It can be seen that all of the assumptions were either answered 'agree' or 'strongly agree', with the exception of question 4 – where the subject matter expert admitted that their knowledge on the question was not enough to provide a definitive answer.

The questions were posed in such a way that the problem statement was validated, with every subject matter expert agreeing that many organisations struggle to enact value-adding digital transformations.

From the results of the validation, shown in Figure 50, it can be concluded that the assumptions that the author made are accurate, and subsequently the research rationale is deemed to be valid.
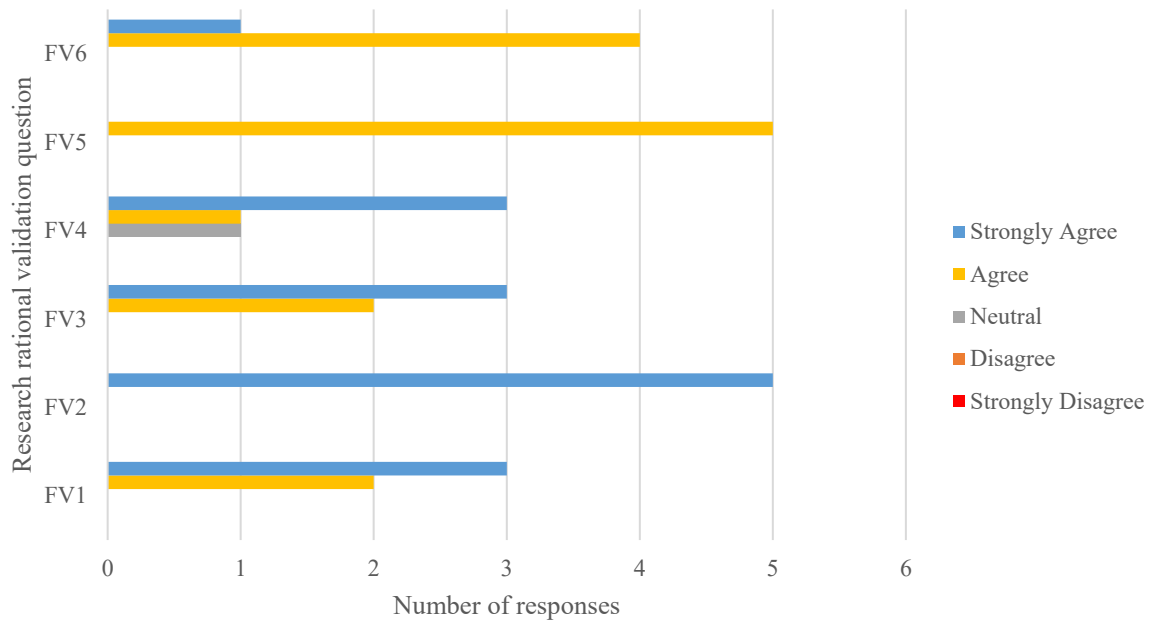
Figure 50: Subject matter expert responses to research rational validation questions

8.4.2 Concept validation

The concept validation was done by using a questionnaire that subject matter experts answered after (i) reading the pre-reading material that the author provided them with that contextualised the framework and all the various concepts within the framework, and after (ii) the author explained each concept and its contribution in the framework during the interview. Six interviews were conducted with subject matter experts, and the questions that each answered can be found in Addendum A4 – Validation design.

Each concept was separately validated, with the questions specifically aimed at determining: (i) whether the outcome of the process is valuable with regards to an initiation of digital initiatives framework, (ii) whether the process was adequate for reaching that outcome, (iii) whether the inputs and outputs of the framework were correct, and (iv) whether the specific concept and its outcomes added value to the framework to achieve its goal of providing organisations with decision support when initiating digital initiatives.

From the validation is was concluded that all of the concepts were found to be relevant to the framework, with most questions regarding each concept being answered with either an 'agree' or a 'strongly agree'. CV2.2 was answered as 'neutral' twice, with both experts agreeing that the tool proposed to address the objective was "too specific", and that more flexibility should be afforded to the organisation to choose their own tool. CV1.3 was answered as neutral by one expert, as the expert argued that the inputs to the phase were slightly vague. CV1.2 was the only question that was answered with a "disagree" by one expert, as they claimed that the outcome of the process, which is the indication of where the organisation finds itself on the incumbent disruption curve found in Phase 1.1.1 was not necessary, and the knowledge of the various disruption domains achieved through using disruption assessment tools was sufficient for this sub-phase.

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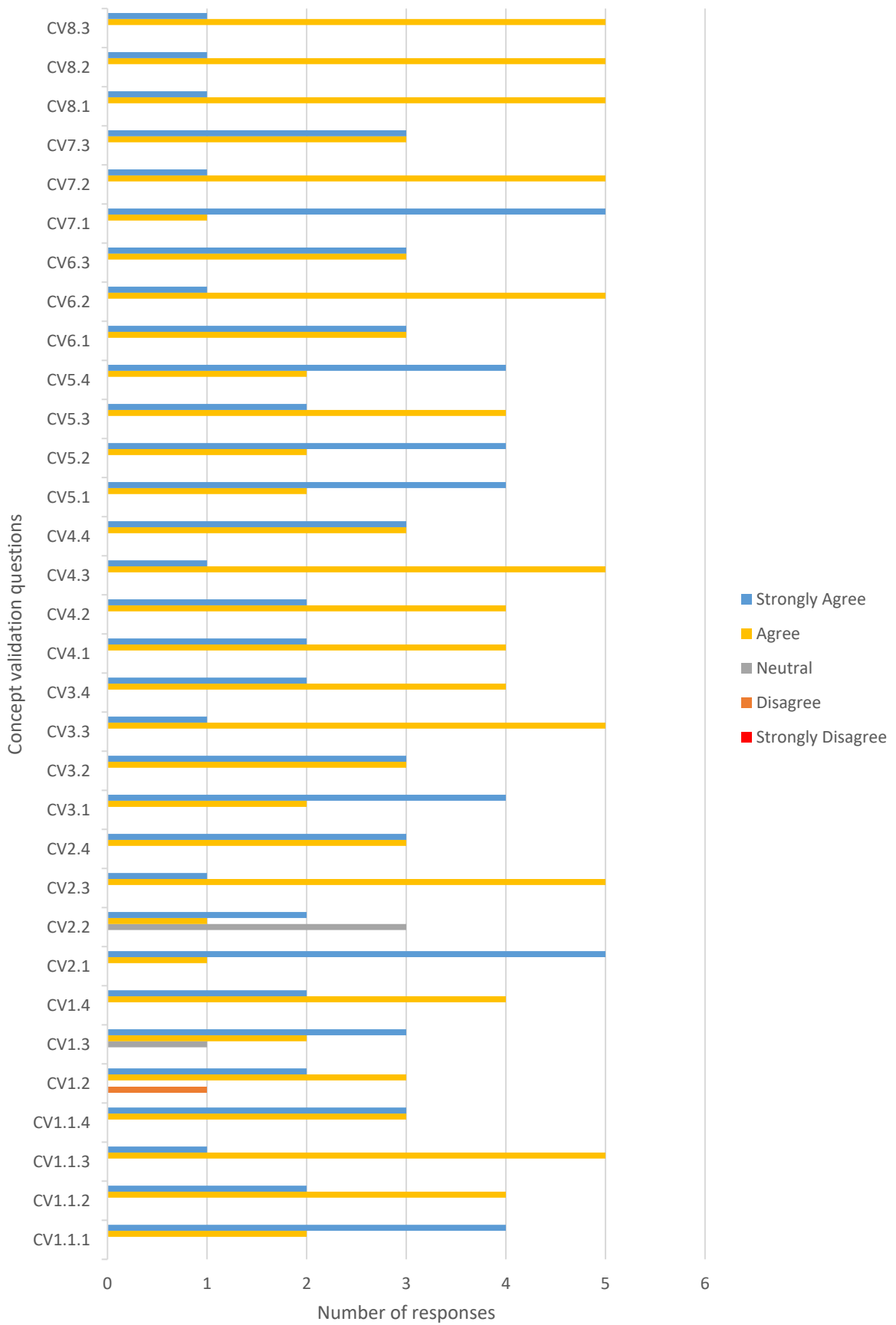
Figure 51: Subject matter expert responses to concept validation questions

8.4.3   User validation

The user validation was conducted to test the usability of the framework within organisations, and the questions were aimed at determining whether the framework would be applicable within the organisation that the subject matter expert was from.

The questions were all either answered as 'agree' or 'strongly agree', and thus the conclusion is drawn that the framework is deemed practicable within organisations (at least within the contexts of the organisations within which the subject matter experts work) to enact a value-adding digital transformation. The results can be seen in Figure 52.
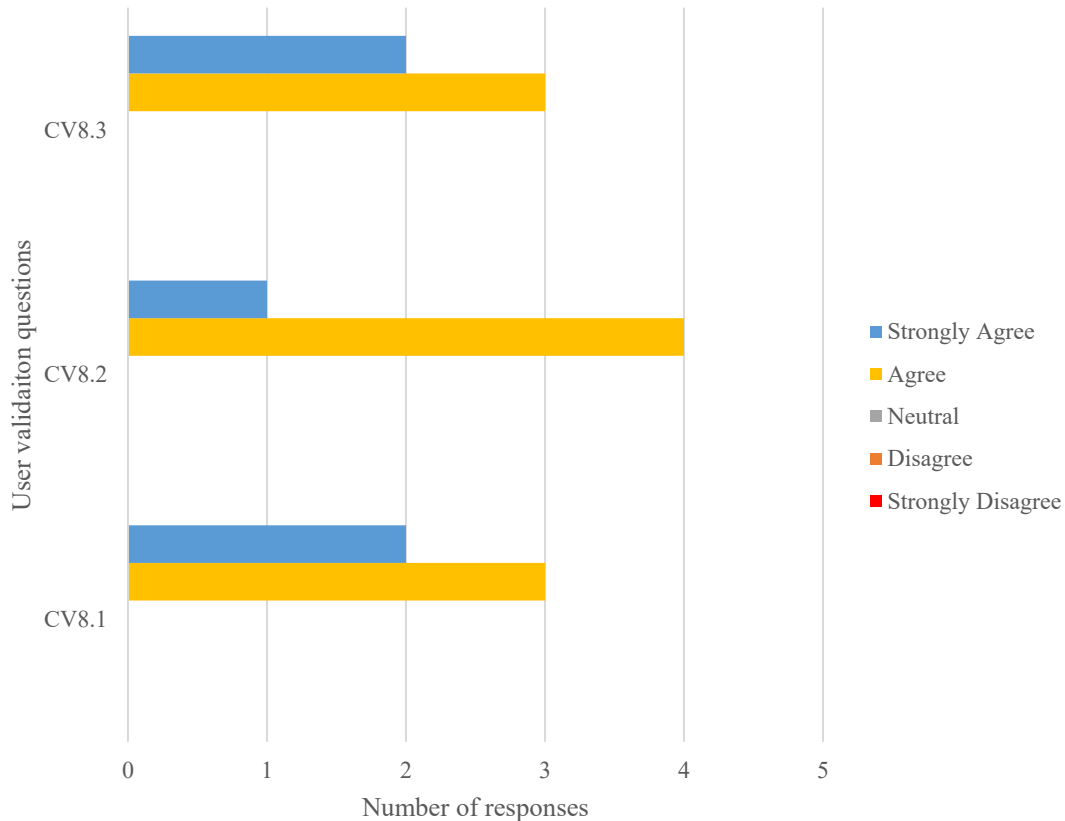
Figure 52: Subject matter expert responses to user validation questions

8.4.4   High level validation

The following section describes the high-level validation questions that were posed to the experts, which tested their over-all perception of the framework once it was explained in its entirety. The posed questions were done in two parts: one question was asked on a Likert-scale, which enquired whether the expert agreed that the framework would help enact a value-adding digital transformation through the initiation of digital initiatives, to which three answered "agree" and three "strongly agree". This can be seen below in Figure 53.

The second part of the high level validation was done in a qualitative manner, as the experts were asked what they believed the key strengths and benefits of the framework is, and what the weaknesses and limitations are. The following sections will elaborate on those two questions.
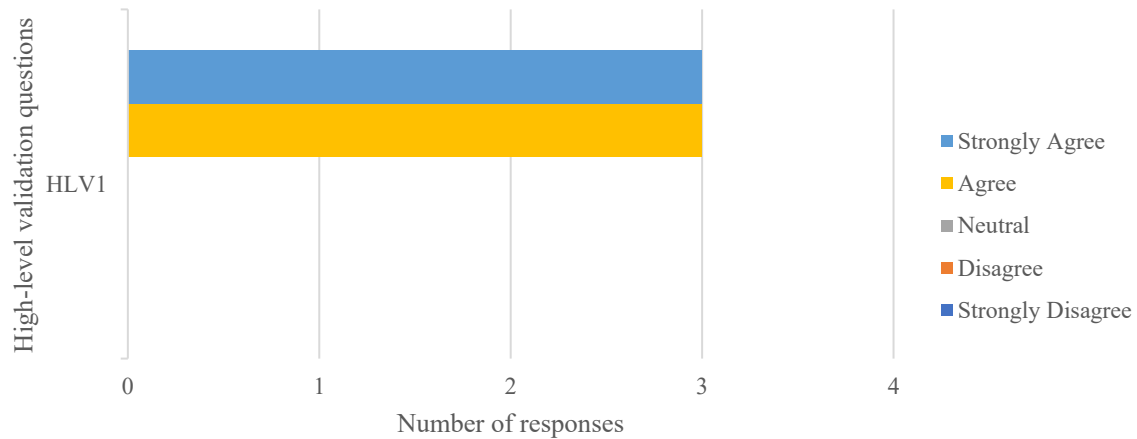
Figure 53: Subject matter expert responses to high level validation questions

8.4.4.1 *Key strengths and benefits*

The experts were asked to indicate what they believed the key strengths and benefits of the framework are. This section is a summary of their feedback.

The framework recognises the strategic and disruptive potential of Industry 4.0 technologies. In particular, it also accounts for the technologies and their interplay with customer demands and expectations as well as the changes in organisational structures and cultures that will be required. The framework seems to be underpinned by a scientific method for articulating the relevant research questions and research methodology. It recognises the importance of being able to adjust these as the research process unfolds, in order to account for new things that are learnt along the way.

The framework increases awareness surrounding the digital transformation challenges, and it serves as an educational tool that facilitates conversations between managers and digital experts. The framework accounts for subjectivity risk by allowing the identification of naivety regarding digital capability maturity through the challenges' assessment tool.

The framework is an overall good starting point for the initiation of digital initiatives, with the intentional and explicit customer focus a good place to start, the intentional creation of awareness surrounding the digital capabilities of the organisation to create an as-is state of the organisation, and the intentional prioritisation of initiatives and capabilities that will create value for the organisation.

8.4.4.2 *Key weaknesses and limitations*

The experts were then asked to indicate what they believed the key weaknesses and limitations of the framework are. This section is a summary of their feedback.

The lack of focus on the operating model of the organisation could inhibit the successful implementation of the digital initiative – although the scope of this study is specifically the initiation of the digital initiatives, more focus could have been given to the operating model of the organisation within the framework. This ties in with a comment made by another expert that the scope of the framework is slightly ill-defined, and more focus should have been given

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to that. A finer balance could have been struck between complexity and usability, as the framework might be too high level for practical use.

One of the challenges identified in Chapter 4 was the lack of commitment on executive level, and it was concluded that securing commitment from top management is of paramount importance in a successful digital transformation. This framework does not speak to securing commitment from top management but requires it for the successful use of the framework.

8.4.5   Theoretical validation concluding remarks

The research rational, concept, and user validation concludes the interview segment of the validation process. The findings indicated a strong sense of agreement from the subject matter experts regarding the research assumptions, included concepts, and applicability of the framework. Subsequent to the expert validation a case study was conducted to further validate the research. The case study is discussed in the following sections.

8.5   Case Study

This section will elaborate on the case study that was applied to a short-term direct insurance organisation. The objective of the case study was to investigate the implementation process of a successful, value-adding initiative, and compare the applied principles to those presented by the research. The comparison served as the final part of the validation of the research.

This section will describe the various design selections that were made based on the framework presented in Sections 0 and 8.3.3. Background will then be provided on the initiative that is being investigated to contextualise the situation of how it was initiated and implemented. A section is then dedicated to present the financial performance of the initiative from its inception to support the argument that it is a successful initiative, after which a discussion will follow that elaborates on the principles applied during the process, and the challenges experienced by the initiative.

The case study concludes with a discussion surrounding the comparison between their principles and the principles identified in this research, as well as the challenges they faced and the identified challenges in Chapter 4. This initiative is considered to be a successful initiative, and therefore the principles identified in this research are compared with their principles to seek parallels and further validate the use of these principles to initiate digital initiatives to support a value-adding digital transformation.

Design selections

The research methodology of a case study is elaborated on in Section 0, with various design selections mentioned in Section 8.3.3. This section will indicate which selections were made for this research. The selections, that can be seen in Table 19, will form the design of the case study.

Table 19: Case study design selections

Consideration	Selection
Design	
Methodology	Single, exploratory case study.
Case question	What principles were prevalent in the successful implementation of the initiative?
Unit of analysis	The initiative.
Organisational theory	The principles presented in the DIIDS Framework contributes to the successful implementation of digital initiatives.
Data collection	
Methods	Interviews, documents.
Data Analysis	
Method	**Explanation building** – this method compares a theory to the findings of an initial case and draws conclusions on the validity of the theory. This case will analyse the principles exhibited in the initiative's initiation and implementation and compare them to the principles presented in the DIIDS Framework.

The process of conducting the case study is elaborated on in the following sections, followed by a discussion surrounding the results from the case study.

8.5.1 Background

Launched in February of 2008 as an initiative of a financial services provider group (consisting of a short-term insurance company and a life insurance company) and an external financial services provider, the initiative was one of the first South African-based direct insurance organisations. They were the first insurance organisation to offer the purchase and administration of short-term policies online through their online portal – which focused on streamlining the end-to-end insurance journey. Having more than 330 000 customers in 2019 and an annualised premium income of R1.5 billion, they are regarded as a highly successful initiative, supported by winning various accolades, including top honours at the *Mail & Guardian Top Companies Reputation Index Awards* in 2014 (Otto, 2019).

Insurance, as a concept that distributes risk among various people, dates back to the second and third millennia BC. In the seventeenth century, British ship owners concluded that each ship travelling to India was at risk of sinking due to the risk-laden nature of the expedition – and the ship owners developed a system whereby that risk was distributed among all the owners – that should a ship sink, the insurance pool would protect the losses of the owner of the sunken ship (Van Zyl, 2019).

Insurance brokers, as they are known today, would calculate the risk of the group involved, and based on the risk of the venture, the premium that each individual had to pay was calculated. The higher the risk of the venture, the higher the probability that some losses would

need to be covered, and thus the premium would be higher. If the pool became too small, the premium that each individual had to contribute would increase. This system would distribute the risk evenly among all the involved individuals, and everyone would contribute an average amount. There are various factors involved that influence the level of risk that each individual carry, and the system of averages thus required the lower-risk individuals to subsidise the higher-risk individuals (Van Zyl, 2019).

There are various types of modern-day insurance, with the short-term insurance company focusing car insurance, home insurance, commercial insurance, corporative insurance, and directors' and officers' liability, amongst other things. The different types of short-term insurance have different levels of complexities. The broker plays an important role in the process of determining the premium for an individual and they make their money through commission on premiums that they sell. Brokers would make 20% commission on the sale of all short-term premiums, except motor cars – where they earned 12.5%. The ex-financial director of the short-term insurance company noted that when considering the value chain of insurance, brokers make a disproportionate amount of money on selling car insurance compared to the value they add due to the simplicity of determining a premium for car insurance (Reyneke, 2019).

In the 1990s, new technology was developed that enabled organisations with computing capabilities to consider several variables and attribute a specific risk factor to an individual. Companies could thus offer individuals a premium based on their own unique risk factor, which was thus lower than the incumbents' offering for low-risk individuals. This technology was specifically applied in car insurance, as the simplicity of the process enabled the new technology to accurately determine individuals' risk factors. The companies offering individual premiums incrementally started taking market share from the incumbent organisations, as the low-risk individuals were lured away through lower premiums (Otto, 2019; Van Zyl, 2019).

In South Africa, two prominent insurance companies were founded in the late 1990s. These new insurance entrants built their business models on the new technology that enabled them to offer individuals premiums based on their risk profile – which was lower than the premiums offered to them by the incumbents, such as . This method is referred to as direct insurance, as the intermediary, the broker, is eliminated from the process (Van Zyl, 2019).

In the early 2000s, the CEO of the short-term insurance company (who later became the CEO of the life insurance company), became aware of the disruption that resulted in them losing market share to their direct competitors. He initiated a project to transform parts of their insurance model to incorporate the new technology to remain competitive with their direct insurance competitors. He describes the decision as "… we simply had to do it – we had no other choice" (Van Zyl, 2019). This sentiment is echoed by the ex-financial director and ex-CEO of the short-term insurance company, and the CEO of the initiative (Kirk, 2019; Otto, 2019; Reyneke, 2019).

With both the short-term and life insurance companies being older than eighty years at the time, the attempt to transform the organisation internally and integrate the new insurance model failed on various attempts, as the new technology nullified the role of the broker in the

insurance process. This caused significant change resistance, as the short-term insurance company's business model was built around brokers, and their employees were not willing to adopt new technology that would potentially replace them in the organisation. The short-term insurance company's clients were all associated with a broker, and their loyalty was with the brokers. the short-term insurance company thus ran the risk that if they were to upset their brokers too much – they threatened to leave the short-term insurance company and take their client book with them to a competitor. There was too much at stake, and it was at this point that the decision was made that this project was to be initiated as an independent enterprise outside of the short-term insurance company (Kirk, 2019; Otto, 2019; Reyneke, 2019; Van Zyl, 2019).

The co-founder of one of the prominent insurance companies that started in the 1990's, was then approached by the ex-CEO of the life insurance company to get involved as the "jockey" of the initiative – the person responsible for holding the project together and 'driving' the implementation of the initiative. He had experience with building business models on the new technology-enabled capabilities and thus had the relevant experience to launch a direct insurance initiative. He was adamant from the start that the initiative be run separately from the short-term insurance company – with his arguments being that the technology would be direct competition for the brokers within the short-term insurance company, and that the staff of the short-term insurance company would not adopt a technology that would potentially render them obsolete in the organisation (Otto, 2019). This received some resistance at a board level, as the ex-CEO of the short-term insurance company admits that he wanted to keep the initiative in the short-term insurance company – they would be able to use the infrastructure of the short-term insurance company and thus save significantly on costs incurred (Kirk, 2019). After various engagements it was finally decided that the initiative would be run independently of the short-term insurance company, and thus the idea of the initiative was born (Kirk, 2019; Otto, 2019; Reyneke, 209; Van Zyl, 2019).

The core group of the ex-CEO of the life insurance company, the CEO of the initiative, the ex-CEO of the short-term insurance company, and the ex-financial director of the short-term insurance company then started drafting a business plan for the initiative. The CEO of the initiative was responsible for building a business model and driving its implementation; the ex-CEO of the short-term insurance company was in charge of the implementation strategy; the ex-financial director of the short-term insurance company was responsible for the financial aspect of the initiative by representing the short-term insurance company, and the CEO of the life insurance company oversaw the project as representative of the financial services provider group (Van Zyl, 2019). Due to the CEO of the initiative's insistence on having the initiative as a separate enterprise, the implementation costs were significantly higher compared to keeping it within the short-term insurance company. They had to develop an entire new system for the initiative, and the initial proposal was set at a R400 million investment. This was eventually brought down to R212 million – which the board accepted. The external financial services provider was then brought in as a 20% shareholder to shoulder some of the financial burden. The final shareholding was as follows: the life insurance company (54%), the short-term insurance company (26%), and external financial services provider (20%) (Otto, 2019; Van Zyl, 2019). They now had a plan, they had the money, the CEO of the initiative gathered the

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team that he believed he needed, and they could start working on launching the initiative (Otto, 2019).

Experiencing various challenges in the lead up to the launch of the initiative, it was finally launched in February of 2008. Not long after the launch, the financial crisis of 2008 hit South Africa – more than a million jobs were lost, and car sales immediately dropped with 25%. This made the car insurance industry very competitive – the companies offering car insurance now had a smaller pool of potential customers, and the competition increased drastically. The initiative's acquisition of clients was based on an inbound model – they would advertise their services over the radio or on television, and would then have people ready in their call centre who took the calls of people reacting to the advertisements. This method did not acquire enough new clients to be profitable, and the CEO of the initiative had to rethink their client acquisition strategy (Otto, 2019; Van Zyl, 2019).

This led to the development of an outbound client acquisition strategy – the initiative would buy lists of names, phone the people, and offer them insurance policies that were lower than their current premiums – calculated using the new technology. The combination of outbound and inbound client acquisitions worked for the organisation – but at this point they had already spent R400 million, R188 million more than the original plan. The external financial services provider, as the third and independent shareholder, then decided that the risk was too great – and they sold their shares back to the life insurance company at cost price (Van Zyl, 2019).

After the implementation of their new client acquisition method, the initiative started making a profit, and within three years the initiative was worth R800 million. They could now repay their debt, and at this point the short-term insurance company tabled a bid to buy the outright control of the initiative from the life insurance company. An analysis was done on the market segments that (i) the short-term insurance company's legacy car insurance department addressed, and (ii) the market segment that the initiative addressed, and it was found that there was only an overlap of about 4% (Kirk, 2019; Otto, 2019). Thus, the legacy part of the short-term insurance company was kept, and the initiative was operated separately as an independent enterprise, but entirely owned by the short-term insurance company. The vast difference in market segments can be attributed to the initiative targeting clients who just wanted to insure their car, whereas most of the short-term insurance company's clients insured their car through the short-term insurance company because they also insured various other assets through them. This resulted in the initiative's client base being much younger than that of the short-term insurance company (Reyneke, 2019).

With the original CEO of the initiative still in office, they continued to grow and was worth R2 billion within 7 years from its initial launch. This growth trend continued, and currently they have more than 350 000 clients, with an annual income of R2 billion, and a market value of R12 billion. The initiative continues to grow to be one of South Africa's biggest direct insurers and embodies the successful initiation and implementation of an initiative that was applied as a transformation initiative for a legacy aspect of an incumbent organisation (Otto, 2019).

8.5.1.1 Organisation growth

The initiative was used as a case of a successful initiative that was implemented in parallel with a parent organisation, and this section aims to elaborate on the performance of the initiative and its growth from its launch in 2008, up to the end of the 2018 financial year, to support this assumption.

The organisation launched in 2008 with a non-existent client base and has over the 10 years of its operations gained 330 000 clients. This works out to an average of 90 new clients joining every day of the year for the past 10 years. Their gross written premium for 2018 was R2.5bn, with an underwriting profit of R334m and underwriting margin of 13.4% for 2018 (Otto, 2019).

The short-term insurance company has a return on capital objective of 24% for all its subsidiaries, and the initiative exceeded that objective with 12% – showing a 34% return on capital for 2018 (Otto, 2019).

It can thus be concluded that it is a successful initiative, as it keeps growing year-on-year in terms of clients and profits. Described by the ex-CEO of the short-term insurance company as one of the their most successful initiatives, the CEO of the initiative refers to the new ventures that the short-term insurance company and the life insurance company are launching as "hopefully being as successful as this initiative" (Kirk, 2019; Otto, 2019).

8.5.2 Successful digital initiative principles

The following sections elaborate on the principles that were identified through the case study that was applied during the implementation process.

8.5.2.1 Initiative initiation principles

Industry awareness

The organisation was aware of which disruptive technologies were introduced into their industry, and what the effect was on the performance of their competitors, and subsequently left them with a sense of transformation urgency to embrace a business model that would incorporate these new capabilities (Van Zyl, 2019).

The new technology enabled organisations to circumvent the intermediary, or the broker, in the insurance process, and enabled organisations to offer direct insurance premiums to low-risk individuals based on their specific risk profile. This resulted in lower returns than the traditional methods, because (i) the risk of high-risk individuals did not have to be subsidised by the lower-risk clients anymore, and (ii) brokers were paid commission, and thus cost the organisation money for each client that they gained (Otto, 2019).

The short-term insurance company was also aware of what their competitors were doing, and subsequently realised that they were systematically losing market share. They had to respond, or they were at risk of losing increasing amounts of market share.

End-to-end customer experience

The initiative designers were aware of the fact that insurance is a grudge-buy, and customers already do not enjoy purchasing it – thus they had to intentionally focus on providing customers with an enhanced experience within the parameters of the insurance industry. This enhanced

experience was deemed to be through (i) offering them lower premiums than their competitors based on their risk profile, and (ii) making it as quick and convenient as possible to acquire the insurance policy, and secondly make a claim should something go wrong. They identified two touchpoints of customers within their customer journey – when they buy the premium, and when they make a claim. The customer experience design was thus done around these two touchpoints (Otto, 2019; Van Zyl, 2019).

The first touchpoint was addressed through their operating model of acquiring customers. The first experience enhancer was the lower premium, with the second being their client acquisition strategy. It was designed around call centres where employees would phone customers, and in a very short time ask a few questions that enabled the organisation to gather enough information on the individual to be able to offer them a relevant and cheaper premium (Otto, 2019).

The second touchpoint for customers is during the claims process, and the initiative designed four methods to ensure the customer can make a claim in a manner that they are comfortable with. To make a claim, one can (i) apply through an online self-service, (ii) claim through the initiative's mobile application, (iii) email a request, or (iv) phone their claims department and let an agent assist them (Otto, 2019).

Operational productivity
Building the operating model of the initiative on the new technology and subsequent capabilities, it allowed them to cut out the intermediary in the process and save costs on employment and commission. An entirely new system was developed that facilitated the process, and they could offer premiums to customers in a very short period of time – often taking only minutes (Otto, 2019).

Value focus
The initiative was very intentional about focusing their resources on what created value for them. They invested heavily in technology that enabled them to determine an individual's risk factor and subsequently their relevant insurance premium, because they knew it would create value for them to be able to offer clients a lower premium than their competitors (Kirk, 2019; Otto, 2019).

The initiative committed to outbound client acquisition strategies not only because it was the norm. They realised it was not creating enough value for them, so they invested in another capability, inbound client acquisition, which enhanced their profitability (Otto, 2019; Van Zyl, 2019).

The initiative thus committed to investing in capabilities that would enable them to provide the desirable customer experience to their clients that was discussed in the '*End-to-end customer experience*' section.

8.5.2.2   *Implementation principles*

Organisational support
The initiative required R212 million to launch – and they wouldn't have been able to raise that amount of money without the support of the incumbent parent organisations – the life insurance company and the short-term insurance company. Thus, there is a requirement for the support

of the parent organisation to invest in the initiative to be successful. This investment could be in various forms – infrastructure, data, capital, or people, amongst others (Kirk, 2019; Otto, 2019; Reyneke, 209; Van Zyl, 2019).

People

All the interviewees claim that the people who were involved in the initiation and implementation of the initiative are considered to be the most important factor that determines the success of the initiative. The requirement for the right people is relevant from the top of the executive level, right through the organisation (Kirk, 2019; Otto, 2019; Reyneke, 209; Van Zyl, 2019).

Change management

The process of transforming parts of a business, internally or externally, infers various changes are going to take place, and the interviewees all agreed that change management principles must be applied when a new initiative is being implemented in the organisation (Kirk, 2019; Otto, 2019; Reyneke, 209; Van Zyl, 2019).

Although the developed conceptual framework is focused on the **initiation** of a digital initiative and not the **implementation** thereof, and thus these principles falls outside the scope of this research, it is important to take implementation principles into account when considering the initiation of a digital initiative.

8.5.3 Implementation challenges

This section will elaborate on the biggest challenges that the initiative faced from its inception through its implementation.

8.5.3.1 *Change resistance from employees and buy-in from stakeholders*

The brokers within the short-term insurance company were not supportive of the initiative at all, because as the intermediaries, their role in the organisation was now being mitigated. All of the interviewees agree that this challenge was the greatest challenge, and also the reason the internal transformation efforts failed several times. The resistance was not only from the brokers – executives in the short-term insurance company were very opposed to changing the organisation's operating model, because the model was working, and they were very profitable. They could thus not see why it was needed to invest more than R200 million in an initiative to improve a system that did not need improvement according to them (Kirk, 2019; Otto, 2019; Van Zyl, 2019).

8.5.3.2 *Competition*

Other financial service providers implemented the same technology and were incrementally taking the short-term insurance company's market share before the initiation of the initiative. The clients that they took were also the better clients with lower risk factors, and subsequently the premiums the short-term insurance company could offer had to increase to subsidise the loss of low-risk individuals' premiums from the various risk pods (Van Zyl, 2019).

8.5.3.3 *Financially challenging*

The market crash of 2008 was a major challenge for the implementation of the initiative, as car sales dropped by 25%. This resulted in fewer people buying cars, and subsequently fewer

people requiring car insurance, which decreased their potential client pool and consequently their potential revenue. Their competitors also responded to the launch of the initiative with strong marketing campaigns and put in a great effort to acquire new clients (Otto, 2019).

The initial capital investment was also lower than what the CEO of the initiative required to successfully implement the initiative, and once they encountered implementation challenges, one of their investors removed their capital from the project (Van Zyl, 2019).

8.5.4 Initiative implementation comparison discussion

The case study was reviewed, and comparisons were drawn between the principles that were applied to ensure the success of the initiative, and the principles that were identified to be relevant in the DIIDS Framework. This served as the third validation method and concludes the validation of the framework.

As the DIIDS Framework is specifically focused on the initiation of the digital initiative and not its implementation, the initiation of the initiative is considered and compared with the framework in a prescriptive manner.

The initiative's initiation was based on two conclusions drawn mentioned in Section 8.5.2.1 – (i) new technology was introduced in the industry that enabled them to increase their capabilities, and (ii) the realisation that their competitors were implementing business models that incorporated these capabilities and were subsequently taking their market share. This correlates with the disruption assessment in Phase 1.1.1 from the DIIDS Framework, where the two relevant categories are (i) technology disruption, and (ii) competitor disruption.

A principle that is inherent in the framework, but based on conclusions that were drawn from literature, is that enacting digital transformations through the implementation of digital initiatives is a more effective way than trying to digitally transform the entire organisation. This assumption is strongly agreed upon by all the interviewees – as they claim that change resistance was too great to enact it internally, and an external initiative was the only option. They do admit that this assumption could be circumstantial, but they maintain that it is the best method to enact any transformation.

The second principle applied in the framework is the design of customer experiences and the intentional focus on the customer needs. This was very prevalent in the initiation and implementation of the initiative and is supported by the interviewees. This approach manifested in the mission statement for the initiative, as their first mission is to "offer its customers excellent service, superior value products, and fair treatment at all times" (Otto, 2019). As mentioned in the Section 8.5.2.1 elaborating on their focus on the end-to-end customer experience, they designed their engagement model with customers to ensure they could get lower premiums, quicker – which speaks to the design of desirable customer experiences.

The initiative realised that the only way to achieve their set objectives for their customer experience was to invest in the relevant capabilities – which was the new technology that would enable them to offer direct insurance to their customers. Once they decided which capabilities were required to offer the envisaged customer experience, they built the business model around this. This correlates to some extent with phases 1.2.1 (digital capability maturity assessment)

and Phase 2.2 (value equation), where they assessed which capabilities they would require, and what level of performance they required to offer the customer experience and increase their operational efficiency.

The phases from the DIIDS Framework that were not prevalent in the initiative case study was Phase 1.2.2 (challenges evaluation), and Phase 2.3 (challenges index). Although the challenges that they experienced correlated with the challenges that were identified in Chapter 4 – there was no proactive approach to mitigate them, as the interviewees believed that some of the challenges could not be predicted, such as the financial crisis of 2008. They approached the mitigation of challenges in their employee acquisition – they believed that getting the right people involved would enable them to adequately deal with the challenges – which is what happened. The CEO of the initiative adequately dealt with the financial crisis through altering their client acquisition strategy, which successfully mitigated the challenge and ensured their profitability and sustainability.

A principle that was identified through the case study that was not addressed in the DIIDS Framework is the intentional focus on the people you employ to initiate and implement the initiative. This is a difficult concept to integrate into a high-level framework, as each initiative will require a specific set of skills that will have to (i) be able to do the required work, (ii) understand the relevant industry and challenges, (iii) work with the team that is already there, and each individual might have specific demands such as (i) remuneration packages, (ii) ability to work on their own terms, (iii) extent to which they have control over decisions, etc., and the organisation will have to have a clear idea of what their requirements are, and reconcile that with the available individuals and their requirements. The important concept that was taken from this conclusion is that organisations require capable individuals to drive the initiation and implementation of the digital initiative, and they need to carefully consider what they require from people to ensure the success of the digital initiative. This is supported by what the ex-CEO of the short-term insurance company said, "… we could have the best strategy in the world, if we didn't have the right people we would've failed" (Kirk, 2019).

8.5.5 Case study conclusion

As can be seen from comparing the DIIDS Framework and initiation and implementation of the initiative – there exists a definite correlation between the framework and the principles applied for the initiative. It has to be taken into account that the initiative was not a purely digital initiative per se, but the principles that are relevant to the initiation of digital initiatives and the initiative are similar, and are thus seen as legitimate validation for a digital initiative. The correlation between the two, as discussed in Section 8.5.4, thus concludes the validation of the DIIDS Framework.

8.6 Validation changes

This section will discuss the changes that was made to the conceptual framework after the advent of the validation process. The final framework is presented in Chapter 6 – including the changes brought about after the validation. The changes are:

- Changing from a digital transformation framework to a digital transformation through digital initiatives framework – it was argued that organisations stand a greater chance to successfully enact a digital transformation through the initiation of digital initiatives. This conclusion was drawn after the first round of semi-structured interviews with subject matter experts and was seen as a part of the development of the initial framework.

- Changing from an initiative implementation framework to an initiative initiation framework – the argument was made that by defining it as an implementation framework, it would have to account for the implementation process – which is outside of the scope of this research.

- Phase 1.1.1 was further developed to include more than just the customer needs identification – it was concluded that the framework should also guide organisations to create customer experiences that would address the customer needs. This would further support them in their value equation assessment in Phase 2.2.

- Focus on presenting the assessment report in a way that would convince the executives of the organisation why they should invest time and money into a digital transformation. Thus, focus should be put on the presentation of Phase 2.1, and not just compile all the assessment results together.

8.7 Chapter 8: Conclusion

This chapter served as the external validation of the research, and was used by the author to (i) validate the conclusions made from literature, and (ii) amend the framework based on the inputs given from subject matter experts to further increase the feasibility of the framework, and to be more effective in achieving its objectives.

The following chapter concludes the research, and a summary is given of the thesis. Reference is made to the research objectives and an assessment is done to determine if each objective has been met through the research. Contributions, limitations, and future research are also discussed.

CHAPTER 9. CONCLUSION

9.1 Introduction

This chapter summarises the three stages of the research and discuss how the research efforts addressed the research objectives presented in Section 1.4. The research contributions will be discussed, followed by a discussion of the research limitations. The chapter concludes with a discussion surrounding future research recommendations. This chapter serves as the conclusion to the thesis. Figure 54 indicates how Chapter 9 fits into the thesis.
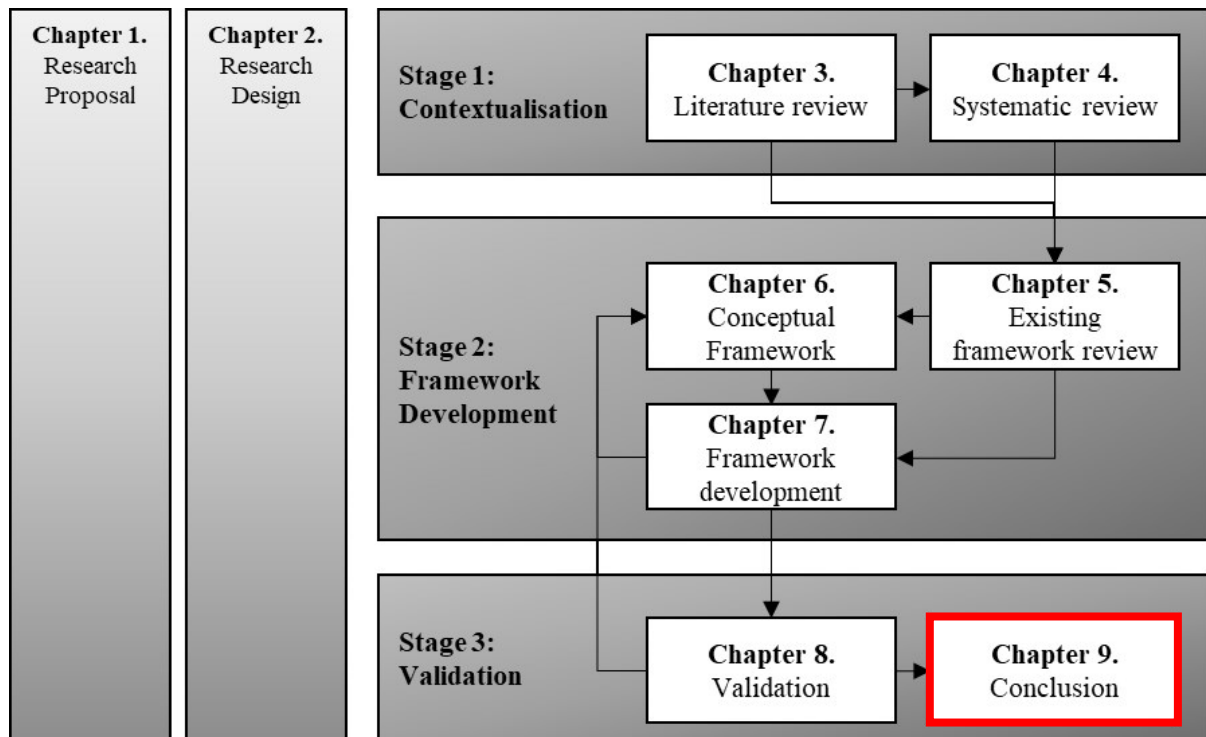
Figure 54: Research design: Chapter 9

9.2 Research review

This section will review the thesis, with a summary of each research stage followed by an assessment of where each research objective, shown in Section 1.4, was addressed and met in this paper.

9.2.1 Research summary

Chapter 1 presents background information to the problem, the problem statement that was derived from the background information, and the research questions and objectives. This is followed by an overview of the research methodology, expected contributions, research design, and document outline.

Chapter 2 addresses the research design and elaborates on the various methodologies that were followed throughout the research process. Specific mention is made of the research strategy, framework development methodology, and validation strategy and methodology.

The first two chapters introduced the research and indicates to the reader how the author plans to address the problem statement and subsequent research questions. The research was

conducted over three stages: contextualising the problem statement (Stage 1), developing the solution to the problem statement (Stage 2), and validating the solution (Stage 3). Each stage is discussed below.

9.2.1.1 Stage 1: Contextualisation
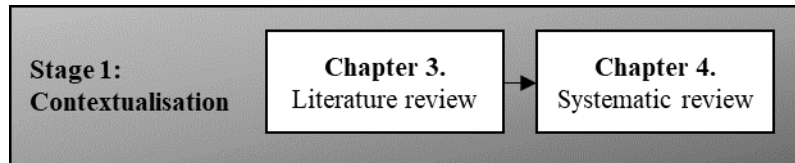
Figure 55: Stage 1: Contextualisation

Stage 1, seen in the Figure 55, involves contextualisation of the problem statement. This was done through a literature review (Chapter 3) which contextualised Industry 4.0 and various related concepts, where the overarching conclusion drawn related to the problem statement was that organisations can create significant value through a digital transformation, but organisations have a low success rate of enacting value-adding digital transformations. This finding warranted further exploration and introduced the following chapter.

Chapter 4 was dedicated to the researching the conclusion drawn from Chapter 3 – and its aim was to determine the various transformation challenges that organisations face when aiming to enact a value-adding digital transformation. This was done through using a systematic literature review, where a digital transformation challenges landscape was created with overarching principles identified and discussed. This chapter concluded the contextualisation of the problem statement and research objectives, and a set of design requirements was generated for a conceptual framework that aims to enable organisations to enact value-adding digital transformations.

9.2.1.2 Stage 2: Framework development
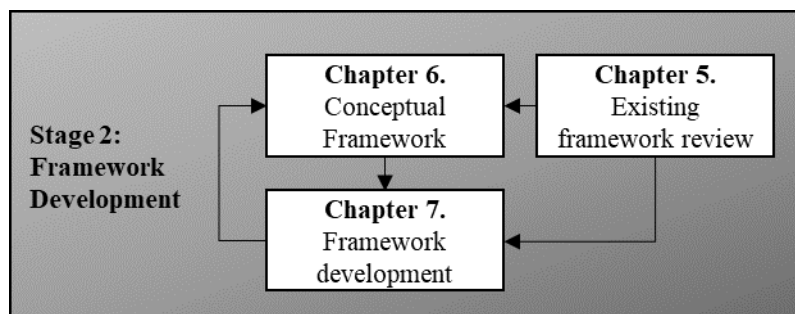
Figure 56: Stage 2: Framework development

Stage 2, seen in Figure 56, was dedicated to the development of the conceptual framework that would address the design requirements presented in Chapter 4 through integrating concepts identified in stage 1 of this research.

In Chapter 5 an assessment of existing frameworks or models that addressed the digital transformation of organisations was conducted. Eleven frameworks were found through a systematic literature review. Each framework was compared to the design requirements, and

the conclusion was drawn that no existing framework or model addresses all of the design requirements, which validated the need of the proposed conceptual framework.

The conclusion that organisations struggle to enact value-adding digital transformations introduced Chapter 6 – where the framework was developed on a conceptual level. Concepts that were identified in Chapters 3 and 4 were integrated into the framework, with the chapter dedicated to explaining the design methodology, how the various concepts were interlinked, and what role each concept plays in the initiation of digital initiatives.

The developed framework was subsequently presented to subject matter experts, and feedback was gathered by conducting semi-structured interviews. Subsequent to the engagements with subject matter experts, modifications were made to the conceptual framework. In addition, findings from the validation process (i.e. that the framework changed from an implementation framework to an initiation framework, amongst other changes) - discussed in the following section - were used to further amend and refine the proposed framework.

Chapter 7 discussed the elaboration of the framework's various phases, with consideration given to the inputs, process, and outputs of every concept within the framework. This chapter concluded the development of the framework.

9.2.1.3   *Stage 3: Validation and conclusions*
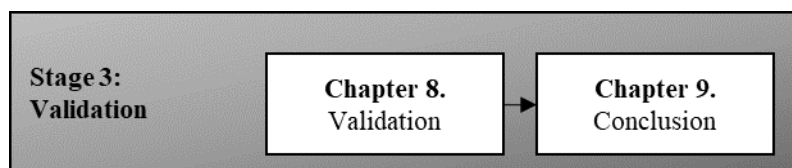
Figure 57: Stage 3: Validation

Stage 3, seen in Figure 57, was conducted to validate the framework, based on the methodology of triangulation that was discussed in Chapter 2. The triangulation included validation through literature (Chapters 3 and 4), interviews, and a case study (Chapter 8).

The validation through subject matter expert interviews involved three validation of three parts: (i) research rational validation, which validated the assumptions on which the research is done, (ii) concept validation, which tests the validity of each concept in the framework, the process, and the inputs and outputs, and (iii) user validation, which validated the feasibility and applicability of the framework.

The findings from the research validation is summarised in Chapter 8 – with the results showing a positive response in all three categories. This concluded the second part of the validation. Subsequently, a case study was conducted. The case study was conducted in a prescriptive manner where the application of a successful initiative was researched and their application principles were compared to the principles presented in the DIIDS Framework. The comparison between the case study and the DIIDS Framework found several parallels, and this finding concluded the validation of the DIIDS Framework.

Chapter 9 is dedicated to summarising the research and concludes the thesis. It gives a brief overview of the thesis as a whole and discusses how the problem statement and subsequent research objectives were met.

9.2.2 Research objectives

In this section each research objective is presented Table 20 below, with reference made to which chapter in the research addresses the objective.

Table 20: Research objectives assessment

Objective	Reference
RO1.i) Contextualise Industry 4.0 and the related concepts.	Chapters 3
RO1.ii) Create context through research of what core principles are present in a successful digital transformation and subsequently a successful digital initiative.	Chapters 3
RO1.iii) Research the challenges organisations face whilst undergoing a digital transformation.	Chapter 4
RO2.i) Determine the various elements that have to be included in the framework and subsequently develop a set of design requirements for the conceptual framework.	Chapter 3, 4
RO2.ii) Compare existing frameworks/models to the set of design requirements.	Chapters 5
RO2.iii) Conceptually develop the framework based on the design requirements.	Chapters 6
RO2.iv) Expand the framework with the development of tools that could achieve the desired outcomes for each phase in the framework.	Chapters 7
RO3.i) Present the framework to industry experts and test the feasibility of implementing the framework within an organisation.	Chapter 8
RO3.ii) Conduct a case study to further validate the use of the framework.	Chapter 8

9.3 Research contributions

This section will discuss the research contributions that this thesis made.

I. The research did an in-depth literature analysis regarding Industry 4.0 and digital transformations – which is valuable due to the evident need of addressing the stated problem and the lack of generally-accepted literature and assumptions in academia. The findings highlight the relevant concepts pertaining to digital transformations and Industry 4.0.

II. The challenges that organisations face from various industries whilst undergoing a digital transformation were identified and contextualised, with a challenges landscape

created to further identify overarching transformation barriers that organisations struggle with through the digital transformation process.

III. A framework was developed that:

   o Guides organisations to consider the relevant concepts pertaining to the implementation of digital initiatives underpinned by literature research and interviews with diverse subject matter experts.

   o Structures the approach to the initiation of a digital initiative.

   o Provides organisations with a tool that assesses the influence of their own digital maturity on their assessment of their maturity – a tool which could not be found in the identified existing frameworks and models.

   o Takes organisations on an educational journey regarding Industry 4.0 and digital transformations – even if they do not apply the framework it increases the understanding of the relevant concepts.

   o Creates awareness regarding (i) the value that organisations can generate through the successful enactment of a digital transformation, and (ii) the challenges that they might encounter along the way.

   o Facilitates cross-actor understanding between managers and digital experts.

9.4 Chapter 9: Conclusion

This section aims to conclude the thesis, with a review of the limitations of this study, and future research recommendations that was identified as the thesis was developed.

9.4.1 Research limitations

Limitations were identified in three areas for this thesis: (i) literature limitations, (ii) interview limitations, and (iii) case study limitations. Table 21 presents the study limitations.

Table 21: Research limitations

Area	Limitations
Literature	1. The scope of the research is wide – and thus the principles are considered at a high level. The greater the scope the less specific the framework will be, and the more the organisation applying it would have to customise it. 2. The systematic reviews were conducted through using one main scientific database (SCOPUS) – where more could have been used to increase the scope of reviewed literature for Chapters 4, 5, and 6.
Interviews	1. One method of interviewing (semi-structured interviews) was used to gather data to validate the research rational, concepts, and user feasibility – more methods could potentially be used that would have presented the author with a more diverse range of inputs that could be used to amend the framework to be more relevant.
Case study	1. One case study was completed, and the argument was made that it is a representative of a successful implementation of a digital initiative. Although it was launched based on the same principles that were identified to be the drivers of a digital transformation, the initiative itself did not incorporate the digital capabilities that this research addresses.

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	2. The challenge was that the emerging nature of the research was a limitation in itself – as not many digital initiatives have been operating for long enough to be able to make the argument that they are successful, and the identified case study was the most relevant case that balanced all of the identified requirements in this research and had been operating long enough to draw conclusions regarding its sustainable success.

9.4.2 Future research recommendations

The wide scope of this research meant that there are various topics that can be further researched after the completion of this research. The limitations mentioned in Section 9.4.1 allude to various areas where future research can be applied to enhance the research. The limitations were considered retrospectively, where this section will discuss the potential future areas of research that could originate from within this research.

Digital organisations

This research dedicated a section in Chapter 3 to researching the organisational building blocks of a digital organisation (Section 3.8), but an extensive study can be conducted to create a more exhaustive list of digital dimensions and their subsequent digital capabilities, and developed into a detailed CMM.

The capability statements can also be further researched to include a wider range of sources to ensure the validity of each statement. The capability statements can also be written related to a specific industry, which will enhance the usability of the framework in the relevant industry.

Framework development

The focus of this research was to develop a conceptual framework that guides organisations to consider relevant concepts to a digital transformation. The development of the framework was generic as it was developed on a high level, and future research can focus on the detailed development of each stage within the framework to make it applicable within a specific industry.

One of the biggest barriers to a successful digital transformation was found to be the commitment from executives to enact a digital transformation – and this framework does not address that barrier. The framework assumes that executives have committed to using it, and future research can inquire how commitment can be secured from top management.

One of the biggest implementation principles identified in the case study was to get the correct people to implement the digital initiative – without such key role players the risk of a digital initiative not being successful increases significantly. This is a challenging concept to quantify in a process-driven framework, and is subsequently presented as future research – i.e. addressing the question of what characteristics are paramount when assembling a team that would ensure the success of the digital initiative.

Framework application

There exists a gap between the theoretical nature of a digital initiative initiation framework such as this one, and the implementation of the concepts – something that was deemed to fall outside the scope of this thesis and was judged to be a future research recommendation. Future research could be the application of the framework to initiate a digital initiative conceptually within an organisation to validate the effectiveness of translating the theory into practice.

The above-mentioned research recommendations are made based on conclusions that the author draw upon the completion of the thesis, and subsequently serves as the conclusion of this thesis.

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ADDENDA

A1 – Capability statements

This addendum showcases the capability statements referred to in Phase 1.2.1. Each digital dimension is further expanded with various digital capabilities, and is each capability is defined according to the five maturity stages discussed in Section 7.3.1 as part of Phase 1.2.1 of the DIIDS Framework.

9.4.3 **Strategy and leadership**

Table 22: Strategy and leadership capability statements

Digital Capabilities	Capability Maturity Stages					
	Digitally Ignorant	**Digital Laggard**	**Digital Follower**	**Digital Collaborator**	**Digital Leader**	
Transformation Strategy	There is no recognition of Industry 4.0 and subsequently no transformation strategy.	Industry 4.0 is recognised at departmental level but is not integrated into the strategy.	Industry 4 is included in the business strategy, but focused on the implementation of Industry 4.0 concepts, and not the transformation of the organisation.	There is a coherent Industry 4 strategy that has been communicated throughout the organisation and is widely understood.	The organisation has a strong, coherent Industry 4 strategy that has been implemented across the organisation.	(Hess *et al.*, 2016; Infor, 2016)
Executive Support	The leaders of the organisations do not support the Industry 4.0 agenda whatsoever, and thus nobody from the top management is taking responsibility for it.	The executive team is aware of Industry 4.0 and the potential changes that it may bring, but they are not actively investigating the potential effects thereof.	The leadership team are exploring the potential benefits of Industry 4 but is not committed to the implementation of Industry 4.0 concepts in the organisation.	The leadership team is aware of the potential financial benefits of integrating Industry 4.0 concepts and developing plans to invest and have appointed, or is in the process of, an executive to take responsibility for the digital transformation.	Industry 4.0 is supported throughout the organisation on executive and departmental level. There is an executive(s) with a clear responsibility of overseeing the digital transformation.	(Hess *et al.*, 2016; Agca *et al.*, 2017)
Transformation Funding	No to minimal Industry 4 investments has been made and there exist no plans to invest resources into the Industry 4.0 agenda.	The organisation has started to explore the financial implications of a digital transformation but have not taken any concrete steps to commit to Industry 4.0 investments.	Industry 4.0 investment(s) have been made, but no ongoing review of cost/benefit analysis for Industry 4 investment(s). Potential funding models is currently being looked at.	The executive team have drafted a preliminary financial plan to subsidise the digital transformation, but lack access to the entire amount required. Organisations conduct irregular cost/benefits analysis of the investments made in Industry 4.0.	The organisation has a structured and sustainable funding model for their digital transformation and has received the financial backing required. They regularly conduct cost/benefit analysis of investments in Industry 4.0.	(Haffke, Kalgovas and Benlian, 2016; Agca *et al.*, 2017)
Transformation Measurement	As there is no transformation at this point, there is nothing to be measured by KPI's.	No KPI's in place to measure the digital transformation. Transformation progression is measured on an ad-hoc basis.	The organisation has KPI's to measure their performance in certain areas, with limited KPI's for their Industry 4.0 investments.	There is a strong drive to measure the transformation progression with KPI's, but the KPI's are not measuring strategic areas of performance that indicates their true digital transformation progression.	The digital transformation is closely monitored with strategically placed KPI's throughout the organisation that is regularly reported to the top management of the organisation and accurately measures their digital transformation progression.	(Agca *et al.*, 2017; Anderson and Proctor, 2019)

9.4.4 **Business operations**

Table 23: Business operations capability statements

Digital Capabilities	Capability Maturity Stages					
	Digitally Ignorant	**Digital Laggard**	**Digital Follower**	**Digital Collaborator**	**Digital Leader**	
Department Collaboration	There is minimal to no collaboration between departments and the organisation operates in functional silos. Main business process supported by IT systems.	Inter-departmental interaction is limited within the organisation. Some areas of the business are integrated and supported by IT systems.	Although the organisation mostly operates in functional silos, the organisation has begun a process to encourage cross functional collaboration and is in the process of implementing IT structures that can support collaborative business processes.	Departments welcome cross functional collaboration with some departments collaborating. Complete IT support of processes but not fully integrated.	The business model functions through collaboration between departments and external organisations. IT systems support all company processes and are integrated.	(Magdaleno, Araujo and Werner, 2011; Westerman *et al.*, 2011; Agca *et al.*, 2017)
Digital supply chain management	No integration or communication with suppliers or customers. Communication with suppliers and customers happens on an ad-hoc basis. Slow response to changing industry conditions. No data collection throughout supply chain.	Basic data sharing where required with suppliers and customers. Slow to moderate response to changing industry conditions and changing customer needs. Data is recorded on an ad-hoc basis.	Strategic data sharing initiatives between suppliers and customers is explored and implemented, but the majority of data sharing is still done where required. Moderate response to changing industry conditions and changing customer needs. Data is strategically collected from certain internal supply chain members.	Data exchange occurs between key strategic suppliers and customers. Moderate response to changing industry conditions and changing customer needs. Data is collected from most internal members, and some external stakeholders throughout the supply chain.	Fully integrated systems with data sharing between customers and suppliers happening for appropriate processes. Immediate response to changing industry conditions and changing customer needs. Data is collected from most supply chain members, internally and externally.	(Kurnia *et al.*, 2014; Farahani, Meier and Wilke, 2015; Agca *et al.*, 2017)
Data Collection and Decision support	Data is manually collected on an ad-hoc basis and not analysed to support the organisation's decision-making.	Data is collected when required, but not widely analysed.	Data is digitally collected where required in certain areas. Some data is analysed and used to review process performance.	Thorough digital data collection in various areas within the organisation. Most data are analysed and used when making business decisions.	Automated digital data collection in most processes within the organisation. Most business decisions are supported through the analysis of the relevant data.	(Shanks, 2012; Agca *et al.*, 2017)
Data Protection	Data protection is not considered in the organisation. No budget allocated to improve it, and staff are not trained to protect data.	Have started to consider the implications of data protection and is starting to implement internal data protection policies. Small budget set out for improving data protection. Started considering training of staff members with regards to cyber security.	Have put internal data protection policies in place but engagements with internal and external stakeholders are not checked for compliance. Medium-sized budget with staff adequately trained to mitigate most cyber security threats. Data protection policies are reviewed on an ad-hoc basis to ensure relevance.	Thorough data protection policies in place where compliance is considered internally and externally. Staff are well-trained and understands how to ensure data safety with an adequate budget in place for cyber security measures. Policies are annually reviewed to ensure relevance.	Excellent internal- and external data protection policies, with a large budget allocated to ensure it remains relevant. Staff are very well trained to prevent cyber-attacks. Data protection policies are regularly reviewed to ensure relevance.	(Agca *et al.*, 2017; Baxter, 2019)

9.4.5 **Technology**

Table 24: Technology capability statements

Digital Maturity Level	Capability Maturity Stages					
	Digitally Ignorant	**Digital Laggard**	**Digital Follower**	**Digital Collaborator**	**Digital Leader**	
Data & Analytics	No data & analytics capabilities are used in the organisation and is not a consideration for the organisation.	Data is only used for quality and regulatory purposes. The organisation is considering investing in data analytics capabilities.	Some data is also used to control processes. The organisation has made small investments into data analytics capabilities.	Most collected data are analysed. Some data is used to control and optimise processes, e.g. predictive maintenance. The organisation has prioritised investing in data analytics capabilities.	Data is strategically analysed to improve processes and support decision-making in the organisation. The organisation has made significant data analytics investments and continuously looks to improve these capabilities.	(Shanks, 2012; Agca *et al.*, 2017)
Process Automation	No automation capabilities have been incorporated into the organisation.	Some simple processes have been automated. Processes are automated on an ad-hoc basis with no strategic intent.	Processes are strategically automated, with the organisation working on the integration of multiple processes.	Most automated processes are integrated. Processes are manually improved, with the organisation considering implementing smart process with feedback systems to automatically improve the process.	Full integration between all relevant automated processes. Self-learning technologies are used to improve the efficiency of the processes continuously.	(Kumar, 2016; Agca *et al.*, 2017)
Cloud integration	Cloud solutions not in use and no plans to implement cloud capabilities. No governance structures exist, and the organisation is not aware of the need to manage cloud computing risk.	The organisation is aware of the potential benefits of cloud computing, and cloud-based software initiatives are planned, but not yet implemented. Some cloud risk management processes exist.	The organisation has a broad cloud-based plan to implement it organisation-wide, with pilot solutions implemented in certain areas of the organisation. Training programs are implemented within the organisation to ensure managers have the required knowledge regarding cloud computing.	Cloud-based software have been implemented in most parts of the organisation, with a few departments yet to implement it. Cloud risk management processes are implemented. KPI's for cloud computing and risk management are identified.	Multiple cloud-based solutions have implemented across the business with a plan regarding its sustainability. Comprehensive risk management plans and strategies exist and is implemented organisation wide.	(Schmidt and Grabski, 2015; Leyh *et al.*, 2016; Agca *et al.*, 2017)
IT Infrastructure (Vertical- and Horizontal integration)	No vertical integration between enterprise systems in the different hierarchical levels of the organisation, and no horizontal integration between different stakeholders in the value chain. IT infrastructure not able to facilitate the integration.	No horizontal- or vertical integration, but the organisation is aware of the need to do so and is investigating IT investments to enable this integration.	IT investment is secured and horizontal and vertical integration is occurring in isolated cases within the organisation. This integration is not yet a priority for the organisation.	Horizontal and vertical integration is a priority for the organisation and the organisation has invested in IT infrastructure that can facilitate said integration. Increasing number of integrated systems and stakeholders throughout the organisation and the value chain.	IT infrastructure that can facilitate the full integration between enterprise systems within the organisation, such as Enterprise Resource Planning (ERP), Product Life cycle Management (PLM) systems, and full integration between various stakeholders within the value chain of the organisation.	(Leyh *et al.*, 2016; Hamidi *et al.*, 2018)

9.4.6 **Product and service offering**

Table 25: Product and service offering capability statements

Digital Maturity Level	Capability Maturity Stages					
	Digitally Ignorant	**Digital Laggard**	**Digital Follower**	**Digital Collaborator**	**Digital Leader**	
Speed-to-market	The organisation is applying the old standard methods of developing products and services through a hierarchical structure. Innovation management is not a focus area for the organisation.	The organisation still follows their legacy design methods, but the executives have become aware of the importance of speed-to-market and how agile methodologies play a role in that. Executives are exploring possible design-method changes.	The organisation is aware that they need to develop products faster to retain market share, but their focus is on integrating parts of the agile method into their legacy design methods. Innovation management has become a focus area of the executives.	The organisation has adopted agile design methods, but they haven't mastered the process to increase the efficiency of the design process. Innovation management is high up on the priority list of the executives.	The organisation is applying agile methods and failing-forward mentalities to develop and test products quickly. Innovation management is run well to prioritise the development of new products and services and is one of the highest priorities for the executives.	(Sommer *et al.*, 2014)
Smart, ICT-enabled Products	Products are valued by their physical capabilities, and data-driven services are offered without physical product or customer integration. No intention to integrate the two.	Organisation has become aware of the need to integrate physical products with customers and data-driven services, and they are exploring the possibilities. No change in products and services yet.	Organisation has explored the integration between products, services, and customers with pilot projects where products exhibit limited digital features, and data-driven services are offered with little customer integration with certain products.	Products are integrated with some digital features, and data-driven services are offered with customer integration throughout most of the organisation with the intent to fully integrate the two.	Products are highly integrated with digital features, and data-driven services are completely integrated with the customer. This has become the highest priority for organisations in their product- and service design.	(Agca *et al.*, 2017; Pflaum and Gölzer, 2018)
Customised Products and Services	Mass produced products with no individualisation options for the user.	The majority of products are mass produced and mostly does not allow for individualisation. The organisation is beginning to think of acquiring technology to enable customisation.	The organisation has prioritised customisation and is in the process of implementing more customer control over the design through the relevant technology. Little- to medium customisation capabilities.	Products are offered with a standardised base but allows the user to customise most aspects of the product through the relevant technology.	Organisation has fully integrated technology that allows customisation of products, and most products can be completely customised by the user.	(Rüßmann *et al.*, 2015; Agca *et al.*, 2017)

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9.4.5   **Customer experience**

Table 26: Customer experience capability statements

Digital Capabilities	Capability Maturity Stages					
	Digitally Ignorant	**Digital Laggard**	**Digital Follower**	**Digital Collaborator**	**Digital Leader**	
Customer Value Focus	The customer experience is an afterthought – the organisation focuses solely on their products and services.	The customer experience of touch points is considered, but in silo, and the link isn't made between customer experience and value creation.	The organisation has become aware of the link between customer experience and value creation and is exploring ways of prioritising the customer experience at executive level. They are currently still considering the customer experience of touch points in silo.	The customer experience across touchpoints (end to end) is considered, but not the main objective of the organisation. The customer experience is an important part of the value creation strategy.	The organisation's entire focus is providing the customer with a desirable, end-to-end experience. The customer experience is considered the biggest driver of value creation within the organisation.	(Westerman *et al.*, 2011; Schwab, 2016)
Customer experience alignment	There is no consideration of designing a customer experience, rather simply addressing a customer need.	The organisation is considering the customer experience of their customer need solutions. Methods of ensuring the alignment between the customer experience and customer needs are considered, but not applied. This alignment is not a priority for the organisation. The customer experience is not reviewed.	The organisation is applying pilot methods on an ad-hoc basis to ensure the customer experience of using their product or service aligns with the needs of the customer. This alignment has become a priority for the organisation. The customer experience is reviewed on an ad-hoc basis.	The organisation has made ensuring the customer experience of using their product or service aligns with the needs of the customer a high priority in organisation, and have certain KPI's in place to measure this alignment. The customer experience is often reviewed.	The organisation has made ensuring the customer experience of using their product or service aligns with the needs of the customer a top priority in the organisation, and have specific KPI's in place to measure the level of alignment. The customer experience is continuously reviewed.	(Lacki, 2009)
Customer Interaction & Feedback	Organisation is very reactive – only responds to customer-complaint, need, or request through traditional methods.	Organisation responds promptly to any customer request but does not engage proactively with customers to use their feedback in customer experience design.	The organisation has become aware of the need to engage customers more regularly and has become a focus area of the executives, and the organisation is exploring new digital methods of interacting with customers throughout their customer journey.	Customer interaction and feedback has become a priority for the organisation, and they incorporate the feedback into their experience design. Interactions between customers and the organisation happens at the crucial points of the customer journey.	Digitally enabled ongoing interaction between customer and organisation throughout the customer journey, where the interactions reflect the customer/partner's role in the design of the customer experience.	(Hood, Brady and Dhanasri, 2016)

9.4.6 **Organisational culture and people**

Table 27: Organisational culture and people capability statements

Digital Capabilities	Capability Maturity Stages					
	Digitally Ignorant	**Digital Laggard**	**Digital Follower**	**Digital Collaborator**	**Digital Leader**	
Organisational Culture	Power-hierarchal organisational culture where rules are enforced on every level of the organisation, with a strong decision-making hierarchy. Employee feedback is not collected or considered.	The organisation has an overall hierarchical culture, with the executives investigating the idea of an agile culture. No concrete steps are taken to address the hierarchical culture. Employee feedback is collected on an ad-hoc basis.	The organisation has implemented an agile culture objective for the organisation, and some of the departments have adopted this approach. The executives are pushing the agile agenda, and the organisation is slowly adopting it. Employee feedback is used to constructively amend the processes within the organisation.	Mostly an agile organisational culture, with some departments still having legacy, hierarchical cultures. The organisation is in the process of implementing agile organisation wide. Employee feedback is valued and employees are encouraged to provide honest feedback within the organisation.	Agile organisational culture with a decentralized decision-making structure where innovation and collaboration are constantly encouraged and rewarded. Employees are engaged and empowered to take responsibility for the digital agenda, with their feedback used as the most important factor when evaluating the organisation's internal processes.	(Strode, Huff and Tretiakov, 2009; Raberger and Krammer, 2013)
Roles of Employees	Roles of employees are static and defined as "because it's always been like that." The changing roles of employees are not a consideration for executives and is not considered in any change management processes.	Executives are taking the changing nature of employee roles into account but have not taken any concrete steps to define and communicate it through any change management processes.	The roles of employees within the organisation are starting to change due to the different demands of Industry 4.0, and the organisation is starting to define and communicate the new employee roles and expectations.	The organisation and employees are aware of the changed nature of their roles, and the employee roles are well defined and the changes are mostly communicated to the employees.	The roles of employees have completely changed to create value in the digital economy, and the organisation has communicated what the new roles are clearly to ensure that everyone understands what is expected of them.	(Elving, 2005; de la Boutetière, Montagner and Reich, 2018)
Digital Talent	The organisation is not aware of the need to invest in new talent, and thus have no talent acquisition plan. Digital skills are not a consideration when looking at new employees.	The organisation has not invested in acquiring any new digital talent for the organisation but are investigating the need for digital talent within their organisation.	The organisation has become aware of the need for new digital talent and has included it as a consideration when looking at potential employees. The organisation is investigating what type of talent they require within the organisation.	The organisation has accepted the mandate of acquiring new digital talent and is actively hiring and looking for digital talent. The talent requirements are reviewed often to ensure the correct talent is being acquired.	The organisation has acquired the digital talent required to give effect to their digital transformation plan and is actively looking at how to retain these employees. The talent requirements are continuously reviewed to ensure the correct talent is being acquired.	(Kane *et al.*, 2015; Snabe and Weinelt, 2016)

A2 – Digital transformation challenges

This addendum is two-part – firstly the challenges assessment matrix that organisations must complete during Phase 1.2.2 of the DIIDS Framework (Table 28), and secondly the link between the challenges and the digital dimensions in the challenges influence matrix (Table 29) that indicates in which region the organisation is for each digital dimension. These two tables can be found on the following pages.

Table 28: Challenges assessment matrix

Which of the following statements corresponds with the challenges presented below?	Not experienced at all. (1)	Starting to experience, not dealt with it. (2)	Experience it, not dealt with it. (3)	Experienced it, starting to deal with it. (4)	Experienced it, dealt with it. (5)
Legacy organisational infrastructure prevents interoperability between departments.					
Legacy IT infrastructure prevents the implementation of new digital initiatives.					
Cybersecurity to protect the organisations from cyberattacks.					
Lack of access to digital skills on the market.					
Lack of policy and regulatory reform.					
Lack of access to technology – especially prevalent in third world countries.					
Disruption from external competition taking market share.					
Increased- and changing demand from customers regarding their customer experience.					
External resistance against change from Unions.					
Lack of clarity regarding the role of employees during- and after a digital transformation can lead to worker resistance.					
Lack of a digital culture (people-centric, agile), and understanding the need for it.					
Lack of leadership and strategy during the process.					
Lack of awareness of the requirement for digital skills.					
Lack of understanding the process, requirements, and benefits of a digital transformation.					
Lack of informed drive from management to transform.					
Uncertainty regarding what technology to invest in.					
Lack of collaboration between departments, interoperability issues, or lack of vision to do so.					
Financial challenges – a digital transformation is very resource-intensive, and it's a challenge to access required funds.					
Job losses from automating or changing processes leading to change-resistance from employees.					
Being agile – remaining profitable during a complete business-model transformation.					

Table 29: Challenges influence matrix

Digital Transformation Challenges	Challenges Assessment (CA)	Strategy & leadership		People & Culture		Products & Services		Technology		Business Operations		Customer Engagement	
		Relation (R)	Impact (I)	Relation	Impact	Relation	Impact	Relation	Impact	Relation	Impact	Relation	Impact
Legacy organisational infrastructure prevents interoperability between departments.		50		40		40		100		80		30	
Legacy IT infrastructure prevents the implementation of new digital initiatives.		50		40		40		100		80		50	
Cybersecurity to protect the organisations from cyberattacks.		30		30		100		100		80		40	
Lack of access to digital skills on the market.		30		100		50		20		50		50	
Lack of policy and regulatory reform.		70		20		60		60		70		40	
Lack of access to technology – especially prevalent in third world countries.		60		20		80		100		80		80	
Disruption from external competition taking market share.		60		20		80		20		20		80	
Increased- and changing demand from customers regarding their customer experience.		20		10		80		80		30		100	
External resistance against change from Unions.		60		100		10		10		10		10	
Lack of clarity regarding the role of employees during- and after a digital transformation can lead to worker resistance.		60		90		20		20		40		20	
Lack of a digital culture (people-centric, agile), and understanding the need for it.		90		100		20		20		50		40	
Lack of leadership and strategy during the process.		100		40		40		40		40		70	
Lack of awareness of the requirement for digital skills.		80		70		30		0		30		40	
Lack of understanding the process, requirements, and benefits of a digital transformation.		100		60		20		30		40		60	
Lack of informed drive from management to transform.		100		60		30		30		40		40	
Uncertainty regarding what technology to invest in.		30		0		40		80		80		20	
Lack of collaboration between departments, interoperability issues, or lack of vision to do so.		100		70		20		50		90		20	
Financial challenges – a digital transformation is very resource-intensive, and it's a challenge to access required funds.		100		20		50		50		50		20	
Job losses from automating or changing processes leading to change-resistance from employees.		100		100		20		30		20		20	
Being agile – remaining profitable during a complete business-model transformation.		100		90		50		50		90		30	
Average													

$$I = \frac{R}{100} * CA$$

A3 – Disruption profile

	Very unlikely	Unlikely	Neutral	Likely	Very likely
Competition					
How likely is it that a tech-based, non-traditional competitor will enter your industry in the next five years?					
How likely is it that a large existing player from another industry will move into your industry in the next five years?					
How likely is it that a low-cost player in your industry will expand significantly in the next five years?					
Legislative environment					
How likely is it that new regulations will affect how your industry operates in the next five years?					
How likely is it that deregulation will affect how your industry operates in the next five years?					
How likely is it that regulations spreading from different geographies will impact how your industry operates during the next five years?					
Customer Behaviour					
How likely is it that your customers will want new attributes from your industry's products or services in the next five years?					
How likely is it that your customers will use alternative solutions to replace your product or service in the next five years?					
How likely is it that customers in important segments of your industry will sharply change their buying behaviour in the next five years?					
Technology					
How likely is it that new technologies will greatly increase your organisation's operational efficiency and effectivity in the next five years?					
How likely is it that new technologies will create new market offerings and thus avenues for revenue in the next five years?					

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A4 – Validation design

Validation consent form

STELLENBOSCH UNIVERSITY

CONSENT TO PARTICIPATE IN RESEARCH

Dear Sir/Madam

My name is Willem Rautenbach and I am a master's student in Industrial Engineering, and I would like to invite you to participate in a thesis entitled a conceptual framework to enable the digital transformation of organisations.

Please take some time to read the information presented here, which will explain the details of this project and contact me if you require further explanation or clarification of any aspect of the study. Also, your participation is **entirely voluntary,** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

The validation workbook's questions are based on the various concepts that was identified through literature and exploratory semi-structured interviews – where the validation questions are specifically aligned to test each concept's relevance to the over-arching objective of the framework.

You are allowed to decline answering a specific question and still be included in the research study, unless requested otherwise. Furthermore, you may withdraw at any stage during the research process. In the case of withdrawal, I will destroy all data provided by the participant (such as the answer sheets).

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If you have any questions or concerns about the research, please feel free to contact me on (071) 563 2070 or 18492797@sun.ac.za or one of my supervisor, Imke de Kock on imkedk@sun.ac.za, or Wyhan Jooste on wljooste@sun.ac.za.

> **RIGHTS OF RESEARCH PARTICIPANTS:** You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.
>
> You have right to receive a copy of the Information and Consent form.

If you are willing to participate in this study, please sign the attached Declaration of Consent and hand it to the investigator.

DECLARATION BY PARTICIPANT

By signing below, I ………………………………..………………. agree to take part in a research study entitled……… **...................** and conducted by …… (Name of Researcher)

I declare that:

- I have read the attached information leaflet and it is written in a language with which I am fluent and comfortable.

- I have had a chance to ask questions and all my questions have been adequately answered.

- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.

- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.

- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.
- All issues related to privacy and the confidentiality and use of the information I provide have been explained to my satisfaction.

Signed on ………….…………..

………………………………………………………………

Signature of participant

<div align="center">

SIGNATURE OF INVESTIGATOR

</div>

I declare that I explained the information given in this document to _____ [*name of the participant]* [*He*/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in [*Afrikaans/*English/*Xhosa/*Other*] and [*no translator was used/this conversation was translated into* _____ by _____].

_____   _____

Signature of Investigator   Date

Validation pre-read document
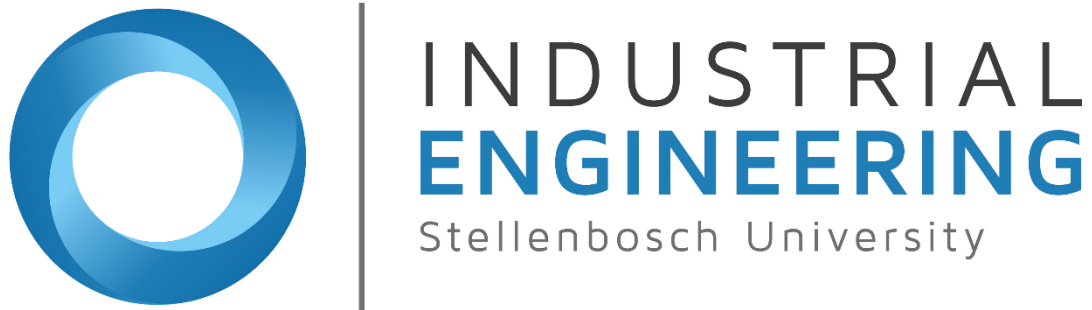
Validation & Case Study Pre-read Document

Thesis title: *A conceptual framework to enable the digital transformation of organisations*

Introduction

Problem statement

The advent of the fourth industrial revolution, or Industry 4.0, is set to disrupt various aspects of the world as we know it. New technologies that have been introduced has opened new streams of revenue for organisations and has disrupted incumbent organisations at a rapid pace – and the manner in which the organisations adapt to these technological changes will determine their long-term financial sustainability. Organisations that have embraced the new technologies and Industry 4.0 concepts owns an ever-increasing share of the market.

It is not disputed whether or not value will be created, rather who will share in that value. In order for organisations to share in that value – they need to be enabled in a digital economy through the process of a digital transformation. Although most executives are aware that some sort of digital change will occur within their organisation – few organisations are successfully enacting value-adding digital transformations.

Organisations must transform digitally to improve- (i) the efficiency and effectiveness of their operations, and (ii) their customer experience offering. The fact that Industry 4.0 has already- and will further create significant value and the low success rate of organisations enacting digital transformation led to the following problem statement:

> *The process of transforming an organisation digitally is ill-defined, and many organisations lack the context, ability, or resources to implement a successful, value-adding digital transformation.*

Research aim

The aim of this research is to develop a resource, which was determined to be a conceptual framework, that will support organisations in their digital transformation journey. The framework will present them with a diversified assessment toolset that guides them to consider important concepts that were identified through literature and exploratory interviews with subject-matter experts and supports them in their decision-making pertaining to these concepts.

Validation aim

The aim of the validation process is to (i) validate the research rationale, (ii) validate the importance and relevance of the concepts that were included in the conceptual framework, (iii) validate the proposed method to address each concept, and (iv) validate the usability and feasibility of the framework. This is executed through reading the following literature, attending the validation workshop, and completing the assessments.

Literature Overview

Industry 4.0

Industry 4.0 aims to use technology to both improve the effectiveness and efficiency of business operations, to optimise business systems, and improve the customer experience(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016)(Schwab, 2016). Industry 4.0 sees systems gather and analyse data across machines, processes, and value chains to enable more effective and efficient business processes; ultimately enabling the creation of higher-quality goods and services at lower costs. Where previous industrial revolutions focused on automating mass production, Industry 4.0 builds on the digital revolution with adaptive, flexible, and customised mass production capabilities. Traditional business models cannot keep up with the demands of the new digital economy, and their sustainability is threatened.

This inability to adhere to these requirements necessitates that organisations build new operating models, referred to in this research as digital organisations. Digital organisations are the operating models that organisations will use to do business in the new digital economy, defined as "[…] an economy based on the digitization of information and its respective information and communication infrastructure" that originated as a result of Industry 4.0.

Four major impacts on organisations were identified with the development of Industry 4.0 – (i) a shift in customer expectations, (ii) improvement in asset productivity through the use of big data, (iii) increased importance of new forms of collaboration, and (iv) the transformation of operating models into digital models. Improving the customer experience is at the centre of the fourth industrial revolution – organisations are focusing more on the customer experience than just the product or the service they provide, as the expectations of customers are shifting. Organisations thus win market share by offering the most valuable experience to their customers.

Subsequently this was identified as the objective of the framework – to support organisations in the process of digitally transforming themselves to (i) increase operational effectivity and efficiency, and (ii) to offer more desirable customer experiences.

Digital Transformation Framework

The Digital Initiative Initiation Decision Support Framework – DIIDS Framework

There are various ways to approach a digital transformation – and after literature research and exploratory interviews with subject-matter experts the method of transformation and subsequently the focus of this framework is through the implementation of digital initiatives – defined as "*independent, disruptive digital business innovations which uses disruptive technologies to create new value-offerings to customers launched by, but can function separately from, a parent organisation(s), with the objective of being integrated into the parent organisation over a time period.*"

It should be noted that the framework does not aim to provide organisations with a roadmap or specific strategy to enact value-adding digital transformation, but rather **it guides organisations to consider relevant topics, identified through literature and exploratory interviews, that is worth considering when deciding to enact a digital transformation. The concepts highlighted in each phase is aligned to (i) contextualise why the concept is relevant, and (ii) to provide the organisation with** *decision support* **regarding these relevant topics.**

The framework is divided into two phases which addresses the over-arching objectives of increasing operational effectivity and efficiency and offering more desirable customer experiences.

> **Phase 1** – *Digital contextualisation*
>
> > **Phase 1.1** – *Customer value design* – the value proposition of the digital initiative is considered within the context of Industry 4.0 to ensure the intentional focus on the customer experience that will be on offer through the digital initiative.
> >
> > **Phase 1.2** – *Digital organisational profile* – the extent to which the organisation is digitally enabled is assessed through looking at the levels of maturity of various digital capabilities that were identified through literature.
>
> **Phase 2** – *Assessment integration and value equation* – where the diverse assessment toolset is summarised to provide the organisation with tangible data that can support their decision-making, guide them to prioritise certain digital capabilities to ensure the effective use of resources, and show them which challenges they might face.

The framework can be seen below – with the various tools within each phase present. A short description is given for each process. Each process will be further contextualised during the validation process.
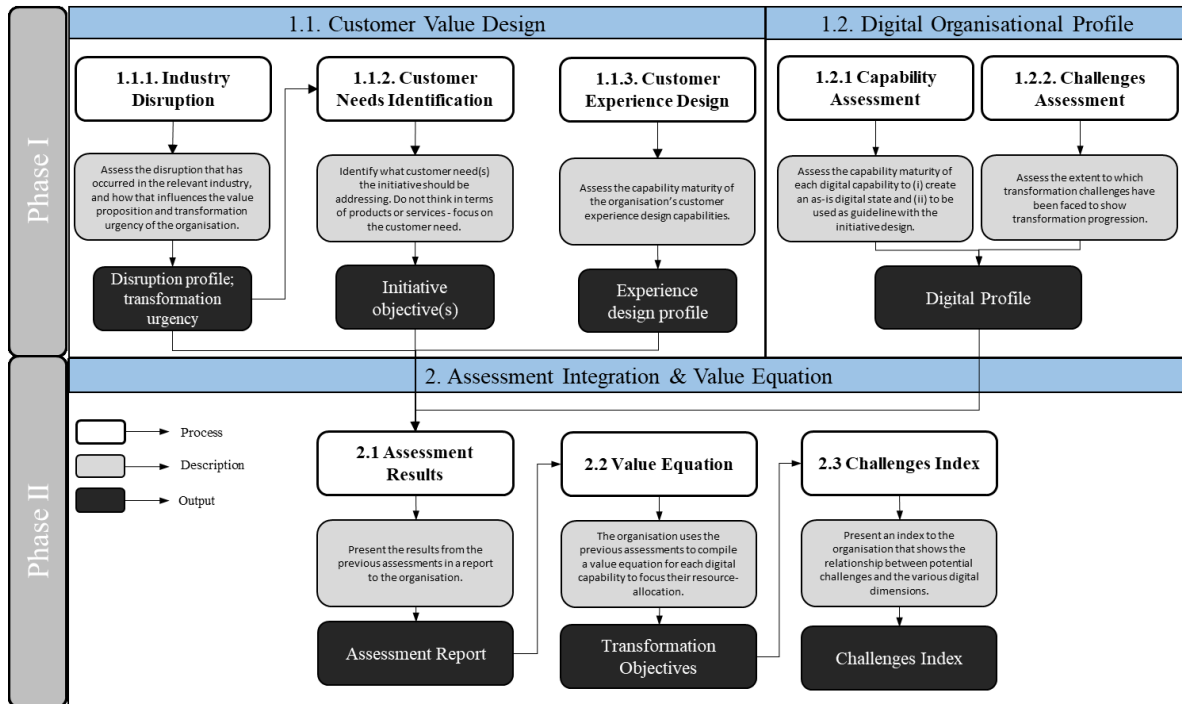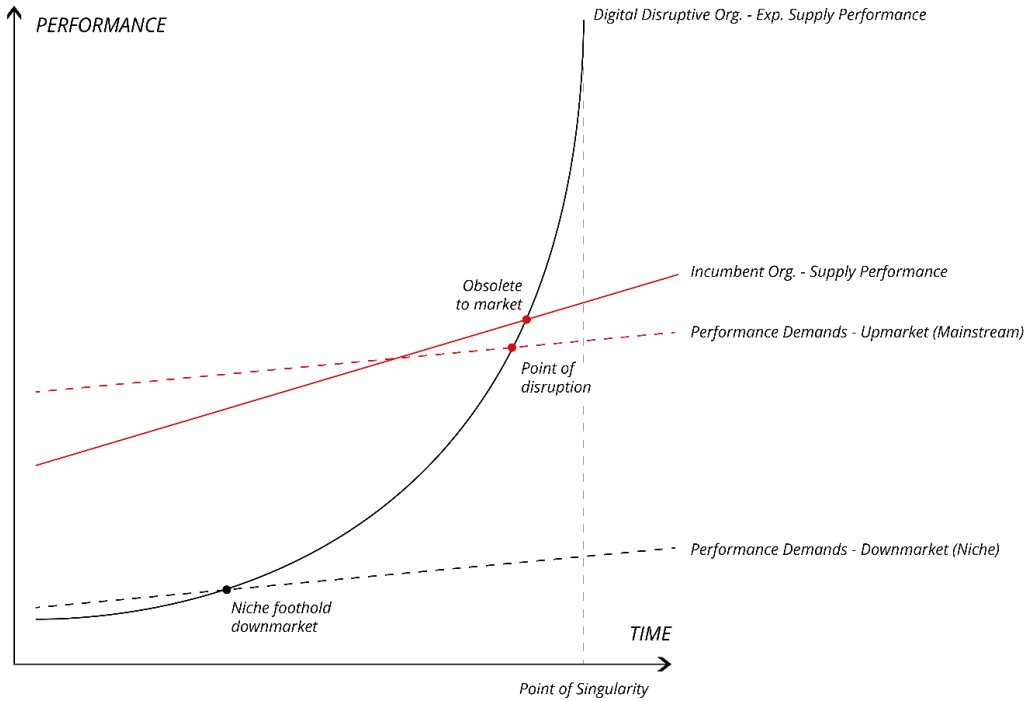
Phase 1.1.1
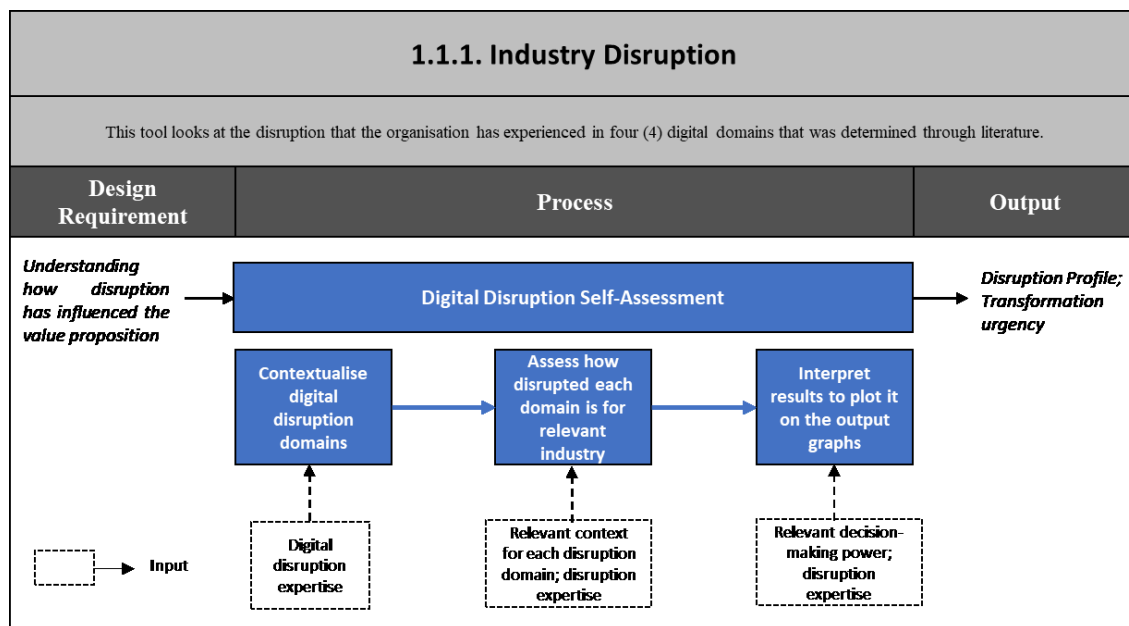
Digital disruption, defined as innovation that prompts a disruption towards current existing products, market and value network, thus subsequently replacing previous technology, from Industry 4.0 has been widespread, and the level of disruption that your organisation has experienced as a result of Industry 4.0 concepts is an indication of how close your value proposition is to becoming obsolete. The purpose of a digital transformation is thus, from the perspective of disruption, to transform your organisation to mitigate the effects of the disruption to remain profitable, and to use the new capabilities to increase revenue and decrease expenditures.

(v) **Legislative environment** – regulations and policy changes could inhibit progression (governments introducing new regulations to meet the COP21 agreement) or allow competitors to progress without being subject to regulations.

(vi) **Technology** – new technology is being developed to increase operational effectiveness and efficiency and subsequently cut expenditures and become more profitable (autonomous robots, artificial intelligence), as well as create new business avenues (i.e. coding apps wasn't a source of revenue 20 years ago) which can also increase profitability.

(vii) **Customer demands** – due to the customer-centricity of a lot of the Industry 4.0 concepts customer demands keep changing and this disrupts your own value proposition. Customers want better products and services, an overall enjoyable customer experience, for less money, and in less time.

(viii) **Competitors** – established organisations enter new industries (Discovery entering the banking industry, Apple entering the health industry) and start-ups are taking market share and threatening incumbents' sustainability.

The purpose of this assessment is to (i) make the organisation aware of the threat that digital disruption poses, (ii) guide the organisations to understand how Industry 4.0 will disrupt organisations, and (iii) provide the organisation a with a good idea of how close they are to becoming obsolete by guiding them to find their position on the incumbent disruption curve (can be seen below), thus presenting them with a sense of transformation urgency.
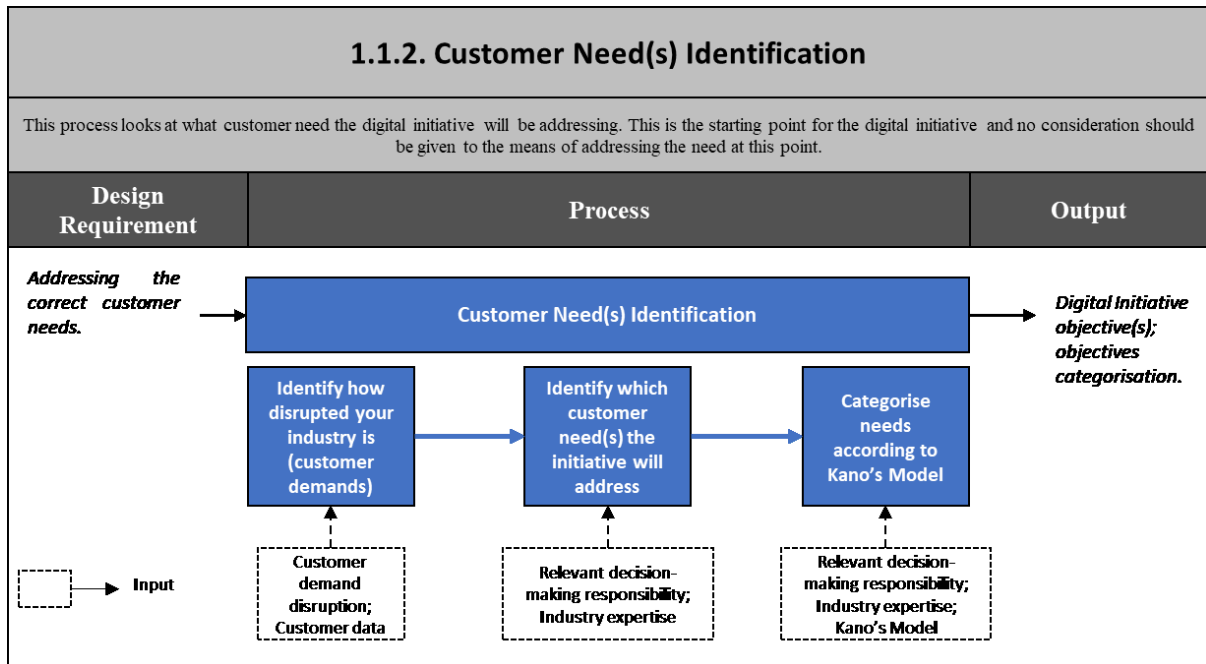

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Phase 1.1.2

| 1.1.2. Customer Need(s) Identification		
This process looks at what customer need the digital initiative will be addressing. This is the starting point for the digital initiative and no consideration should be given to the means of addressing the need at this point.		
Design Requirement	**Process**	**Output**
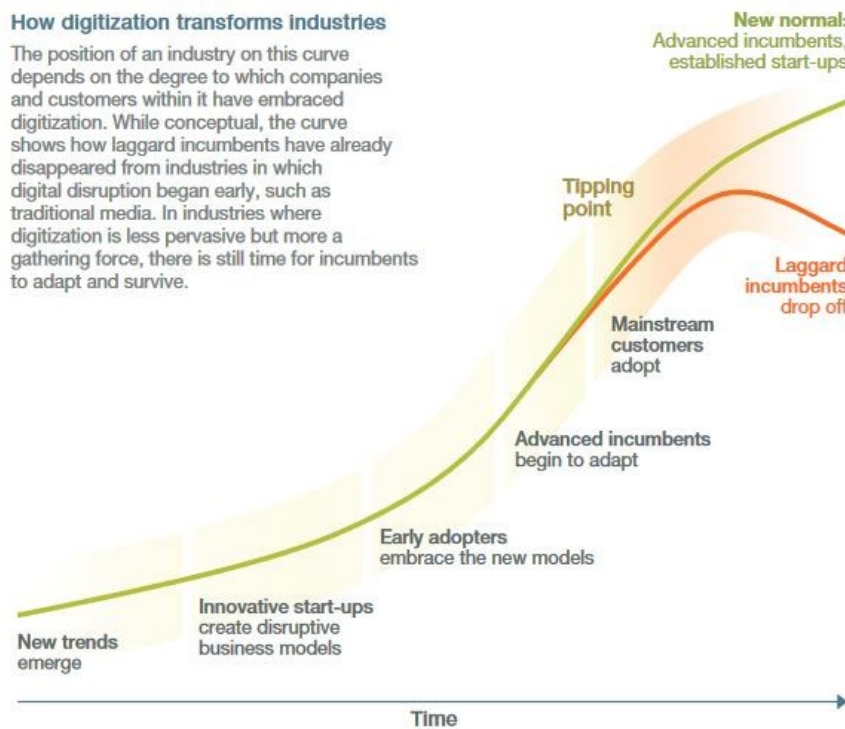
The organisation performs this step to determine what *customer need(s)* they are- and should be addressing in which industries. This step must not focus on product or service offering, but rather the core need that the organisation aims to address. The disruption that was determined in the previous step must be central to this step, as the organisation will then better understand how their identified needs fits into the current climate of their industry – which in turn will ensure a more accurate and desirable customer need.

The structure of the Kano model, which will be used in this step, is questionnaire-based, as the idea is to generate an in-depth understanding of how your current or potential customers perceive the customer requirements that the organisation wants to meet through their digital initiative. The execution of this step happens in two parts: (1) The organisations are tasked with identifying customer needs that they believe the digital initiative should address, and (2) using the Kano model to determine the nature of these requirements, and whether value will be created for the organisation and its customers through meeting these requirements.

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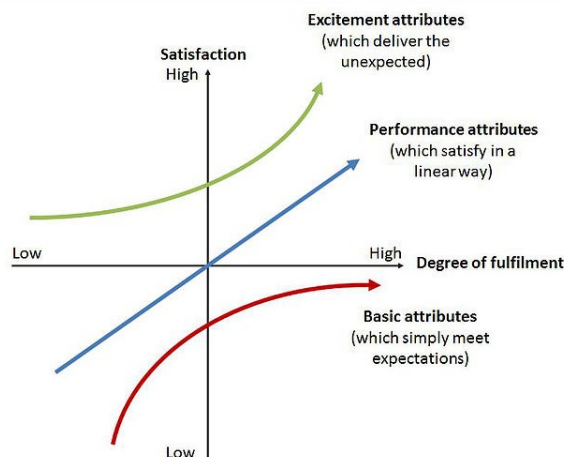
Phase 1.1.3
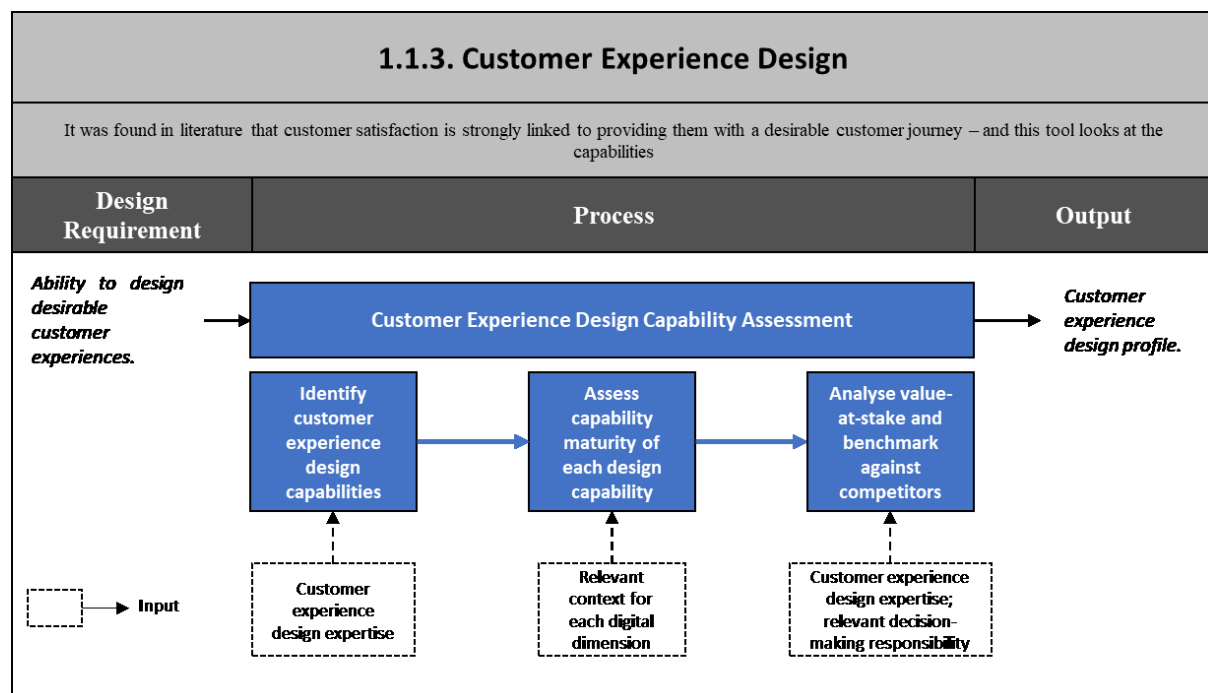
The organisation performs this step to assess the design capabilities of the organisation pertaining to the designing of customer journeys for the digital initiatives that focuses on end-to-end, desirable customer experiences. The structure is an assessment where the questions guide the organisation to determine their performance within each design capability.

The research found that organisations who intentionally focus on the customer experience do significantly better than their peers who do not. Organisations who focuses on the customer experience made cumulative gains of 43%, compared to the S&P Index of 14.5% cumulative gains. Organisations who failed to prioritise the customer experience achieved cumulative returns of -33.9% (Accenture study).

The McKinsey Design Index, used for this step, proposes the following design capabilities:

v.   *Analytical leadership* – organisations should drive design focus from the executive level and the design performance should be viewed with the same level of importance as the financial aspects of the organisation.

vi. *User experience* – focus should be put on integrating physical-, digital-, and service design to provide customers with a cross-functional product or service.

vii. *Cross-functional talent* – organisations must break away from making design performance the responsibility of one department – all of the departments should focus on customer-centric design.

viii. *Continuous iteration* – decrease the risk of product- or service development by continuously listening to-, testing-, and iterating with end-users.

When comparing the companies who scored in the top quartile of each design capability to their industry peers, they found that the companies who scored in the top quartile thus generated 32% more revenue and a 56% greater total return to shareholders respectively over the 5-year period.

Phase 1.2.1
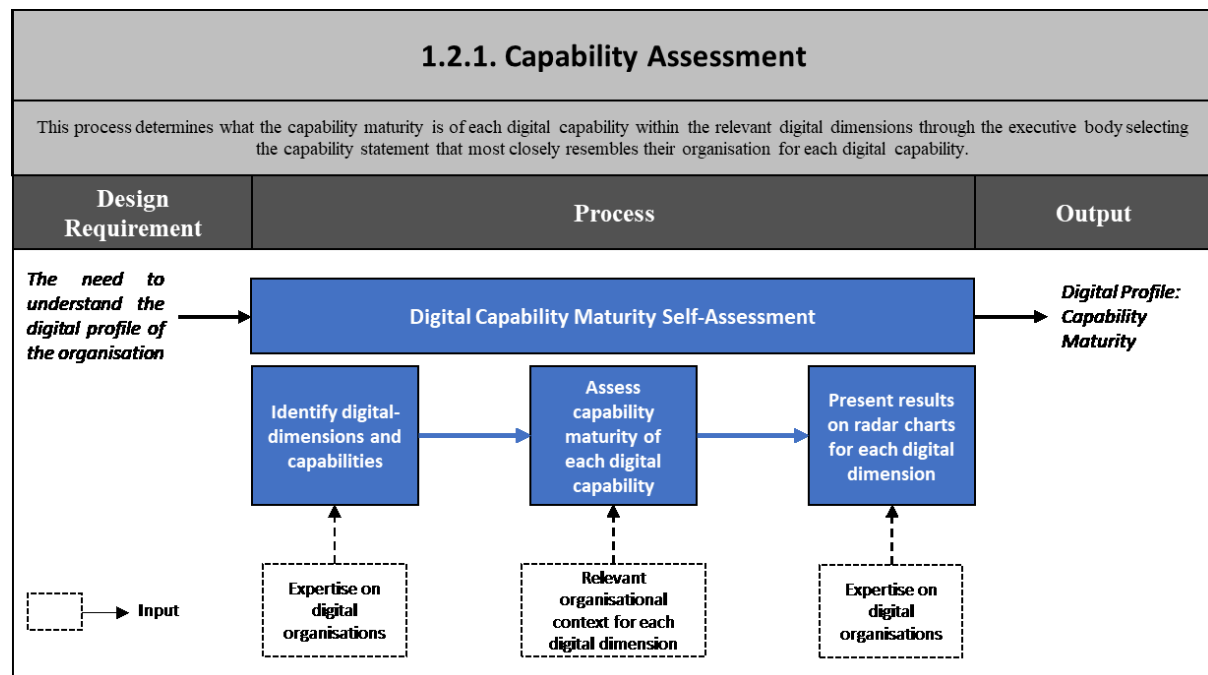
As the contextualisation of digital transformations and subsequently the makeup of a digital organisation is lacking for a significant number of organisations – this step aims to further contextualise a digital organisation by breaking it up into six digital dimensions – with various digital capabilities within each dimension. Each capability is further contextualised by five distinct maturity statements – each one including the maturity characteristics of the latter levels, but each an increasing level of capability maturity. The maturity statement is a description of the performance level of the specific capability from a digital perspective – and ranges from (i) digitally ignorant, (ii) digital laggard, (iii) digital follower, (iv) digital collaborator, to (v) digital leader. The list of digital dimensions and subsequent digital capabilities can be found in addendum A.

A questionnaire is filled out to determine the capability maturity of each digital dimension. The questions will be structured around the different digital dimensions, with the capability statements of each level incorporated in the answers, and the relevant person in the organisation is tasked with indicating which capability statement most closely represents the performance level of the current organisation. This creates a as-is state for the organisation, as well as guiding them to understand the digital building blocks of a digital organisation.

Phase 1.2.2
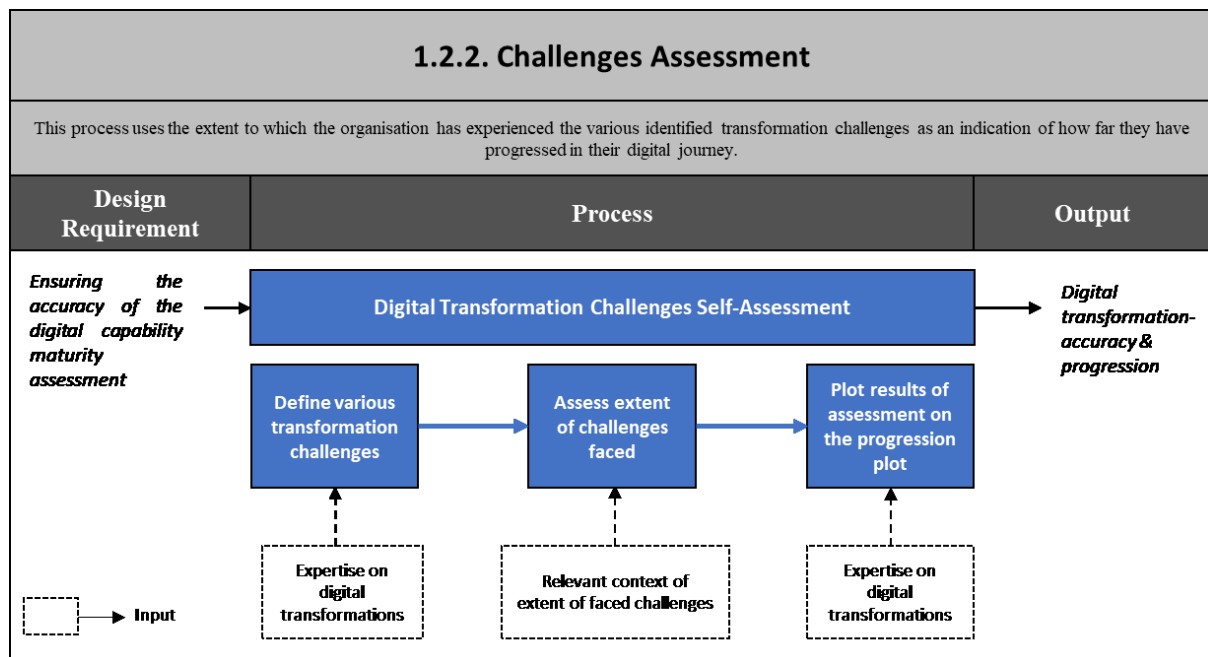
As it was found that very few organisations manage to successfully enact a digital transformation – the research looked at what challenges organisations face whilst undergoing the transformation. Several challenges were identified – where the lack of understanding the process was a theme with many of the challenges. This issue was further looked at and it was found that the lack of understanding could influence the organisations' perception of their own digital maturity – and subsequently a measure was put in place to ensure the accuracy of their digital capability maturity self-assessment. The list of challenges can be found in addendum B.

The extent to which the challenges have been faced was identified as a good way to check the accuracy, and an assessment was created that measures to what extent the organisation has experienced the digital transformation challenges. If the organisation has not experienced many of the identified challenges yet, this tool implies that they are not far along in their digital transformation journey, and their perception of digital capability maturity will be skewed positively (I). If the organisation is at the point of disillusionment (II), the lack of optimism could skew their perception to be lower than what it is. If the organisation has faced the challenges, but also overcame them, the perception of digital capability maturity will be more accurate (III)


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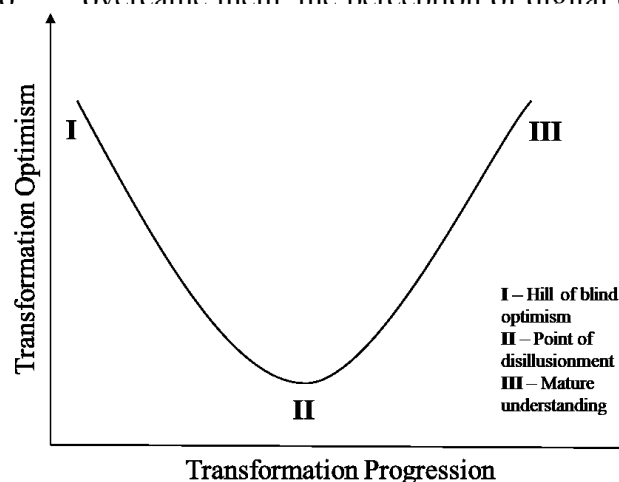
Phase 2.1
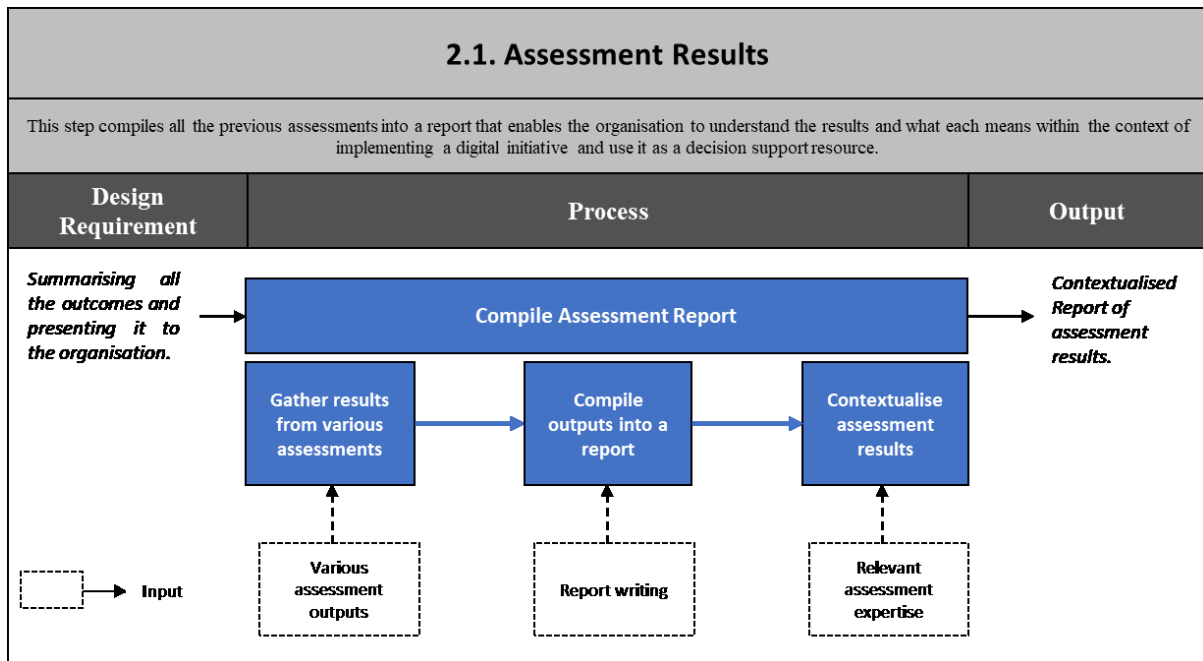
This step compiles a report of all the previous assessment that were completed to present the organisation with a summarised presentation of what the output of each assessment is – and what that means for their digital initiative implementation process. At this point they will know (1.1.1) where they are disrupted and how that influences their value proposition, (1.1.2) what customer need(s) the initiative should be addressing, (1.1.3) how effective they are in designing desirable customer journeys, (1.2.1) how digitally enabled the organisation is at their current point of existence, and (1.2.2) to what extent they have faced the transformation challenges, and subsequently how accurate their digital maturity perception is.

Phase 2.2
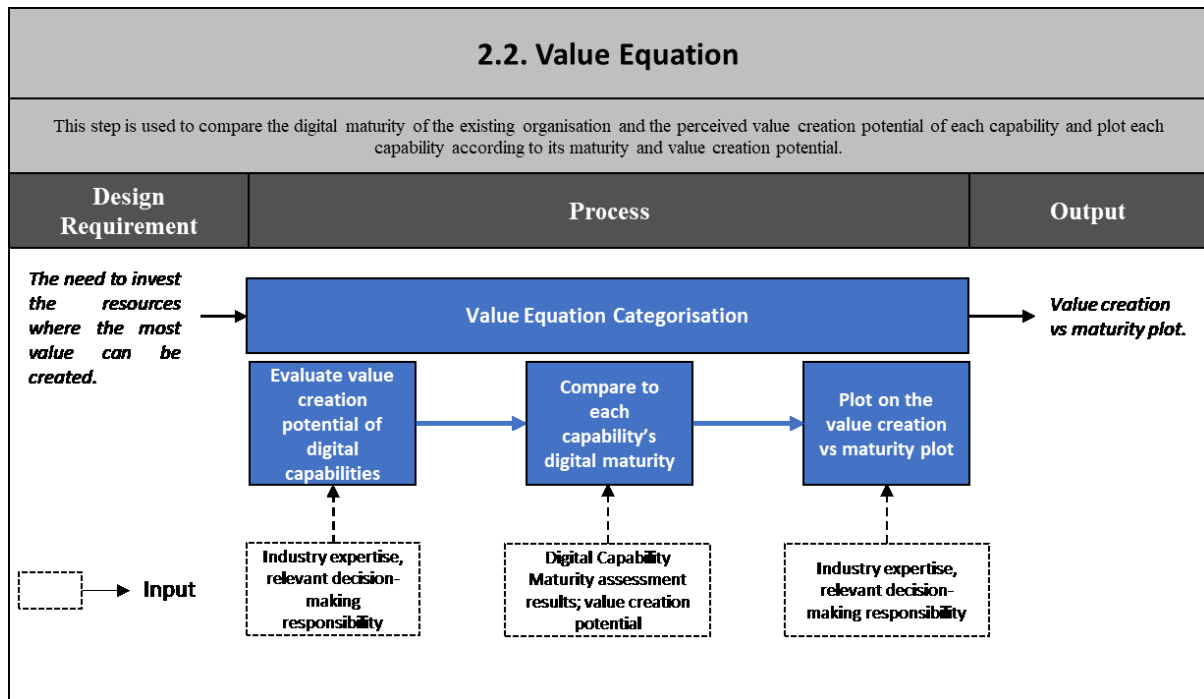
This step guides the organisation to consider each digital capability according to two variables – (i) digital maturity and (ii) value creation potential. It presents the organisation with a plot on which they have to plot each capability – with the value being that the organisation can more effectively allocate resources to the digital capabilities that will create value for the organisation. The plot is found below:
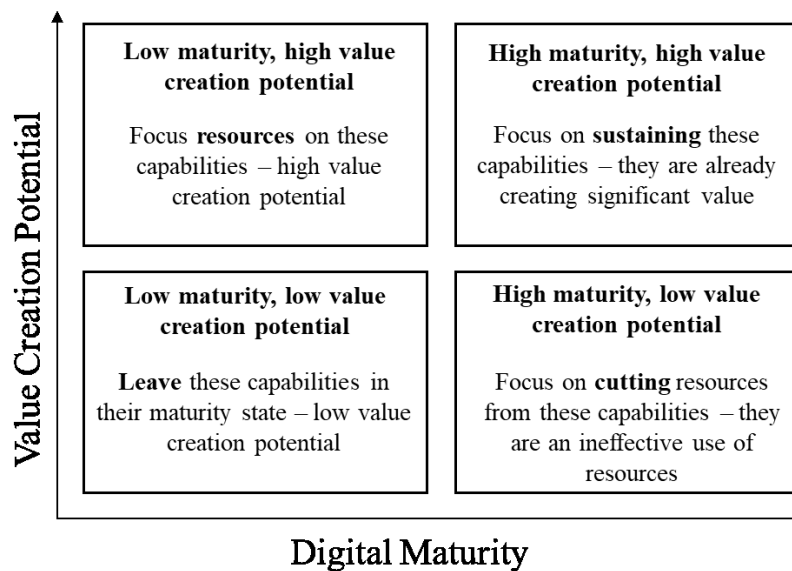
Phase 2.3
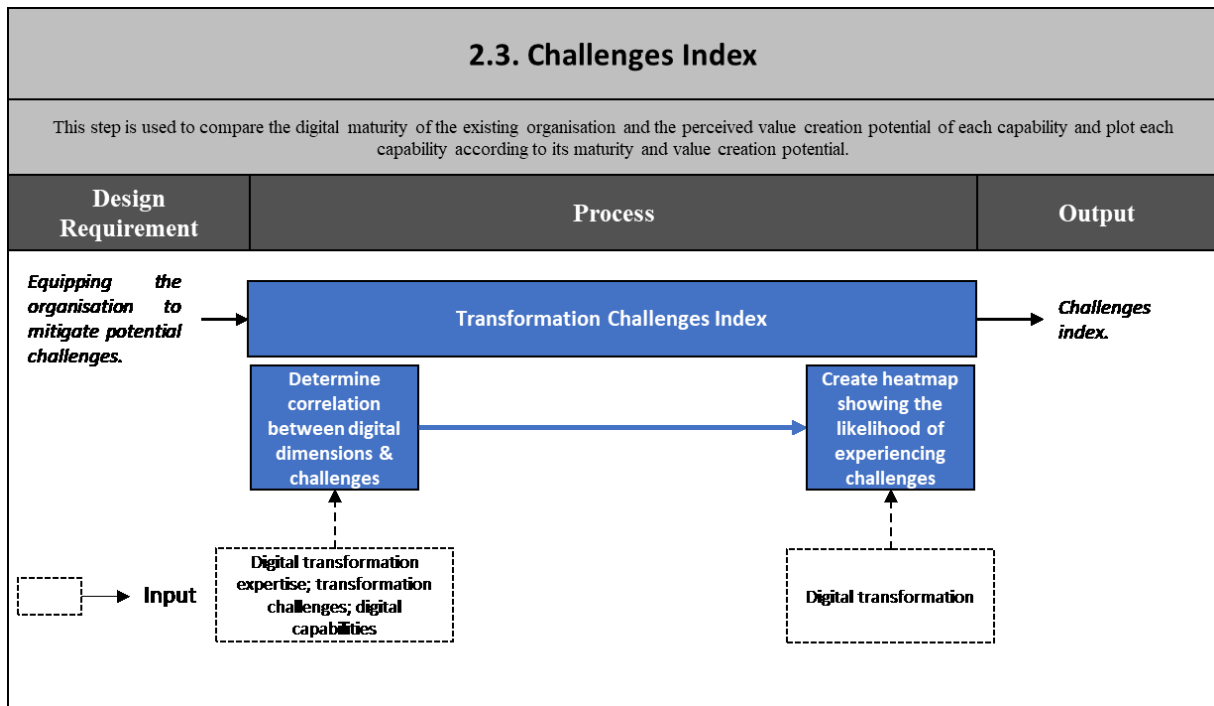
This step relates the identified challenges to the digital dimensions and presents the organisation with a challenges index where they will be able to see what challenges they are most likely to face based on the digital capabilities that they want to invest resources in. This will guide them to effectively mitigate the challenges, which translates to having a better chance at enacting a value-adding digital transformation.

Digital Dimensions & Capabilities

Strategy & Leadership	Transformation strategy
	Executive support
	Transformation funding
	Transformation progression measurement
Business Operations	Department collaboration
	Policy & Governance
	Digital supply chain management
	Data collection & decision support
	Data privacy & protection
	Enterprise Resource Planning (ERP) system
Organisational Culture & People	Organisational culture
	Roles of employees
	Digital talent
	Employee empowerment
	Teamwork prioritization
	Feedback & learning
Technology	Data & analytics
	Process automation
	Equipment readiness for Industry 4.0
	Cyber risk management
	Cloud integration
Product & service design	Speed-to-market
	Physical & digital integration
	Smart, ICT-enabled products
	Customised products & services
Customer Engagement	Customer value focus
	Multi-channel customer interaction & feedback
	Customer & design integration

Digital Transformation Challenges

Challenge
Legacy organisational infrastructure prevents interoperability between departments.
Legacy IT infrastructure prevents the implementation of new digital initiatives.
Lack of access to digital skills on the market.
Lack of clarity regarding the role of employees during- and after a digital transformation can lead to worker resistance.
Lack of collaboration between departments, interoperability issues, or lack of vision to do so.
Lack of a digital culture (people-centric, agile), and understanding the need for it.
Lack of leadership and strategy during the process.
Lack of awareness of the requirement for digital skills.
Lack of policy and regulatory reform.
Financial challenges – a digital transformation is very resource-intensive, and it's a challenge to access required funds.
Lack of understanding the process, requirements, and benefits of a digital transformation.
Lack of informed drive from management to transform.
Cybersecurity to protect the organisations from cyberattacks.
Uncertainty regarding what technology to invest in.
Lack of access to technology – especially prevalent in third world countries.
Job losses from automating processes leading to change-resistance from employees.
Disruption from external competition taking market share.
Being agile – remaining profitable during a complete business-model transformation.
Increased- and changing demand from customers regarding their customer experience.
External resistance against change from Unions.

Validation questionnaires
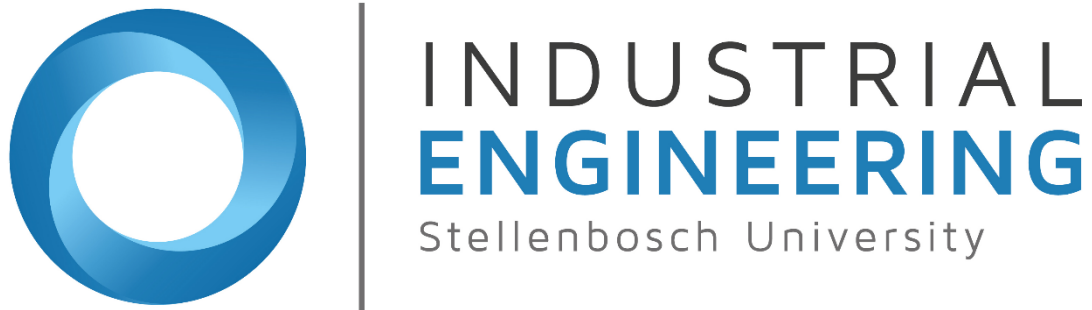
Validation Workbook

Thesis title: *A conceptual framework to enable the digital transformation of organisations*

FV1	There is significant value to be created in Industry 4.0.
FV2	Organisations mostly don't understand the concept of a digital transformation.
FV3	Organisations find it challenging to enact value-adding digital transformations.
FV4	Enacting a DT through the implementation of digital initiatives could be a more effective way than trying to transform the entire business all at once.
FV5	External resources could help organisations enact value-adding digital transformations.
FV6	A framework that will contextualize the digital transformation process and assist organizations in enacting a value-adding digital transformation through providing them with decision-support would be valuable.
CV1.1	Understanding how digital disruption has influenced the following sectors. Please indicate how much you agree with this statement regarding each separate topic.
CV1.1.1	(1) Customer demands
CV1.1.2	(2) The market
CV1.1.3	(3) Your competitors
CV1.1.4	(4) Technology
CV1.2	A tool that will contextualize disruption and indicate where the organisation is on the Incumbent Disruption curve.
CV1.3	Do you agree with the inputs & outputs of the process?
CV1.4	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV2.1	A tool that would help you determine and categorise customer need(s) to help you understand where you are and should be creating value.
CV2.2	The Kano Model (explain the outputs) would be an adequate tool to contextualize the customer need(s).
CV2.3	Do you agree with the inputs & outputs of the process?
CV2.4	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV3.1	A tool that will assess organisations' customer experience design capabilities and provide value-at-stake information about each design capability.
CV3.2	A tool that will benchmark your design capabilities against other organisations.
CV3.3	Do you agree with the inputs & outputs of the process?
CV3.4	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV4.1	Understanding the composition of a digital organisation will aid in focusing on the correct organisational dimensions when launching a digital initiative.
CV4.2	Understanding the various capability levels of each digital dimension.
CV4.3	A tool that will enable you to determine your capability level in each digital dimension to create a digital profile.
CV4.4	Do you agree with the inputs & outputs of the process?

CV4.5	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV5.1	A tool that will present the various challenges that organisations face in their digital transformation journeys and assess the extent to which each has been faced, will be valuable for the organisation.
CV5.2	The most pertinent digital transformation challenges are covered in the challenge's assessment.
CV5.3	Drawing a correlation between the output of this tool and the accuracy of the digital capability maturity assessment will be valuable to the organisation.
CV5.3	Do you agree with the inputs & outputs of the process?
CV5.4	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV6.1	Presenting the results from the Phase 1 assessments in a concise report to aid the organisation in using the results as decision support resources.
CV6.2	Do you agree with the inputs & outputs of the process?
CV6.3	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV7.1	Presenting a tool that will aid organisations in categorising the various digital capabilities according to their digital maturity (1.2.1) and the potential to add value for the organisation.
CV7.2	Do you agree with the inputs & outputs of the process?
CV7.3	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
CV8.1	Presenting the organisation with a digital transformation challenges index - to indicate which challenges they are most likely to face depending on the current maturity of each digital capability.
CV8.2	Do you agree with the inputs & outputs of the process?
CV8.3	Do you agree that this process adds value in the framework - thus would you include this tool in the framework?
HLV1	To what extent do you agree that this framework will contribute to enacting a value-adding digital transformation through providing the user with decision support during the implementation of digital initiatives?
HLV2	What are the key strengths and benefits of the framework?
HLV3	What are the key limitations and weaknesses of the framework?
UV1	The outcomes that the framework proposes would be useful in our environment, regardless of the process that the framework proposes.
UV2	It would be possible to use a framework such as this one to implement digital initiatives within our environment.
UV3	This framework, with its processes and outcomes, would be useful in our environment to assist with the implementation of digital initiatives.
UV4	What changes would you suggest/require to be able to use this framework?