A STRUCTURED APPROACH TO THE IMPLEMENTATION OF INFORMATION TECHNOLOGY (IT) GOVERNANCE PRINCIPLES TO ADDRESS APPLICATION SOFTWARE PROJECT FAILURE AT A STRATEGIC AND OPERATIONAL LEVEL

by
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Declaration

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Nadine van Vuuren
Date: April 2019

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ABSTRACT

Application software projects continue to fail at an alarming rate, despite extensive research on the subject and various attempts by organisations to prevent such failures. These failures are mainly attributable to the misalignment between an organisation's business requirements, which are driven by the business strategy, and the capabilities of application software selected and implemented to support those business requirements. This misalignment is commonly referred to as the Information Technology (IT) gap.

IT governance plays an integral role in the alignment of application software capabilities with business requirements to address the risks of application software project failure at a strategic and operational level. While it is apparent that control frameworks provide a critical foundation for implementing IT governance, these frameworks are generic and lack guidance on how organisations in different industries can practically implement IT governance principles to address software project failure.

The purpose of the study is to develop a structured approach, based on IT governance principles, to provide organisations with practical guidance for addressing application software project failure by bridging the IT gap at a strategic and operational level. The development of the structured approach involved the following steps:

- A recognised control framework was applied to identify potential failure factors that can contribute to application software project failure. A matrix was accordingly developed for aligning those failure factors with the applicable processes of the selected control framework to address software project failure at a strategic and operational level. This matrix can provide organisations with practical guidance for using the selected control framework to identify and address failure factors that can lead to the failure of application software projects.
- A second matrix was also compiled for aligning a generic list of business imperatives with recommended software requirements to achieve business/IT alignment in software projects. This is based on the study's recommendation that organisations should use their own unique business imperatives to drive the alignment between application software capabilities and business requirements, which can in turn mitigate the risk of application software project failure.

In conclusion, the structured approach developed in this study can ultimately provide organisations in different industries with a set of practical guidelines for mitigating the risks of software project failure by applying IT governance principles to bridge the IT gap at both a strategic and operational level. Furthermore, all stakeholders involved in application software projects can use the above two matrixes as guidelines to engage in the selection, design and implementation of application software to ultimately support an organisation's strategic objectives.

UITTREKSEL

Die hoë koers van mislukte toepassingsprogrammatuur-projekte duur steeds voort, ondanks uitgebreide navorsing rakende die onderwerp en verskeie pogings deur organisasies om sulke mislukkings te voorkom. Hierdie mislukkings word hoofsaaklik toegeskryf aan die wanbelyning tussen ŉ organisasie se besigheidsvereistes, wat gedryf word deur die besigheidstrategie, en die eienskappe en funksies van toepassingsprogrammatuur wat gekies en geïmplementeer is om hierdie besigheidsvereistes te ondersteun. Hierdie wanbeleiding is algemeen bekend as die Informasie Tegnologie (IT) gaping.

IT-beheer speel ŉ belangrike rol in die belyning van die eienskappe en funksies van toepassingsprogrammatuur met besigheidsvereistes ten einde die risiko's van mislukking van hierdie projekte op beide ŉ strategiese en operasionele vlak aan te spreek. Alhoewel dit opmerklik is dat IT-beheerraamwerke ŉ fundamentele grondslag vir die implementering van IT-beheer kan bied, is hierdie raamwerke generies en ontbreek leiding oor hoe organisasies in verskillende industrieë IT-beheerbeginsels prakties kan implementeer om die mislukking van toepassingsprogrammatuur-projekte aan te spreek.

Hierdie studie het ten doel om ŉ gestruktureerde benadering te ontwikkel, gebaseer op IT-beheerbeginsels, om praktiese leiding vir organisasies te verskaf om die mislukking van toepassingsprogrammatuur-projekte aan te spreek deur die IT-gaping op ŉ strategiese en operasionele vlak te oorbrug. Die ontwikkeling van die gestruktureerde benadering het die volgende stappe behels:

- ŉ Erkende kontroleraamwerk is aangewend om potensiële mislukkingsfaktore te identifiseer wat kan bydra tot mislukte toepassingsprogrammatuur-projekte. ŉ Matriks is dienooreenkomstig ontwikkel vir die belyning van daardie mislukkingsfaktore met die toepaslike prosesse van die gekose kontroleraamwerk om die mislukking van toepassingsprogrammatuur-projekte op ŉ strategiese en operasionele vlak aan te spreek. Hierdie matriks kan praktiese leiding aan organisasies bied vir die gebruik van die gekose kontroleraamwerk om potensiële mislukkingsfaktore, wat kan lei tot die mislukking van toepassingsprogrammatuur-projekte, te identifiseer en aan te spreek.
- ŉ Tweede matriks is ook saamgestel vir die belyning van ŉ generiese lys besigheidsimperatiewe met aanbevole vereistes vir toepassingsprogrammatuur om die belyning van besigheid en IT te bewerkstellig. Dit is gegrond op die studie se aanbeveling

dat organisasies hul eie unieke besigheidsimperatiewe moet gebruik om die belyning tussen die eienskappe en funksies van toepassingsprogrammatuur en besigheidsvereistes te dryf, wat die risiko's van mislukte toepassingsprogrammatuur-projekte kan teenwerk.

Ten slotte kan die gestruktureerde benadering wat in hierdie studie ontwikkel is, organisasies in verskillende industrieë van 'n stel praktiese riglyne voorsien om die risiko's van mislukte toepassingsprogrammatuur-projekte te kan teenwerk deur IT-beheerbeginsels toe te pas om die IT gaping op beide 'n strategiese en operasionele vlak te oorbrug. Verder kan alle belangegroepe betrokke by toepassingsprogrammatuur-projekte die bogenoemde twee matrikse as riglyne gebruik om insae te lewer rakende die keuse, ontwerp en implementering van toepassingsprogrammatuur om uiteindelik 'n organisasie se strategiese doelwitte te ondersteun.

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CHAPTER 1: INTRODUCTION AND RESEARCH OBJECTIVE

1.1 Introduction and background

The evolution of an integrated and globalised world economy is resulting in continuous and significant changes to the internal and external environments in which industries operate (Li, Chang & Yen, 2017:269). These changes are constantly leading to an increased demand for improved technology and serve as an incentive for organisations to exploit the opportunities provided by technological developments to maintain a competitive advantage (Whitney & Daniels, 2013:325; Ewusi-Mensah, 2003).

The growing demand for technological advancements in recent years has lead to various challenges and complexities that organisations need to manage (Taxén & Lilliesköld, 2008:527). It, however, appears that the abilities of users of technology to manage these challenges and complexities have not increased at the same speed. This results in a misalignment between the opportunities presented by technological advancements and organisations' capabilities to use those opportunities to their advantage (Taxén & Lilliesköld, 2008:527).

While technological advancements continue to provide software developers and organisations with numerous opportunities for project success, they also present increased risks of failure. The prevalence of Information Technology (IT) project failure, which continues to be a significant challenge for organisations, suggests that the IT industry is more prone to project failure than other industries (Whitney & Daniels, 2013:325; Wong, Scarbrough, Chau & Davison, 2005). From the continuous pattern of IT project failure over the past four decades, it appears that organisations are unable to learn from past mistakes made in failed IT projects (Hughes, Dwivedi, Rana and Simintiras, 2016:1314). The results of a recent study performed by the Standish Group (2015:1) support this statement by finding the success rates of IT projects undertaken from 2011 to 2015 to be as low as 27%.

IT project failure is one of the most prominent fields in information systems research (Dwivedi, Wastell, Laumer, Henriksen, Myers, Bunker, Elbanna, Ravishankar & Srivastava, 2015:143). Past research regarding IT project failure has mainly focused on project management with a specific emphasis on resource consumption, i.e. the ability to complete a specific project within the allocated budget and time (Dwivedi *et al.*, 2015:152). Existing studies also found that the explanatory factors for IT project failure can generally be classified into the following three categories, also referred to as the triple constraints for project management (Basten, Joosten & Mellis, 2011:12; Johnson & Crear, n.d.; Whitney & Daniels, 2013:325; Standish Group, 2013:2):

- failure to be completed within budget;
- failure to meet the agreed schedule; and
- failure to provide the contracted project scope.

However, many projects that succeeded in the aforementioned categories still failed to deliver value to the organisation or failed to meet stakeholder needs (Hastie & Wojewoda, 2015). The reliance on project management methodologies that measure project success mainly with reference to the requirements of the triple constraints may therefore be insufficient in preventing IT project failure (Dvir, 2008). The Standish Group (2015:1) supports this view by recently extending their traditional definition of software project success beyond the requirements of the triple constraints described above. In addition to the above criteria, the Standish Group's new definition of software project success further includes the provision of user satisfaction, the creation of business value and alignment with the strategic goals of the organisation as critical measures for success (Hastie & Wojewoda, 2015; Johnson & Crear, n.d.).

Based on available literature, it appears that the implementation of project management methodologies and practices alone is not sufficient to prevent IT project failure. The fact that IT projects continue to fail, despite the extensive research performed on the subject, suggests that the understanding of both academics and practitioners' in this field is still insufficient to mitigate the risks of IT project failure. This creates the need to gain a better understanding of the causes for IT project failure and the warning signs preceding it (Hughes *et al*., 2016:1314).

The misalignment between the capabilities of application software (hereafter referred to as "software") and an organisation's business requirements is widely recognised as the most significant cause of software project failure (Shiang-Yen, Idrus & Wong, 2013:59; Kruger, 2012:2). Strong and Volkoff (2010:731) describes this misalignment as key misfits between an organisation and its IT solutions that result from the use of software that is designed to support generic requirements rather than the specific business requirements of a particular organisation.

According to Strong and Volkoff (2010:732), the ubiquitous use of software solutions to support and enable business activities increases the urgency for organisations to better understand and align software capabilities with organisational goals. The importance of this alignment is evidenced by various studies that have identified alignment as one of the most complex and critical issues facing organisations today (Tallon, 2007:228).

1.2 Problem statement and research objective

Software projects still fail at an alarming rate despite ongoing research performed regarding the subject and the implementation of new methodologies and techniques to prevent those failures (Pratt, 2017). Various authors agree that such failures can mainly be attributed to the misalignment between software capabilities and business requirements (also referred to as the "IT gap") (Shiang-Yen *et al*., 2013:59; Boshoff, 2014; Kruger, 2012:2). This results from the misalignment between an organisation's specific business requirements, which are driven by the business strategy, and the capabilities of the software implemented to support those business requirements.

The implementation of IT governance is critical for aligning an organisation's IT strategy with its organisational objectives (also referred to as "business/IT alignment"). IT governance principles should therefore form the foundation for governing software projects in a manner that supports the achievement of an organisation's business strategy and, in turn, mitigate the potential risks of software project failure (Rincon, 2012).

Various existing frameworks, best practices, methodologies, policies and standards provide guidance for implementing IT governance principles to achieve the alignment between business and IT in organisations (Boshoff, 2014). These frameworks are, however, theoretical and do not specifically address the unique strategic objectives of organisations operating in different industries and contexts (Goosen & Rudman, 2013:91). Consequently, a lack of practical guidance exists for assisting organisations in aligning the objectives and requirements of software projects with their unique business strategies and related business requirements (Boshoff, 2014). El-Telbany and Elragal (2014:250) support this argument by stating that a lack in practical guidance still exists on how organisations should use existing frameworks and models to achieve business/IT alignment, other than to understand those frameworks and models only at a conceptual level.

According to Boshoff (2014), the risk of software project failure can only be addressed if the capabilities of an organisation's selected and implemented software are aligned with its business requirements at both a strategic and operational level. While strategic-level alignment comprises the alignment between an organisation's business- and IT strategies, including the selection of appropriate software to support strategic objectives, operational-level alignment ensures that the technical capabilities, functionality and configuration of software support the business processes needed to execute the business strategy (Rahimi, Møller & Hvam, 2016:148; Boshoff, 2014). Numerous authors have, however, recognised that a lack of practical guidance still exists on how organisations can achieve alignment at both of the levels described above (De Haes, Van Grembergen & Debreceny, 2013b:312; Bernroider & Ivanov, 2011:325; Rahimi *et al.*, 2016:142; Tarafdar & Qrunfleh, 2009:339).

Boshoff (2014) suggests that organisations can achieve business/IT alignment at both the strategic and operational level by using their unique business imperatives to drive the selection, implementation and configuration of software to meet business requirements. The business imperatives of an organisation are those unique principles that are fundamental and critical in achieving an organisation's strategic objectives (Boshoff, 2014).

When evaluating the ability of software to create business value and support an organisation's strategic objectives, it appears that the application of generic best practices, frameworks and methodologies is not sufficient. A detailed analysis of the technical capabilities of specific software, which are required to support business requirements at a strategic and operational level, is necessary to assist organisations in bridging the IT gap. This can be achieved by using an organisation's unique business imperatives to drive the selection, customisation and configuration of software to fit the specific business requirements and business processes of the organisation (Boshoff, 2014).

The main research problem is to determine how organisations can practically implement IT governance principles to address software project failure, which results from the misalignment between an organisation's business requirements and the capabilities of software needed to support those business requirements, at a strategic and operational level.

The main research problem may be categorised in the following sub-problems and related objectives:

Research question 1: Which of the detailed Control Objectives for Information and Related Technologies (COBIT) 5th edition (COBIT 5) processes are applicable to software project failure?

A detailed review of the COBIT 5 detailed processes and related governance practices will be performed to address this question. The objective of this review is to identify which of the detailed processes of COBIT 5, referred to as the “applicable COBIT 5 processes”, address software project failure, which results from the misalignment between an organisation’s business requirements and the capabilities of software needed to support those business requirements.

Research question 2: How can an organisation practically implement the applicable COBIT 5 processes to address potential failure factors associated with software project failure at a strategic and operational level?

This question will be addressed by applying the guidance provided by the applicable COBIT 5 processes to identify potential failure factors associated with the misalignment between an organisation’s business requirements and software capabilities at a strategic and operational level. The objective of the above process is to develop a structured approach, based on the guidance provided by the COBIT 5 framework, to assist organisations in proactively identifying and mitigating the risks of potential failure factors that can contribute to software project failure.

Research question 3: How can an organisation practically align their business requirements, which are driven by their unique business imperatives, and the software capabilities needed to achieve those business requirements?

This question will be addressed by firstly identifying a generic and broad list of business imperatives that may be applicable to a particular organisation. Secondly, each identified business imperative will be linked to recommended software requirements that may be needed to achieve the particular business imperative. As the guidance provided by COBIT 5 is generic, the objective of this approach is to provide practical guidance, which may be relevant to organisations in different industries and contexts, for:

- identifying their own unique business imperatives; and
- using their specific business imperatives to drive the alignment between their business requirements and software capabilities.

1.3 Scope limitations

This study will focus on identifying failure factors or risks associated with the misalignment between software capabilities and business requirements. The aim is not, however, to create an exhaustive list of all potential failure factors or risks associated with software project failure.

Numerous authors have taken different approaches to obtain an understanding of IT project failure. These approaches include studies focusing on IT project failure factors, IT project critical success factors, user resistance, organisation/system fit and IT project risks (Dwivedi *et al*., 2015:145). This study will focus only on identifying failure factors or risks associated with the misalignment between software projects and business requirements. The following aspects relating to software project failure are specifically excluded from the scope of this study and will not be addressed:

- Critical success factors associated with application software projects; and
- General risks or failure factors associated with inappropriate project management, such as failure to complete a project on time, which are not associated with business/IT alignment in software projects.

This study proposes a structured approach to using the COBIT 5 framework to address the failure factors associated with the misalignment between software capabilities and business requirements. However, a complete list of controls and measures, which are required to address these factors, fall outside the scope of this study.

While this study addresses the factors associated with application software and application architecture as a component of an organisation's overall IT architecture, other components of the IT architecture, such as databases or networks, will not be addressed.

Numerous studies relating to IT project failure do not specify the type of application software, such as Enterprise Resource Planning (ERP) systems, custom developed software or other types of packaged software, addressed. All types of application software were therefore included in the scope of the definition of application software projects for the purposes of this study. The unique technical attributes and project failure factors relating to specific application software will, however, not be considered.

This study proposes the use of an organisation's unique business imperatives as the drivers for aligning their business requirements with the required software capabilities needed to achieve those business requirements. The list of business imperatives referred to in this study comprises a wide range of generic business imperatives. As unique business imperatives are applicable to different organisations and industries, this study does not aim to provide a complete list of business imperatives that may be applicable to a particular organisation. Furthermore, while this study provides a list of recommended software requirements that can assist organisations in using their business imperatives to achieve business/IT alignment in software projects, the aim is not to provide an exhaustive list of all software requirements that may be applicable to a particular organisation or industry.

1.4 Structure of the research

The study consists of the following chapters:

- Chapter 1 focuses on the background of software project failure research. It addresses the research problem, objective and scope, limitations of the research, research design and structure of the research.
- Chapter 2 describes the research design and methodology followed to achieve the research objectives.
- Chapter 3 contains the literature review and includes an evaluation of historical research. It furthermore defines important theoretical concepts that form the basis of this study.
- Chapter 4 contains the findings of the study and describes the structured approach developed to achieve the research objectives.
- Chapter 5 summarises the research performed and the conclusions of the study.

CHAPTER 2: RESEARCH DESIGN AND METHODOLOGY

A non-empirical, qualitative study was performed to gain an understanding of software project failure, to identify related failure factors and to determine how IT governance principles can address such failure. The following methodology was followed to address the research objectives:

2.1 Literature review methodology

An extensive literature review was performed. According to Webster and Watson (2002:xiii) a review of prior literature relevant to the research topic forms an essential aspect of any academic project. Webster and Watson (2002:xiii) state that an effective literature review "creates a firm foundation in advancing knowledge". The objectives of the literature review include the following:

- The facilitation of theory development and providing a theoretical foundation for subsequent research (Okoli & Schabram, 2010; Webster & Watson, 2002:xiii);
- The identification of areas where gaps in research exist (Webster & Watson, 2002:xiii); and
- The description of the significance of prior literature in addressing the research questions (Okoli & Schabram, 2010).

The literature review formed the foundation of the study. As part of the literature review, accredited articles in local and international journals, white papers, theses, books, popular press articles, electronic sources and unpublished class notes were considered. As described above, the objectives of the literature review were to identify gaps in prior research and to gain an understanding of important theoretical concepts underlying to the study, notably:

- The concept of an application software project, including the different types and characteristics of software projects;
- The definition and determinants of application software project success and failure. This understanding formed the basis for defining application software project failure and identifying the failure factors that may contribute to such failure;
- The concept of misalignment between software capabilities and business requirements;

- The definition, objective and scope of IT governance and the importance of IT governance in the context of software projects;
- The concept of business/IT alignment and its relevance to software projects, both at a strategic and operational level;
- The role of business imperatives in achieving business/IT alignment as described above;
- The role of control frameworks in implementing IT governance and achieving business/IT alignment; and
- A review of the Control Objectives for Information and Related Technologies (COBIT) 5th edition (COBIT 5) framework, which confirmed the relevance of the framework for the purposes of the study.

2.2 Research methodology for the development of a structured approach

As previously described, the structured approach developed in this study comprises the application of IT governance principles to address the failure factors contributing to software project failure at a strategic and operational level. The following methodology was employed to develop the stated approach:

Step 1: A detailed review of the COBIT 5 framework was performed. The purpose of this review was to identify which of the detailed processes of COBIT 5, hereafter referred to as the "applicable COBIT 5 processes", are relevant for addressing software project failure (i.e. the misalignment between an organisation's business requirements, as determined by the business strategy, and the capabilities of software needed to support those business requirements).

Step 2: The applicable COBIT 5 processes were then used to identify failure factors associated with software project failure. These factors were mapped to the applicable COBIT 5 processes and were further categorised according to the two levels of business/IT alignment, namely strategic and operational. A matrix was subsequently compiled to link each applicable COBIT 5 process to the failure factors it can potentially address and the applicable level of business/IT alignment (strategic and/or operational) to which it applies.

Step 3: Finally, a second matrix was compiled which links a generic and wide list of identified business imperatives, which may apply to a particular organisation, to the recommended software requirements needed to achieve business/IT alignment in software projects.

By following the methodology described above, a structured approach was developed to provide organisations with practical guidance for implementing IT governance principles to address application software project failure. This methodology ultimately resulted in the development of the following two matrixes:

- A matrix for aligning software project failure factors with the applicable COBIT 5 processes to address software project failure at a strategic and operational level: This matrix can assist organisations in identifying and mitigating potential risks relating to the misalignment between software projects and business requirements; and

- A matrix for aligning business imperatives with recommended software requirements: This matrix can assist organisations in identifying their unique business imperatives and, accordingly, determine the related software requirements needed to support their business requirements and ultimately their business strategy.

CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

This study proposes to provide organisations with a structured approach to the implementation of IT governance principles to address software project failure. The objective of the literature review performed in this chapter is to gain an understanding of historical research, identify gaps in prior research and to define the fundamental theoretical concepts underlying to the study. The literature review will form the foundation for the development of the aforementioned structured approach.

3.2 Application software projects defined

3.2.1 Definition of an IT project

Kerzner (2017:3) defines a project, with reference to the PMBOK Guide (6^{th} Edition), as a series of tasks and activities that:

- have a defined objective, with an emphasis on the creation of business value, to be completed within specific requirements;
- have specific start and end dates;
- have, in most cases, funding restrictions;
- span across multiple functional business lines; and
- consumes human and non-human resources.

Specifically, an IT project is defined as any project involving hardware, software and networks to produce a result, product or service (Schwalbe, 2016:3).

3.2.2 Definition of an application software project

ISACA (n.d.) defines software as the collective term used for the "programs and supporting documentation that enable and facilitate the use of the computer". Application software is a type of software that comprises an integrated collection of application programs designed to serve specific functions that include input, processing and output activities (ISACA, n.d.).

ISACA (n.d.) further defines application programs as software that "processes business data through activities such as data entry, update or query".

Based on the concepts defined above, an application software project can be defined as any project involving the implementation of application software to produce a result, product or service (Schwalbe, 2016:3; Smith, 2002). Ewusi-Mensah (2003:29) further describes a software project as an exceptionally complex and challenging creative process involving the continued collaboration of disparate stakeholder groups with the aim of meeting performance objectives and organisational requirements.

3.2.3 Types of application software projects

Application software projects can include any type of software, such as packaged software solutions, bespoke developed software or a combination of bespoke and packaged software (Smith, 2002; Boshoff, 2014). Examples of application software include human resource management or the general ledger (ISACA, n.d.). A popular example of packaged software solutions is Enterprise Resource Planning (ERP) systems. Due to the prominence of ERP system implementations as a component of software projects, these systems will be discussed in the remainder of this section.

ERP systems have become the fastest growing market in business software resulting from globalisation and the subsequent need to increase data visibility and transactional interoperability (Shiang-Yen *et al.*, 2013:60). In today's business environments, where the pace of change and technological developments continues to accelerate, successful organisations have harnessed the capabilities that integrated systems can provide to improve customer satisfaction, quality and performance. ERP systems have accordingly continued to be a popular and widespread software solution to enable the integration and automation of business processes, cost reduction and performance improvements (Bahssas, AlBar & Hoque: 2015:72; Sia & Soh, 2007:568). Furthermore, ERP systems can support organisations in reaching best practices in business process management by enabling data- and information sharing across multi-functional modules (Bahssas *et al.*, 2015:73).

Gartner (n.d.) defined ERP software in the postmodern era as “a technology strategy that automates and links administrative and operational business capabilities (such as finance, HR, purchasing, manufacturing and distribution) with appropriate levels of integration that balance the benefits of vendor-delivered integration against business flexibility and agility”. This definition identifies an administrative strategy and an operational strategy as two types of ERP strategies. An administrative ERP strategy focuses on administrative dimensions such as financials, indirect procurement and human capital management (Gartner, n.d.). Organisations in specific industries, often referred to as product-centric industries, often follow an operational ERP strategy that stretches beyond administrative functions and includes operational areas such as supply chain and order management to maximise operational efficiencies (Gartner, n.d.). Such organisations can realise benefits from the integration between administrative and operational modules that enables the financial effect of operational transactions to be recorded directly in financial modules (Gartner, n.d.).

3.2.4 The unique characteristics of IT and software projects

In literature, various studies have identified several characteristics unique to IT projects, including software projects. Technology-based projects are often regarded as the most challenging projects to manage due to the high level of complexity, risk, innovation and experimentation involved in their implementation (Kerzner, 2017:10). Whitney and Daniels (2013:325) support this statement by viewing the IT industry as more susceptible to risk than other industries. According to Ewusi-Mensah (2003:29), it is of critical importance for organisations to understand the factors that impact software projects, as these projects are inherently susceptible to significant business risks and failure. The unique factors inherent to software projects include the following:

- **Project complexity:** Software development is an inherently complex endeavour, requiring the solving of complex problems, highly specialised skill sets, iterative approaches and innovative solutions (Thamhain, 2014:3). It requires organisations to not only comprehend the different dimensions of the design problem but also to create a reliable and robust design that is implemented in a technical programming-language context (Ewusi-Mensah, 2003:29).

- **Collaborative and complex decision-making:** The collaboration and coordination of disparate groups of stakeholders add additional complexity to software projects (Ewusi-Mensah, 2003:31). The high risks associated with software projects further lead to complex decision-making processes, often requiring distributed- or team-based decision-making and collaboration (Thamhain, 2014:8).

- **Project size:** The complexity of a software project inevitably increases as the project size increases (Ewusi-Mensah, 2003:29). A large-scale software project requires significantly more coordination of various stakeholders and is more prone to changes in requirements during the project's lifetime (Ewusi-Mensah, 2003:39).

- **Requirements formulation and abstraction:** Software projects aim to solve conceptual design problems. As a result, it may be challenging to comprehend the interaction between system components, intrinsically unique to each new project, before system implementation. The diverse perspectives of various stakeholders further complicate the formulation of the information- and functionality requirements (Ewusi-Mensah, 2003:33).

- **Project team composition and skills:** Software projects require highly skilled and educated team members with a broad range of skills (Thamhain, 2014:5). Gaps in the knowledge-levels of team members from various backgrounds may lead to the following project risks (Boshoff, 2014): Firstly, technical developers or personnel with intensive technical experience and training may lack knowledge of the problem domain and business requirements. Secondly, end users may have an in-depth understanding of the business requirements but may have only limited technical experience. Thirdly, management, who usually sponsors the software project, may have neither sufficient technical knowledge nor an in-depth understanding of operational requirements to oversee the project direction. Lastly, changes in project team members throughout the lifetime of the project can lead to the corrosion of the project team's combined knowledge and skills (Ewusi-Mensah, 2003:36).

- **Technical issues:** Technology is, by definition, a rapidly changing knowledge area associated with elevated levels of risk and uncertainty and requires highly specialised skill sets (Thamhain, 2014:3). Various technical factors, such as the incorrect definition of technical requirements or software functionality and the prevalence of errors inherent to coding, testing and the integration of systems, may increase the risks of software project failure (Ewusi-Mensah, 2003:38).

- **Capital intensive**: Software projects require substantial capital investment, which increases the risk of financial losses when projects are cancelled or not completed within budget. The inherent complexity of requirements and uncertainties associated with software projects may further complicate the task of managing resources within budget constraints (Thamhain, 2014:6).

- **The strategic significance of IT:** The pervasive impact of IT on organisational performance has lead to an increased focus on management practices that influence the quality and scope of IT in organisations (Rahimi *et al.*, 2016:142). In highly connected business environments, most industry segments attempt to leverage technology to promote operational efficiency and market responsiveness to increase their competitive advantage (Thamhain, 2014:5). Rapidly developing technologies require sophisticated project management skills to address the new risks associated with those technologies and require an understanding of how IT can create business value (Thamhain, 2014:5).

From the above, it is apparent that various factors inherent to software projects may lead to project failure, which amplifies the importance of understanding those factors and the methods that may be implemented to mitigate the risks of failure.

3.3 Application software project success and failure

In the view of Schwalbe (2016), many organisations' future depends on their ability to exploit the opportunities provided by IT to maintain a competitive and strategic advantage. As a result, executives are continuously proposing new software projects to increase the efficiency and productivity of organisations and to support the business strategy (Ewusi-Mensah, 2003:3). A recent forecast by Gartner (2018a) supports this view by estimating that enterprise software spending will reach its highest growth in 2018, with an 11.1% increase since 2017. Gartner (2018a) further notes that this growth in the software industry is expected to continue in subsequent years as organisations seek to capitalise on the digital business evolution and modernisation initiatives (Gartner, 2018a).

Despite a significant focus on project management research over the past few decades, recent studies demonstrate that IT project failure continues to be a frequent occurrence (Hughes *et al*., 2016:1314). The results of the 2015 Chaos Report, published by the Standish Group (2015:2), indicate that more than half of IT projects do not succeed and found the success rates of over 25 000 IT projects undertaken from 2011 to 2015 to range only between 27% and 31%. This failure results from the inability of organisations to deliver projects that are consistently delivering the expected outcomes and required business value to organisations (Hughes *et al*., 2016:1314; KPMG, 2017:7).

The failure of software projects, as described above, have had detrimental impacts on organisations' performance in terms of significant financial losses and other risks (Wong *et al*., 2005; Dwivedi *et al*., 2015:144; Hughes *et al*., 2016:1313). The results of a global survey conducted by the Project Management Institute indicate that $99 million are wasted for every $1 billion invested due to poor project performance (PMI, 2018:2). In some cases, significant software project failures may even endanger the survival of organisations (Ewusi-Mensah, 2003:3).

Despite the above difficulties, it has however become nearly impossible for organisations to execute their business strategy without the implementation of new technologies and applications required to support their strategic objectives (Tarafdar & Qrunfleh, 2009:339). Consequently, the importance of IT project management to support the successful implementation of these technologies is becoming more evident (Schwalbe, 2016:2). The importance of IT project management is further emphasised by the results of a survey conducted by PwC (2014:13), which indicates that 47% of CEO's are concerned about the impact of technological change on their organisations' growth prospects. This report further highlighted the importance of structuring project management with the necessary flexibility to enable organisations to respond to the opportunities and threats resulting from such technological changes.

Based on the above, it is apparent that the success of software projects and the corresponding efforts required to enable this success continues to be a significant challenge for organisations. As a result, there remains a need for future research to address these issues. Consequently, the concepts of software project success and failure are investigated in further detail below.

3.3.1 Software project success and failure defined

Kerzner (2017:3) defines successful project management as "meeting a continuous stream of project objectives within time, within cost, at the desired performance or technology level, while utilising the assigned resources effectively and efficiently, and having the results accepted by the customer and stakeholders". Similarly, the Standish Group (2015) defines successful IT projects as projects that are on time, on budget and delivers a satisfactory result. This definition includes the following attributes of a successful IT project:

- the project was delivered within a reasonable estimated time;
- the project was delivered within budget; and
- the project delivered both user- and customer satisfaction, irrespective of the original scope.

In contrast with the above concept of project success, Ewusi-Mensah (2003) defines software project failure as the "perceived inability of the project to meet the requirements or expectations of various combinations of organisational stakeholders". Amid, Moalagh and Ravasan (2012) further classify software project failure into two categories: the project itself and the outcomes achieved by the project. While the first category focuses on project-related constraints such as factors relating to cost or time, the second category defines failure as the inability of the project to achieve implementation goals, such as improved integration and operational efficiencies (Amid *et al*., 2012).

Numerous authors have acknowledged the fact that the terms "failure" and "success" in IT research continue to be difficult to define, despite extensive research performed on the subject (Hughes *et al*., 2016:1314, Dwivedi *et al*., 2015:144). The definition of project success and, consequently, the related criteria for measuring success is therefore still evolving (Musawir, Abd-Karim & Mohd Danuri, 2016:2). As a result, there has also been a shift in the focus of IT project management regarding the definition and determinants of project success in recent years.

In the past, research regarding project management placed a strong focus on completing projects to meet the traditional measures of project success, such as budget, time and scope, which are often referred to as the triple constraints (PMI, 2018:3; Standish Group, 2015:2). Adhering to the triple constraints of budget, time and scope alone is, however, not sufficient to ensure that a project is successful in meeting long-term business objectives (Dvir, 2008; PMI:2018:3). KPMG (2017:16) found that, while numerous organisations still rely on these traditional metrics for determining projects' success, these metrics do not adequately reflect projects' contribution to business value. Based on the results of empirical studies of over 25 000 IT projects, the Standish Group (2015:2) supports this argument by stating that, while many projects achieved the measures for success according to the triple constraints, users were not consistently satisfied with the outcomes of those projects.

Project management studies in recent years have shifted their focus from the traditional measures of project success, as discussed above, to the ability of projects to create business value and support the business strategy as critical measures for success (PMI, 2018; KPMG: 2017; PwC, 2014). This new trend in project management research, with a strong focus on value creation, is expected to increase (Kerzner, 2017:10). Accordingly, recent studies further view the misalignment between project objectives and an organisation's business strategy as the most significant factor contributing to project failure. This view is supported by the following studies:

- In a recent report, the Project Management Institute (PMI, 2018:4) found that organisations who undervalue the importance of project management in delivering the business strategy report an average of 50% failure of their projects.
- In maturity assessments of organisations' programmes, portfolios and projects, PwC (2014) found that only 62% of organisations' programmes had a mature or established link between project objectives and the organisational strategy, which may contribute to continuing project failure.
- In a similar project management survey, KPMG (2017:17) found that only 30% of organisations' projects are likely to meet their business objectives and create business value. Furthermore, 47% of respondents of the survey indicated that their organisations do not regularly review project outcomes with organisational strategies to ensure business/IT alignment.

Based on the above, it appears that the misalignment between an organisation's business requirements and the capabilities of software needed to support those requirements is the most significant factor contributing to software project failure (Boshoff, 2014; Shiang-Yen *et al*., 2013:60; Sia & Soh, 2007:568). Accordingly, software project failure may, amongst other possible interpretations, be defined as follows: The inability of software to create business value due to the misalignment between an organisation's business requirements, which are driven by the business strategy, and the capabilities of software needed to support those business requirements. Hereafter, further references to software project failure refer to the definition assigned to this concept above. Boshoff (2014) refers to this misalignment as the IT gap, which will be discussed within the context of software projects in the next section.

3.3.2 The IT gap within the context of software projects

As discussed previously, the IT gap within the context of software projects refers to the misalignment between an organisation's business requirements, as determined by the business strategy, and the capabilities of software needed to support those requirements. The above misalignment refers to the inappropriate or inadequate functionality, configuration or customisation of implemented software that may lead to the inability of the software to support an organisation's unique business processes and, ultimately, the business strategy.

Sia and Soh (2007:568) are of the opinion that the IT gap, as described above, is becoming more prominent due to the widespread adoption of packaged software solutions, such as ERP systems. This increases the need for significant customisation of packaged software to match an organisation's existing business processes that, in turn, can lead to higher risks and increased complexities associated with software projects (Sia & Soh, 2007:572).

Rahimi *et al*. (2016:143) argue that the misalignment between software capabilities and business requirements often results from the inadequate involvement of stakeholders from both the business- and the IT functions in decision-making regarding software implementations. On the one hand, failure to include business roles in IT decisions may lead to misfits between the IT strategy and the business strategy, a fixation on technology or a loss of competitive advantage when software do not support critical business processes. On the other hand, the failure to consider IT roles in decisions regarding business functions and business processes may lead to complex application architecture, increased costs, increased complexity and additional risks associated with software implementations (Rahimi *et al*., 2016:143).

According to Tarafdar and Qrunfleh (2009:339), the misalignment between software capabilities and business requirements may often result in the incorrect selection and configuration of software, the duplication or wastage of resources and ultimately in the failure of software projects. This creates a need for organisations to understand the factors contributing to the above misalignment to mitigate the risks of software project failure.

3.3.3 Failure factors associated with the misalignment between software capabilities and business requirements

Wong *et al*. (2005) define critical failure factors in software projects as the key aspects or areas where the inappropriate or incorrect undertaking of a software project results in a high level of failure for such a project. As discussed previously, this study addresses the misalignment between an organisation’s business requirements, as determined by the business strategy, and the ability of software to support those requirements as the most significant reason contributing to software project failure. Accordingly, for the purpose of this study, the concept of failure factors refers to those factors associated with the concept of misalignment described above.

Numerous authors have recognised the value of analysing and understanding the explanatory factors associated with software project failure for avoiding past mistakes and identifying common characteristics across cases (Wong *et al*., 2005; Ravasan & Mansouri, 2016:66; Hughes *et al*., 2016:1313; Dwivedi *et al*., 2015:145). Hughes *et al*. (2016:1313) argue that this analysis of failure factors can assist organisations in identifying warning signs and potential risks for software project failure at an earlier stage in the project life cycle to mitigate the negative impact of such risks.

Based on the above, it is critical for organisations to identify and understand the failure factors associated with software project failure. The effective implementation of IT governance principles in software projects can assist organisations in addressing these failure factors and, consequently, improve the success rates of software projects (ITGI, 2011:7)

3.4 Governance of software projects

3.4.1 Corporate governance

Rubino and Vitolla (2014:321) view corporate governance as an extensive subject due to its broad scope and the different stakeholders, governing bodies and mechanisms involved in the governance of an organisation. Cadbury (2002:1) defined corporate governance as the system that directs and controls the organisation. This system involves the relationships between the board, management, shareholders and other stakeholders of an organisation (OECD, 2015:9). It creates a structure for setting objectives and determines the mechanisms for achieving those objectives and for monitoring performance (OECD, 2015:9).

One of the core principals of corporate governance is the application of effective and ethical governance principles and practices by the board of directors to meet the present needs and expectations of all stakeholders while setting the strategic direction to create long-term value for the organisation (Institute of Directors Southern Africa, 2016:20). The application of these governance principles can benefit an organisation by creating an ethical culture, achieving effective control and improved performance and attaining legitimacy with stakeholders. These stakeholders include not only shareholders but also consumers, employees, the environment and the community (Institute of Directors Southern Africa, 2016:26).

To attain the above benefits of corporate governance, organisations need to adapt to constant changes in the dynamic environment in which they operate. These changes can present organisations with opportunities for growth as well as challenges and emerging risks (Institute of Directors Southern Africa, 2016:26).

The King IV Report on Corporate Governance for South Africa (King IV) specifically identifies technological developments as an emerging issue that corporate governance principles and practices need to address (Institute of Directors Southern Africa, 2016:28). King IV describes rapid technological advancements in recent years as being so significant that it is revolutionising the way in which organisations operate (Institute of Directors Southern Africa, 2016:30). The governance of information technology therefore forms a critical part of the overall corporate governance framework.

3.4.2 IT governance

The pervasive use of technology in organisations and the increasing dependency of organisations on IT has resulted in the need for a specific focus on Information Technology (IT) governance (ITGI, 2003:6). According to the ITGI, IT governance is "the responsibility of executives and the board of directors, and consists of the leadership, organisational structures and processes that ensure that the enterprise's IT sustains and extends the organisation's strategies and objectives" (ITGI, 2008:11).

IT governance is a subset discipline of corporate governance and forms an integral part of an organisation's overall corporate governance (ITGI, 2003:6). The governance of technology is regarded as a critical aspect of corporate governance by the Institute of Directors Southern Africa (2016:6) in terms of King IV. Technology forms the platform for enabling business activities and has become an integral and pervasive aspect of any business. Although technological advancements are increasingly providing organisations with new opportunities, these changes also lead to incremental and significant risks of potential disruption (Institute of Directors Southern Africa, 2016:6).

King IV distinguishes between technology and information as distinct and separate contributors to value creation as both create unique risks and possibilities for an organisation (Institute of Directors Southern Africa, 2016:30). According to King IV, the overarching principle for the governance of technology and information is that the governing body should govern technology and information in a manner that supports the organisation in determining and reaching its strategic objectives (Institute of Directors Southern Africa, 2016:62).

The ITGI (2011:11) identified the principal objective of IT governance as ensuring that IT creates value for the organisation through the alignment of IT with its strategic objectives while mitigating potential IT-related risks. Adequate IT governance aims to drive these objectives through the strategic alignment between IT and the organisation and by enforcing accountability in the organisation. Additionally, the achievement of an organisation's strategic objectives requires the adequate allocation of resources and the monitoring of results (ITGI, 2003:19; ITGI, 2008:11).

The ITGI identified the following five focus areas of IT governance: strategic alignment, value delivery, risk management, resource management and performance measurement (ITGI, 2003:17; ITGI, 2008:11; ITGI, 2011:7). Numerous authors in academic literature have recognised these five focus areas as significant enablers of IT governance (Li *et al*., 2017:270; De Haes *et al.*, 2013b:318; Wilkin & Chenhall, 2010:107). The five focus areas of IT governance are described below:

- **Strategic alignment:** Strategic alignment should ensure that IT delivers business value through the alignment of IT strategies and plans with strategic business objectives. As the foundation of IT governance, strategic alignment should drive the direction of the other focus areas including, *inter alia,* ensuring that investments in IT provide business value and driving tactical plans for risk- and resource management (Wilkin & Chenhall, 2010:113).

- **Value delivery**: Value delivery evaluates the ability of IT to create new business value, maintain and enhance existing value and eliminate endeavours and assets that are not creating value sufficiently (ITGI, 2008:11). It involves, *inter alia,* strategically evaluating the opportunities, risks and impact of IT investments on business processes throughout the IT life cycle (Wilkin & Chenhall, 2010:126).

- **Risk management:** Risk management directs IT's role in managing business risks and addresses the mitigation of IT-related risks (ITGI, 2008:12). It addresses the management of IT-related events that can potentially influence the business and that can prevent the organisation from meeting its strategic objectives. Risk categories include, *inter alia*, IT benefit/value enablement, IT solutions' contribution to business value, IT project delivery and IT service delivery (ISACA, 2009:7).

- **Resource management**: Resource management focuses on the formulation, execution and adherence to budgets, processes and tactical plans for the implementation of IT strategies to support the business strategy. It involves the skills, human resources technologies, applications and data required to fulfil an organisation's business requirements (Wilkin & Chenhall, 2010:122).

- **Performance measurement:** Performance management involves the monitoring of the achievement of the organisation's objectives, as determined by the above focus areas, and monitoring the organisation's compliance with predefined external requirements (ITGI, 2008:12).

3.4.3 The governance of software projects

Significant financial resources are wasted because of poor project performance resulting from the failure of organisations to bridge the gap between the design and execution of their business strategy (PMI, 2018:2). The effective governance of software projects is a critical tool for both aligning projects' objectives with the business strategy and for executing the business strategy through projects (PMI, 2018:3; Musawir *et al.*, 2016:7). The ITGI (2011:7) support this few by finding that effective IT governance, including the governance of software projects, can assist organisations in increasing the success rates of software projects.

Although governance has been a research topic for decades, there has been a significant focus on project governance in recent years as organisations recognise the need for oversight mechanisms to control, support and monitor projects to meet their strategic goals (Khan, 2012:6). King IV explicitly states that the ongoing oversight of the management of technology and information should result in "the assessment of value delivered to the organisation through significant investments in technology and information, including the evaluation of projects throughout their life cycles and significant operational expenditure" (Institute of Directors Southern Africa, 2016:62). IT projects can only create value for organisations if their benefits and outcomes are aligned with the organisation's strategy (Musawir *et al.*, 2016:7). This suggests that the governance of software projects represents a significant dimension of an organisation's overall IT governance.

The Project Management Institute (2016), as referenced by Musawir *et al.* (2016), defines project governance as the "framework, functions, and processes that guide project management activities in order to create a unique product, service, or result to meet organisational strategic and operational goals." Alie (2015) and Rincon (2012) state that the governance of software projects needs to be aligned with IT governance principles to support the achievement of business/IT alignment. The implementation of IT governance principles, in turn, plays a prominent part in promoting IT project success and creating business value from IT projects (Bowen, Cheung & Rohde, 2007:191; ITGI, 2011:7).

Organisations, however, often invest in IT projects and activities that contravene good IT governance principles. According to the ITGI (2008:9), IT-enabled changes that are delivered late, exceed the budget and fail to meet business requirements indicate poor IT oversight. On the one hand, numerous organisations designate a large portion of IT spending to the post-implementation maintenance and operational costs associated with non-value-adding legacy systems that can diminish the budget remaining for investments in strategic IT initiatives. On the other hand, when organisations do invest considerably in strategic initiatives, they often fail to deliver the required outcomes (ITGI, 2008:9). A global survey conducted by the ITGI indicated that the problematic implementation of new IT systems is a prevalent challenge affecting the quality of IT governance in organisations (ITGI, 2011:20).

From the above, it is apparent that investments in software are essential strategic assets for organisations. Consequently, the effective governance of software projects is critical for supporting the aforementioned IT governance focus areas, namely value delivery, strategic alignment, risk management, resource management and performance management. This can in turn mitigate the risks of software project failure (Boshoff, 2014). The following findings of a global survey of 834 business executives and IT managers, conducted by the ITGI (2011:7), support this statement:

- Participants viewed the alignment of IT functionality with business requirements as the primary driver of governance activities.
- Nine out of ten respondents found that the value of IT investments is one of the most critical areas of IT's contribution to their organisation.
- The effective governance of enterprise IT can help to increase the success rates of IT projects by, for example, addressing the criteria for the selection, approval and governance of projects.

3.5 Business/IT Alignment

3.5.1 Basic business assumptions defined

The basic business assumptions of an organisation are those critical objectives that are necessary for an organisation to perform its day-to-day operations within its specific business context. Such objectives include, *inter alia*, proper accounting and internal controls and the accuracy of data (Boshoff, 2014).

3.5.2 Business imperatives defined

The role of business imperatives in driving an organisation's IT strategy extends beyond basic business assumptions. The business imperatives of an organisation are those unique drivers of an organisation of which the successful execution is critical for achieving a competitive advantage and for meeting the organisation's strategic objectives (Boshoff, 2014).

3.5.3 IT architecture defined

ISACA (n.d.) defines IT architecture as the "description of the fundamental underlying design of the IT components of the business, the relationships among them, and the manner in which they support the enterprise's objectives". The IT architecture of an organisation comprises the conceptual design of the specific IT components, such as data, application software and infrastructure, and addresses the interdependencies between those IT components. This conceptual design directs the organisation's decisions regarding applications and the technical IT infrastructure required by the chosen applications. Furthermore, the IT architecture should set out the plan for the integration of the chosen applications (Boshoff, 2014).

3.5.4 The achievement of business/IT alignment

As previously stated, the principal goal of IT governance is to achieve improved business/IT alignment (De Haes & Van Grembergen, 2009:124). Boshoff (2014) argues that the design of all the IT components in the IT architecture should be aligned with an organisation's unique business imperatives to ensure that IT supports the achievement of the business strategy. Principle 12.15 of the King IV report supports this argument by stating that the ongoing oversight of the management of technology should result in "a technology architecture that enables the achievement of strategic and operational objectives" (Institute of Directors Southern Africa, 2016:63). According to Tallon (2007:228), strategic alignment, defined as the interaction and fit between the business strategy and the IT strategy, is critical for IT to create business value for organisations.

Tallon (2007:228) argues that strategic business/IT alignment continues to be a challenge for organisations due to the complex nature of both the business strategy and the IT strategy as the building blocks of alignment. Boshoff (2014) argues that organisations need to consider the IT governance focus areas within the following contexts to achieve business/IT alignment:

- **Business context:** The business context is influenced by an organisation's specific industry, business strategy, business model and related business processes. The business context is driven by an organisation's unique business imperatives together with the basic business assumptions underlying to the organisational environment (Boshoff, 2014).

- **Strategic IT context:** The strategic IT context involves identifying where the organisation is positioned in terms the evolution of IT, thus the maturity level of the organisation in adopting new technologies and managing the related changes, as well as the strategic direction of the organisation for implementing IT in the long term.

- **Operational IT context:** The operational IT context comprises the governance and the management of the individual technology components that form part of an organisation's IT architecture to support an organisation's business requirements and ultimately the business strategy.

It is apparent from the above that alignment needs to be achieved within multiple levels to ultimately achieve an organisation's strategic objectives (Boshoff, 2014). Various authors support the view that alignment at both a strategic and an operational level is required to ultimately achieve business/IT alignment within an organisation (ITGI, 2003:10; Tarafdar &

Qrunfleh, 2009:338, Rahimi *et al.*, 2016:148). Business/IT alignment at these two levels will be further explained below within the context of software projects.

3.5.5 Business/IT alignment in software projects

Strong and Volkoff (2010:732) describe alignment at an application software level as the fit between the implemented software and the multiple dimensions of an organisation's operations. Similarly, Shiang-Yen *et al.* (2013:60) define this fit as the alignment between the requirements of a particular task and the capabilities of software to support those requirements.

As discussed previously, software projects can only be successful and create value if the capabilities of the implemented software support an organisation's strategic objectives. Various studies have found that the alignment between an organisation's business strategy and IT capabilities positively influences users' perceived success of the performance of both the organisation and IT (Tarafadar & Qrunfleh, 2007:339; Rahimi *et al*., 2016:146; Tallon, 2007:228). Li *et al.* (2017:273) corroborate this view by arguing that strategic alignment is the most critical factor contributing to the success of software implementations.

The alignment of software capabilities with business requirements at both a strategic and operational level is critical for mitigating the risks of software project failure (Tarafdar & Qrunfleh, 2009:339). To achieve this, an organisation's unique business imperatives should be used as the drivers to achieve alignment between business and IT at both of the above levels (Boshoff, 2014; Tallon, 2007:228). This includes, *inter alia,* decision-making regarding the selection of applications, the design of the application architecture and the configuration of applications to support the strategic objectives of the organisation (Boshoff, 2014). Business/IT alignment in software projects will be further discussed below for each of these two levels, namely strategic and operational.

3.5.5.1 Business/IT alignment in software projects at a strategic level

Tarafdar and Qrunfleh (2009:339) describe business/IT alignment at a strategic level as the fit between an organisation's business strategy and the scope of IT, including processes associated with planning and the selection of software that is appropriate for achieving the organisation's strategic objectives. At the strategic level, close collaboration between business- and IT specialists should drive the translation of the business strategy into the IT strategy and guide decisions regarding the design of the IT architecture and investments in IT (Rahimi *et al*., 2016:148).

It is critical for strategic-level considerations regarding the IT architecture and significant investments in software to include the design of the application architecture prior to the commencement of software projects (Boshoff, 2014). Application architecture refers to the "logical grouping of capabilities that manage the objects necessary to process information and support the enterprise's objectives" (ISACA, n.d.). Proactive planning for the application architecture may decrease the risks of software project failure by preventing subsequent changes to the design of applications and by supporting the achievement of strategic objectives throughout the life cycle of projects (Boshoff, 2014).

Siah and Soh (2007:581) corroborate this view by emphasising the importance of identifying significant misalignments between software capabilities and business requirements at an early stage during the selection and evaluation of software. The early identification of potential misalignments is necessary to make well-grounded decisions regarding the adoption of software. These decisions include, *inter alia*, the scope of required customisation, the scope of organisational change, the allocation of adequate resources and the implementation of sufficient change management practices (Siah and Soh, 2007:581).

3.5.5.2 Business/IT alignment in software projects at an operational level

While alignment at a strategic or planning level drives the alignment between the business- and IT strategies, alignment at an operational level ensures that the strategically planned design of the IT architecture and applications are successfully and effectively implemented (Rahimi *et al*., 2016:148; Tarafdar & Qrunfleh, 2009:339).

Tallon (2007:228) and Rahimi *et al*. (2016:142) argue that, as an organisation's business strategy is executed through a unique mix of business processes, the first impact of IT is on a business process level. Consequently, alignment at the process-level is required for IT investments to support the business strategy and create business value for organisations. While IT governance mechanisms coordinate decision-making regarding business and IT, business processes and their related information requirements link the business strategy to business requirements and IT capabilities at an operational level (Rahimi *et al*., 2016:146; Tallon, 2007:229).

Based on the above, operational-level alignment in software projects represents the fit between an organisation's business processes and the ability of applications, including the configuration of applications, to support those business processes in executing the business strategy (Tallon, 2007:255). The use of application software to effectively support production and delivery processes in a manufacturing environment may, for example, lead to a shorter time-to-market and higher customer satisfaction (Tallon, 2007:238).

To achieve alignment at the process- or operational level as described above, Boshoff (2014) argue that an organisation's unique business imperatives should drive the alignment between software capabilities and business requirements. This approach ensures that the business processes of an organisation, through which the business strategy is executed, and the related information requirements of those processes are translated into technical specifications when selecting, integrating and configuring applications (Lee, Siau & Hong, 2003:57). This view is supported by Tallon (2007:227), who argues that an organisation's unique strategic focus areas should drive the alignment between the critical business processes that execute the business strategy and the required applications and configurations needed to support those business processes.

As the business imperatives of different organisations in various industries are unique, the required level of integration and the direction of integration between software capabilities and business processes will be different for each particular organisation (Rahimi *et al*., 2016:142; Tarafadar & Qrunfleh, 2007:340). For certain organisations, software implementations may drive business process reengineering and business process innovation through the adaptation of an organisation's existing business processes, procedures and rules to fit the implemented software. This approach can enable organisations to exploit innovative technologies, implement industry best practices embedded in applications and avoid the high costs of software modification (Rahimi *et al*., 2016:142). Other organisations may follow an approach of software modification that requires changes to applications' source code to enable the software to fit an organisation's existing business processes (Shiang-Yen *et al*., 2013:59). This approach can enable IT to support those unique business processes that give a particular organisation a competitive advantage.

It is apparent from the above that the alignment between an organisation's software capabilities and business requirements at a strategic and operational level plays a fundamental role in obtaining business value from IT investments, achieving an organisation's business strategy and mitigating the risks of software project failure. Control frameworks can provide organisations with guidance for implementing IT governance principles to achieve the above business/IT alignment.

3.6 Control frameworks

3.6.1 The role of control frameworks in implementing IT governance

The focus on the governance and management of IT has increased as organisations are progressively relying on IT for the creation of business value. In a study performed by Weil and Ross (2004:6), comprising the evaluation of the IT governance practices of over 250 multi-business organisations, it was found that the effective design of IT governance can enable organisations to gain improved returns on their IT investments and deliver superior firm performance. As a result, organisations are often looking to the guidance provided by industry frameworks for the governance and management of enterprise IT (De Haes, Huygh, Joshi & Van Grembergen, 2016:50).

Various such frameworks, best practices, methodologies, policies and standards exist which can be used as tools for organisations to implement IT governance principles (Boshoff, 2014). The ITGI (2008:17) argues that it is almost impossible for organisations to implement effective IT governance without the use of an effective governance framework. Such frameworks should direct decision-making, monitor results and ensure that corrective actions are taken when the required results are not realised (ITGI, 2008:17). The above frameworks further provide standard best practices and guidance to support organizations in implementing various processes and procedures for governing IT (Mangalaraj, Singh & Taneja, 2014:1).

3.6.2 Selection of the COBIT 5 framework for the purpose of this study

As previously discussed, the implementation of IT governance frameworks can assist organisations in implementing governance principles to align their IT strategy with their business strategy.

Many organisations use generic frameworks, specific to project management methodology, such as Project Management Body of Knowledge (PMBOK) and Projects in Controlled Environments, Version 2 (PRINCE 2), to assist them in managing projects (KPMG, 2017). These methodologies, however, pertain to project management in general and do not specifically cover all the domains of IT governance, including strategic business/IT alignment and value delivery, in organisations. The results of a project management survey conducted by KPMG (2017:17), for instance, indicate that while 80% of respondents confirmed their use of more than one project management methodology in their organisations, most commonly PRINCE 2, only 21% of organisations' projects were consistently delivering the planned benefits. The findings of a study conducted by Kruger and Rudman (2013:1250) further support this view by indicating that the PRINCE 2 framework does not address the issues regarding strategic alignment of an organisation's business processes with the functionality of software.

From the above, it is apparent that the application of generic project management methodologies, such as PMBOK and PRINCE 2, is not appropriate for the purpose of this study, as it does not adequately address the role of IT governance in achieving business/IT alignment in software projects. Mangalaraj *et al.* (2014:1) argue that organisations need a comprehensive framework that addresses all dimensions of IT governance, such as aligning the IT strategy with the business strategy, managing resources effectively, designing appropriate controls and preventing issues relating to software errors. An example of such a comprehensive framework is the Control Objectives for Information and Related Technology (COBIT) framework (De Haes, Huygh, Joshi & Van Grembergen, 2016:50; Mangalaraj *et al.*, 2014:1).

According to the ITGI (2008:17), the successful application of the processes defined by COBIT can assist organisations to significantly improve IT governance and the return on their investments in IT. Multiple authors have recognised the increasing popularity of COBIT-based implementations as COBIT is the framework of choice for the governance and management of IT in numerous organisations (De Haes *et al*., 2016:50). Both Mangalaraj *et al*. (2014:1) and De Haes *et al*. (2016:50) emphasise the importance of studying COBIT as a prominent IT governance framework, as it's principles are directly aligned with the focus areas of IT governance and is therefore highly relevant to information systems research.

COBIT 5 is designed to be a single integrated framework that can be used for both the management and governance of IT (ISACA, 2012; Ahriz, El Yamami, Mansouri & Qbadou, 2018:94). While the focus of most other frameworks is only on certain IT domains, such as service delivery and information security, the COBIT framework addresses all IT domains. COBIT can therefore act as an integrator of other relevant standards, frameworks and practices to enable improved business/IT alignment (ITGI, 2011:49). De Haes, Debreceny and Van Grembergen (2013a:5) support the above view by stating that many of the processes in COBIT 5 are aligned to other frameworks such as PMBOK, PRINCE 2 and IT Infrastructure Library (ITIL).

COBIT 5, as a single integrated framework, further classifies its underlying processes into governance processes and operational-level management processes. Ahriz *et al.* (2018:94) found that the COBIT 5 framework is therefore valuable to address the governance and management of IT projects at both a strategic and operational level. The Align, Plan and Organise (APO) domain of COBIT 5, for instance, addresses the alignment of IT investments with the strategic goals of an organisation as well as the management of IT projects on an operational level (Ahriz *et al.*, 2018:94).

In conclusion, based on the following factors discussed above, COBIT 5 is regarded as the most appropriate framework for the purpose of this research:

- Numerous unique characteristics and risks are intrinsic to software projects. A governance framework that is specific to the governance of IT, such as COBIT 5, is therefore required to address those unique characteristics.
- The inability of software to create business value, resulting from the misalignment between software capabilities and the business requirements of an organisation, was found to be the most significant factor contributing to software project failure. According to De Haes *et al.* (2013a:1), the achievement of strategic alignment between IT- and organisational goals is a core element of the COBIT framework. COBIT 5 further

specifically addresses the IT governance area of value creation through the alignment of investments in IT, such as software implementation projects, with the business strategy of an organisation.

- In addition to specifically addressing business/IT alignment, COBIT 5 integrates the guidance and best practices provided by other recognised project management methodologies, such as PRINCE 2 and PMBOK, into its underlying processes.
- COBIT 5 distinguishes between processes at a governance level and a management level, which provides organisations with comprehensive guidance for governing and managing software projects throughout their life cycles.

3.6.3 An overview of the COBIT framework

COBIT, developed by ISACA, is a globally recognised framework that executives of all enterprises can use to promote IT's contribution in achieving their goals and objectives (ITGI 2008:17). The fifth edition of the framework, COBIT 5, is "a comprehensive framework of globally accepted principles, practices, analytical tools and models that can help any enterprise effectively address critical business issues related to the governance and management of information and technology" (ISACA, 2012). The framework addresses business challenges in the domains of risk management, regulatory compliance and the alignment of the IT strategy with organisational goals (ISACA, n.d.).

In COBIT 5, governance is defined as "ensuring that stakeholder needs, conditions and options are evaluated to determine balanced, agreed-on enterprise objectives to be achieved; setting direction through prioritisation and decision-making; and monitoring performance and compliance against agreed-on direction and objectives" (COBIT 5, as referenced by Preittigun, Chantatub & Vatanasakdakul, 2012:582).

The COBIT 5 framework provides 37 processes, categorised into five IT domains, for enabling the governance and management of IT at both a strategic and operational level (ISACA, 2012). COBIT 5 indicates that the governance processes, driven by an organisation's strategic objectives, should direct the management processes, while the management processes should, in turn, provide feedback on how well these directions are executed (Preittigun *et al*., 2012:582). Through the above domains and enabling processes, COBIT 5 therefore supports the alignment of the IT strategy with an organisation's strategic goals.

To address the issue of how organisations can achieve business/IT alignment, the COBIT 5 framework suggests that organisations should start by identifying, defining and aligning their enterprise goals to IT-related goals (De Haes *et al.*, 2013b:312). The guidance provided by COBIT 5 is, however, comprehensive and generic. Consequently, this results in a lack of guidance for how organisations in different industries can practically implement IT governance processes to achieve business/IT alignment within their unique contexts (De Haes *et al*., 2013b:312; Ahriz *et al*., 2018:94; Bernroider & Ivanov, 2011:325). Boshoff (2014) suggests that this lack of guidance can be addressed by using an organisation's unique business imperatives to align their business requirements with IT capabilities at a strategic and operational level.

In Chapter 4 the detailed processes and IT domains in the COBIT 5 framework will be further discussed and applied to address software project failure.

3.7 Summary of historic research and conclusion

Despite substantial academic research performed to identify and analyse the failure factors associated with software projects, the failure of these projects remains a frequent occurrence (Hughes *et al*., 2016:1314). Hughes *et al*. (2016:1314) argue that a gap still exists in both academics' and practitioners' understanding of the complex characteristics of the above failure factors and the relationships between those factors in contributing to project failure in organisations. Dwivedi *et al*. (2015:147) further state that existing research on this subject often fails to consider the impact of different organisations' unique context on the success of software implementations.

The misalignment between an organisation's business requirements and the capabilities of software to support those business requirements was identified as the most significant factor contributing to software project failure. Although past research has placed a strong focus on the role of project management in addressing software project failure, it was found that the implementation of project management methodologies alone does not sufficiently address the issues of value delivery and business/IT alignment in mitigating the risks of such failure.

Numerous studies have emphasised the importance of IT governance in supporting business/IT alignment and ensuring the success of software implementation projects. Furthermore, it is apparent from the literature review that control frameworks can provide a critical foundation for the implementation of IT governance. Various authors have, however, recognised a gap in research regarding practice-based guidance for the implementation of IT governance principles to accomplish business/IT alignment at both a strategic and operational level (De Haes *et al*., 2013b:312; Ahriz *et al*., 2018:94; Bernroider & Ivanov, 2011:325; Rahimi *et al*., 2016:142; Tarafdar & Qrunfleh, 2009:339).

The COBIT 5 framework was identified as the most appropriate framework for the purpose of this study as it specifically addresses the misalignment between software capabilities and business requirements as the most significant reason for software project failure. However, based on a detailed review of existing literature, it was found that few studies apply the COBIT 5 framework to address software project failure and the governance of software projects. The following two authors support this gap in historic research:

- Mangalaraj *et al*. (2014:7) found that, while a number of articles focused on the role of COBIT with regard to internal control and compliance, there is only a limited focus on the application of COBIT in the domain of IT governance.
- In a study of the relationship between IT project failure factors, Hughes *et.al* (2016:1330) highlighted the importance of future studies to align failure factors with a specific project methodology to gain a better understanding of those factors.

Based on the above, the achievement of both strategic- and operational-level alignment between software and business requirements remains elusive, despite extensive research performed on the subject. A structured approach, based on IT governance principles, is therefore required to provide organisations with practical guidance for addressing software project failure by preventing the misalignment between software capabilities and business requirements at a strategic and operational level. The literature review performed in Chapter 3 created the foundation for the development of the structured approach in Chapter 4. In Chapter 4, the COBIT 5 framework formed the basis for identifying and addressing potential failure factors that can contribute to software project failure at a strategic and operational level. Furthermore, a list of generic business imperatives, mapped to the recommended software requirements needed to achieve those business imperatives, is provided to practically assist organisations in achieving business/IT alignment in software projects and, as a result, mitigate the risks of software project failure.

CHAPTER 4: FINDINGS ON THE DEVELOPMENT OF A STRUCTURED APPROACH TO ADDRESS APPLICATION SOFTWARE PROJECT FAILURE

4.1 Introduction

As previously discussed, the implementation of IT governance principles is critical for managing software projects in a manner that supports an organisation's strategic objectives and for ensuring that software delivers value to an organisation. The effective implementation of IT governance can therefore assist organisations in mitigating the potential risks of software project failure (Rincon, 2012; Boshoff, 2014). The aim of this study is to develop a structured approach to the application of IT governance principles to address potential failure factors that can contribute to software project failure at a strategic and operational level. The research methodology as described in section 2.2 was applied to develop the above structured approach, of which the findings will be discussed in the remainder of this chapter.

4.2 The identification of potential failure factors associated with software project failure at a strategic and operational level

4.2.1 Identification of the applicable COBIT 5 processes

COBIT 5 was selected as the most appropriate framework for implementing IT governance principles to address software project failure. The review and application of the COBIT 5 framework therefore formed the foundation for developing the aforementioned structured approach.

A detailed review of the 37 processes of COBIT 5 and related governance practices was performed to determine which processes, referred to as the "applicable COBIT 5 processes", address software project failure. This review was based on the definition of software project failure assigned to this concept for the purposes of this study, namely the misalignment between an organisation's business requirements, which are driven by the business strategy, and the capabilities of software needed to support those business requirements. To determine the relevance of a specific process to software project failure, the process description, process purpose statement and related governance practices in COBIT 5 were reviewed. The findings and detail considerations of the above review process are documented in the Appendix, which resulted in the identification of 30 applicable COBIT 5 processes that cover both the governance and management of IT on a strategic and operational level. As previously discussed, COBIT 5 is a comprehensive framework that covers all aspects of IT governance. For this reason, the processes that do not specifically address software project failure were not included in the Appendix.

4.2.2 Application of the applicable COBIT 5 processes to identify potential failure factors associated with software project failure

As previously discussed, the identification of potential failure factors that can contribute to software project failure can assist organisations in mitigating the risks of such failure. This can be achieved by using a set of potential failure factors as guidelines for identifying risks early in the project life cycle and avoiding past mistakes to consequently mitigate the risks of software project failure (Hughes *et al*., 2016:1313, Ravasan & Mansouri, 2016:66; Dwivedi *et al*., 2015:145; Wong *et al*., 2005). Hughes *et al*. (2016:1330) further state that the alignment of potential failure factors with existing frameworks and methodologies can further assist organisations in the early identification of the risks of software project failure.

Based on the above, the applicable COBIT 5 processes, as presented in the Appendix, were applied to identify failure factors that may contribute to software project failure. The purpose of this approach is to ensure the inclusion of all significant failure factors and to provide organisations with practical guidance for how COBIT 5 can be applied to address software project failure. This procedure resulted in the identification of 47 potential failure factors, which are presented in Table 4.1.

Table 4.1: Identification of potential failure factors that can contribute to software project failure

Failure factors		Sources
F1	Inadequate executive support, commitment and project sponsorship	Hughes *et al*., 2016:1318; Kruger & Rudman, 2013:1248; Ewusi-Mensah, 2003:56; Hughes, Dwivedi & Rana, 2017:780; Panorama Consulting Solutions, 2018; Ravasan & Mansouri, 2016:69; Nelson, 2007:71; Wallace, Keil & Rai, 2004:117; Aloini, Dunlin & Mininno, 2012:193
F2	Insufficient strategic planning regarding the fit between software capabilities and the business strategy	Kruger & Rudman, 2013:1248; ITGI, 2011:21; Panorama Consulting Solutions, 2018; Ravasan & Mansouri, 2016:69; Jagoda & Samaranayake, 2017:94; Nelson, 2007:71; El-Telbany and Elragal, 2014:259; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F3	Poor definition of the business case, strategic goals and benefits realisation plan	Hughes *et al*., 2016:1319; Kruger & Rudman, 2013:1248; Hughes *et al*., 2017:780; Panorama Consulting Solutions, 2018; Ravasan & Mansouri, 2016:69
F4	Inappropriate software selection and insufficient evaluation of technical software capabilities prior to implementation (e.g., functionality, scalability, portability, user-friendliness, interoperability, modularity, simple upgradeability, flexibility, security, data accuracy and complete procedure manuals)	Ewusi-Mensah, 2003:56; Aloini *et al*., 2012:193
F5	Insufficient involvement of stakeholders and key users	Hughes *et al*., 2016:1328; Kruger & Rudman, 2013:1248; Ewusi-Mensah, 2003:56; Hughes *et al*., 2017:780; Klaus & Blanton, 2010; Ravasan & Mansouri, 2016:69; Nelson, 2007:71; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F6	Lack of mutual decision-making and collaboration between business and IT that reflect business requirements and IT's specialised knowledge	El-Telbany and Elragal, 2014:259
F7	Significant business process reengineering and organisational adaptation is required that contravenes the organisation's business imperatives	Klaus & Blanton, 2010; Zaitar & Ouzarf, 2012:36; Ravasan & Mansouri, 2016:69; Strong & Volkoff, 2010:737; Shiang-Yen *et al*., 2013:66

Failure factors		Sources
F8	Poor financial management regarding the project budget	Hughes *et al*., 2016:1320; Ewusi-Mensah, 2003:56; ITGI, 2011:21; Panorama Consulting Solutions, 2018; Aloini *et al*., 2012:193
F9	Inadequate evaluation and planning for IT solution feasibility during the pilot phase	Hughes *et al*., 2016:1332; Nelson, 2007:71
F10	Inadequate strategic project risk management of technical risks (e.g., software capabilities in terms of integration, interoperability, security, scalability and retrofit risk)	Hughes *et al*., 2016:1324; Kruger & Rudman, 2013:1248; Ravasan & Mansouri, 2016:69; Nelson, 2007:71
F11	High level of project complexity due to significant project size or scope, large number of users or distributed nature of the organisation	Hughes *et al*., 2016:1323; Kruger & Rudman, 2013:1248; Hughes *et al.*, 2017:780; Zaitar & Ouzarf, 2012:36; Nelson, 2007:71; Wallace *et al*., 2004:117
F12	High level of technical complexity (e.g., new technology, complex architecture, complex business processes, multiple modules or significant integration with other systems)	Hughes *et al*., 2016:1323; Hughes *et al*., 2017:780; Zaitar & Ouzarf, 2012:36; Nelson, 2007:71; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F13	Lack of organisational readiness for change and new technologies	Klaus & Blanton, 2010; Ravasan & Mansouri, 2016:69; Jagoda & Samaranayake, 2017:94
F14	Insufficient planning and management of required resources	Kruger & Rudman, 2013:1248; Wallace *et al*., 2004:117
F15	Insufficient evaluation of external contractor performance, skills and stability	Hughes *et al.*, 2017:780; Panorama Consulting Solutions, 2018; Aloini *et al*., 2012:193
F16	Poor relationship between external contractors and the organisation, including inadequate knowledge transfer	Hughes *et al*., 2016:1317; Kruger & Rudman, 2013:1248; Hughes *et al.*, 2017:780; Zaitar & Ouzarf, 2012:36; Ravasan & Mansouri, 2016:69; Nelson, 2007:71
F17	High team member turnover (i.e. key staff leaving the project or added late to a project)	Hughes *et al*., 2016:1333; Nelson, 2007; Wallace *et al*., 2004:117
F18	Inappropriate composition of project team members (e.g., differences in skills or expertise and inadequate involvement from both IT and business)	Ewusi-Mensah, 2003:56; Ravasan & Mansouri, 2016:69; Wallace *et al*., 2004:117

Failure factors		Sources
F19	Lack of understanding, skills or technical competence of team members and poor team performance	Hughes *et al*., 2016:1321; Kruger & Rudman, 2013:1248; Ewusi-Mensah, 2003:56; Hughes *et al.*, 2017:780; Zaitar & Ouzarf, 2012:36; Ravasan & Mansouri, 2016:69; Nelson, 2007:71; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F20	Poor communication between the organisation and stakeholders, project teams, users and external contractors	Hughes *et al*., 2016:1328; Kruger & Rudman, 2013:1248; Hughes *et al.*, 2017:780; Klaus & Blanton, 2010; Ravasan & Mansouri, 2016:69; Aloini *et al*., 2012:193
F21	Poor staff commitment or ownership, teamwork and performance	Hughes *et al*., 2016:1321; Kruger & Rudman, 2013:1248; Hughes *et al.*, 2017:780; Ravasan & Mansouri, 2016:69; Nelson, 2007:71; Wallace *et al*., 2004:117
F22	Poor technical project management- and implementation methodology and documentation	Hughes *et al*., 2016:1325; Kruger & Rudman, 2013:1248; Ewusi-Mensah, 2003:56; Hughes *et al.*, 2017:780; Panorama Consulting Solutions, 2018; Ravasan & Mansouri, 2016:69; Nelson, 2007:71; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F23	Inadequate, incorrect or conflicting definition of requirements and scope (e.g., incorporation of new technologies or requirements that do not support the business case)	Hughes *et al*., 2016:1326; Kruger & Rudman, 2013:1248; Hughes *et al.*, 2017:780; Panorama Consulting Solutions, 2018; Nelson, 2007:71; Wallace *et al*., 2004:117
F24	Inadequate management and documentation of changes in requirements or scope during the project life cycle	Hughes *et al*., 2016:1327; Ewusi-Mensah, 2003:56; ITGI, 2011:21; Nelson, 2007:71; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F25	Insufficient business process reengineering	Kruger & Rudman, 2013:1248; Panorama Consulting Solutions, 2018; Ravasan & Mansouri, 2016:69; Aloini *et al*., 2012:193
F26	Inadequate or inappropriate software design (e.g., technical structure and reporting requirements)	Nelson, 2007:71
F27	Incorrect or inappropriate configuration, allocation of access right or set-up of parameters, rules and chart of accounts	Kruger & Rudman, 2013:1248; Klaus & Blanton, 2010; Zaitar & Ouzarf, 2012:36; Ravasan & Mansouri, 2016:69

Failure factors		Sources
F28	A lack of software functionality or flexibility required to tailor software to an organisation's business processes, resulting in workarounds (functionality misfit)	Klaus & Blanton, 2010; Zaitar & Ouzarf, 2012:36; Strong & Volkoff, 2010:737; Shiang-Yen *et al*., 2013:66; Le Roux, 2015: 66
F29	Significant modification of software functionality by changing the source code leads to increased complexity, risks of errors and problematic future updates (functionality misfit)	Zaitar & Ouzarf, 2012:36; Ravasan & Mansouri, 2016:69; Shiang-Yen *et al*., 2013:66
F30	Embedded integration, standardisation or strict, predefined workflow of software creates a misalignment between software functionality and the organisational structure and related business processes (functionality misfit)	Strong & Volkoff, 2010:737; Le Roux, 2015: 69
F31	Master data lack the data fields and level of detail required for extracting data and supporting the organisation's business processes (data misfit)	Ravasan & Mansouri, 2016:69; Strong & Volkoff, 2010:737; Shiang-Yen *et al*., 2013:66; Le Roux, 2015: 71
F32	Data characteristics of software result in data quality issues, e.g., inaccuracy, inconsistency or inappropriate data for users' needs (data misfit)	Ravasan & Mansouri, 2016:69; Shiang-Yen *et al*., 2013:66
F33	Embedded integration and standardisation of software requires consistent data field definitions that are misaligned with data requirements of different business units (data misfit)	Ravasan & Mansouri, 2016:69; Strong & Volkoff, 2010:737; Shiang-Yen *et al*., 2013:66; Le Roux, 2015: 73
F34	Users' interaction with software is experienced as complicated or cumbersome, requiring non-value-adding tasks (usability misfit)	Klaus & Blanton, 2010; Strong & Volkoff, 2010:737; Le Roux, 2015: 74
F35	User interfaces of software lack the required data fields and reports needed for data capture and decision-making (usability misfit)	Strong & Volkoff, 2010:737; Shiang-Yen *et al*., 2013:66; Le Roux, 2015: 75
F36	Overly complex presentation of data due to the integration of application areas between different business units (usability misfit)	Strong & Volkoff, 2010:737; Shiang-Yen *et al*., 2013:66; Le Roux, 2015: 76
F37	User roles required by software are incompatible with the availability of skills or contravenes workloads specified by the organisational structure (role misfit)	Klaus & Blanton, 2010; Strong & Volkoff, 2010:737; Le Roux, 2015: 77

Failure factors		Sources
F38	Software does not support the setup of roles or access rights according to the organisation's required level of accountability and authority (role misfit)	Strong & Volkoff, 2010:737; Le Roux, 2015: 78
F39	An imbalance between software's rigid enforcement of embedded controls or workflow and the normal level of control and sequence of processes required by the organisation (control misfit)	Klaus & Blanton, 2010; Strong & Volkoff, 2010:737; Le Roux, 2015: 80
F40	Weak post-mortem process (i.e. a lack of commitment to learn from past failures)	Hughes *et al*., 2016:1322; Hughes *et al*., 2017:780
F41	Employee resistance to accepting new project initiatives, technologies, processes and system changes	Hughes *et al*., 2016:1329; Klaus & Blanton, 2010; Zaitar & Ouzarf, 2012:36; Wallace *et al*., 2004:117; Le Roux, 2015: 66
F42	Lack of software testing and final user acceptance testing	Kruger & Rudman, 2013:1248; Ravasan & Mansouri, 2016:69; Aloini *et al*., 2012:193
F43	Lack of training or inappropriate training of users	Hughes *et al*., 2016:1334; Kruger & Rudman, 2013:1248Klaus & Blanton, 2010; Ravasan & Mansouri, 2016:69
F44	Lack of technical and organisational support for users	Klaus & Blanton, 2010
F45	Poor organisational change management	Hughes *et al*., 2016:1330; Kruger & Rudman, 2013:1248; Hughes *et al.*, 2017:780; Klaus & Blanton, 2010; Panorama Consulting Solutions, 2018; Zaitar & Ouzarf, 2012:36; Ravasan & Mansouri, 2016:69; Wallace *et al*., 2004:117; Aloini *et al*., 2012:193
F46	Insufficient performance measurement, quality control and status monitoring	Kruger & Rudman, 2013:1248; Ravasan & Mansouri, 2016:69
F47	Inadequate management of legacy systems and conversion of data	Aloini *et al*., 2012:193

4.2.3 The development of a matrix for aligning software project failure factors with the applicable COBIT 5 processes to address software project failure at a strategic and operational level

After identifying the potential failure factors, as shown in Table 4.1 above, a matrix was developed by mapping these factors to the applicable COBIT 5 processes. The detailed considerations are documented in the Appendix. Furthermore, the applicable COBIT 5 processes and related failure factors were further categorised according to the following two levels of business/IT alignment:

- **Strategic level:** Failure factors relating to the insufficient governance of software projects at a strategic level refer to the inadequate planning and selection of appropriate software, as an integral component of the overall IT architecture, required to achieve an organisation's strategic objectives. This includes inadequate consideration of the technical attributes of software (such as the application architecture, technical design and functionality) prior to the implementation of software (Rahimi *et al*., 2016:148; Tarafdar & Qrunfleh, 2009:339).

- **Operational level:** Failure factors relating to the insufficient management of software projects at an operational level comprises the failure to effectively execute the implementation of strategically planned applications to meet business requirements (Rahimi *et al*., 2016:148; Tarafdar & Qrunfleh, 2009:339). This includes the inability of software to support an organisation's unique mix of business processes, which are required to execute the business strategy, at an operational level (Tallon, 2007:255; Rahimi *et al*., 2016:146).

In addition to the above understanding of the two levels of business/IT alignment, namely the strategic and operational level, the following five COBIT 5 domains were also applied to categorise the identified failure factors according to these two levels:

- One governance domain: Evaluate, Direct and Monitor (EDM). The EDM domain includes five detailed processes (ISACA, 2012).
- Four management domains: Align, Plan and Organize (APO); Acquire and Implement (BAI); Deliver, Service and Support (DSS); and Monitor, Evaluate and Assess (MEA) (ISACA, 2012). The above management domains are categorised according to the IT life cycle and consist of 32 processes (Preittigun *et al*., 2012:582).

Certain failure factors, with a pervasive impact on software projects, were found to be applicable to both the strategic and operational level. COBIT 5, for instance, views certain management domains as being directly associated with the governance domain (Preittigun *et al*., 2012:582). Consequently, many of the failure factors associated with the management domains of COBIT 5 were found to be applicable to both the strategic and operational level.

Based on the findings of the above procedures, a matrix table was compiled, presented in Table 4.2, which aligns potential failure factors with the applicable COBIT 5 processes and further indicates the applicability of the particular failure factors to the strategic and/or operational level (indicated by "X" in Table 4.2). The findings, presented in Table 4.2, are further explained and summarised in section 4.2.3.1 and 4.2.3.2 below.

4.2.3.1 Insufficient governance of software projects at a strategic level

All failure factors relating to the governance domain of COBIT 5 (EDM) were found to apply to the strategic level of business/IT alignment. Certain processes in three of the management domains (APO, BAI, and MEA) relate to the identification of software requirements in line with strategic objectives, the sourcing of external contractors and the evaluation of project feasibility. Consequently, the failure factors associated with these processes were also found to apply to the strategic level as they pertain to the alignment of software capabilities with the organisation's strategic objectives.

In summary, the failure factors associated with the insufficient governance of software projects at a strategic level refer to inadequate measures taken to address the following areas (Boshoff, 2014):

- **Strategic alignment:** Inadequate strategic planning and decision-making regarding the alignment between software capabilities and the business strategy during the software selection and pre-implementation phases of software projects. This includes the poor evaluation of the technical software capabilities required to support business requirements (e.g., functionality, scalability, portability, user-friendliness, interoperability, modularity, upgradeability, flexibility and security).

- **Risk management:** Insufficient identification and management of the strategic risks associated with software project delivery. These risks relate to software capabilities in terms of integration, interoperability, security, scalability and retrofit risk (i.e. the ability to upgrade software without complications).

- **Value delivery:** Insufficient evaluation of the ability of software to create business value, which includes the inadequate assessment of the above strategic risks and the impact of software on an organisation's business processes.

- **Resource management**: Poor management of the skills, human resources (e.g., business executives, IT managers, the project team, key users and external contractors) and financial resources required for delivering software projects according to business requirements.

- **Performance measurement and status monitoring**: A lack of monitoring regarding software project quality and the extent to which software projects supports the achievement of strategic objectives throughout the project life cycle.

- **Organisational issues:** Inadequate change management practices or insufficient assessment of organisational readiness for software implementation.

4.2.3.2 Insufficient management of software projects at an operational level

The failure factors that were found to apply to the operational level relate to the following four management domains of COBIT 5, which are categorised according to the IT life cycle (Preittigun *et al*., 2012:582): APO, BAI, DSS and MEA. The following areas, relating to the insufficient management of software projects during the different phases of the project life cycle, were identified (Boshoff, 2014; Ravasan & Mansouri, 2016:66):

- **Planning and design of software:** The following aspects may give rise to failure factors during the planning and design phases of software projects:
  - Inadequate composition of the project team, including a lack of skills, which may result in a poor understanding of the technical- and business impact of the selected software.
  - Inadequate planning for how the organisational structure and business processes should be translated into the technical structure of the software (e.g., the workflow of tasks and number of modules required).
  - Inappropriate decision-making regarding whether an organisation should apply an approach of business process reengineering (i.e. the redesign of business processes

to fit the selected software) or an approach of customisation (i.e. the modification of software functionality to fit an organisation's existing business processes).

  - Insufficient consideration of the software in relation to the organisation's existing infrastructure and existing applications.
  - Poor planning for the requirements for master data, the chart of accounts, reporting requirements, the allocation of access rights (i.e. segregation of duties) and workflow to support the organisational structure and business requirements.

- **Building, configuring and setup of software:** Failure factors may arise from the following activities:
  - Inappropriate or incorrect configuration, allocation of access rights and setup of parameters, rules or chart of accounts that are misaligned with the organisational structure and business processes. This includes the misalignment between various technical capabilities of software (e.g., functionality, levels of detail for data, the setup of roles, workflow, built-in controls, user interfaces and usability) and an organisation's business requirements.
  - The inappropriate software selection at the strategic level that results in the inability to tailor software functionality embedded in the system (e.g., integration and strict embedded workflow) to an organisation's requirements and business processes at an operational level.
  - Problematic integration of software with existing applications.

- **Final implementation activities:** Problematic conversion of data from legacy systems, insufficient final user acceptance testing, inadequate training of users or insufficient management of employee resistance to the implemented changes.

- **"Go Live" and support:** Inadequate cut-off of legacy systems or a lack of technical and operational support for users.

- **Performance measurement:** A lack of monitoring of the implemented software's operational performance in terms of meeting user needs and supporting the organisation's business requirements.

Table 4.2: A matrix for aligning software project failure factors with the applicable COBIT 5 processes to address software project failure at a strategic and operational level

Process ID	Process (Appendix)	Mapped to failure factors (Table 4.1)	Strategic level	Operational level
Governance domain: Evaluate, Direct and Monitor (EDM)				
EDM01	Ensure Governance Framework Setting and Maintenance	F1, F2, F3, F4, F5, F6, F7	X	
EDM02	Ensure Benefits Delivery	F3, F8, F9	X	
EDM03	Ensure Risk Optimisation	F10, F11, F12	X	
EDM04	Ensure Resource Optimisation	F3, F8, F9, F13, F14, F15, F16	X	
EDM05	Ensure Stakeholder Transparency	F5, F6, F16, F20	X	
Management domain: Align, Plan and Organise (APO)				
APO01	Manage the IT Management Framework	F1, F6, F18, F19, F20, F21, F22, F23, F46	X	
APO02	Manage Strategy	F2, F3, F4, F5, F6, F7, F10, F15, F20, F23	X	
APO03	Manage Enterprise Architecture	F4, F5, F6, F7, F8, F9, F10, F12, F13, F14, F20, F23, F24, F25, F26		X
APO04	Manage Innovation	F2, F3, F4, F5, F6, F9, F10, F12, F13, F23, F40, F41, F45	X	X
APO05	Manage Portfolio	F1, F2, F3, F4, F7, F8, F9, F10, F11, F14	X	
APO06	Manage Budget and Costs	F3, F5, F6, F8, F9, F14, F20	X	X
APO07	Manage Human Resources	F6, F14, F15, F16, F17, F18, F19, F20, F21, F40, F41, F43, F44	X	X
APO08	Manage Relationships	F1, F5, F6, F17, F20, F21, F23, F24	X	X
APO10	Manage Suppliers	F15, F16, F20, F23, F24	X	X

Process ID	Process (Appendix)	Mapped to failure factors (Table 4.1)	Strategic level	Operational level
APO11	Manage Quality	F4, F15, F19, F22, F23, F24, F25, F29, F32, F46	X	X
APO12	Manage Risk	F10, F11, F12	X	X
APO13	Manage Security	F10	X	
Management domain: Build, Acquire and Implement (BAI)				
BAI01	Manage Programmes and Projects	F1, F2, F3, F5, F6, F8, F9, F10, F11, F14, F20, F22, F23, F24, F40, F46	X	X
BAI02	Manage Requirements Definition	F2, F3, F4, F5, F6, F7, F9, F12, F23, F24, F25	X	X
BAI03	Manage Solutions Identification and Build	F5, F12, F15, F16, F20, F23, F24, F25, F26, F27, F28, F29, F30, F31, F32, F33, F34, F35, F36, F37, F38, F39, F42	X	X
BAI04	Manage Availability and Capacity	F4, F10, F46	X	X
BAI05	Manage Organisational Change Enablement	F13, F20, F21, F37, F41, F43, F44, F45	X	X
BAI06	Manage Changes	F22, F24, F27, F29, F41		X
BAI07	Manage Change Acceptance and Transitioning	F20, F40, F42, F43, F44, F45, F47		X
BAI08	Manage Knowledge	F31, F32, F33, F34, F35, F36, F39		X
BAI09	Manage Assets	F3, F4, F9, F10, F27, F29, F46	X	X
BAI10	Manage Configuration	F22, F24, F27		X
Management domain: Deliver, Service and Support (DSS)				
DSS03	Manage Problems	F40, F46		X
DSS06	Manage Business Process Controls	F27, F28, F29, F30, F31, F32, F33, F34, F35, F36, F37, F38, F39		X
Management domain: Monitor, Evaluate and Assess (MEA)				
MEA01	Monitor, Evaluate and Assess Performance and Conformance	F3, F5, F9, F40, F46	X	X

4.3 The development of a matrix for aligning business imperatives with recommended software requirements to achieve business/IT alignment in software projects

As illustrated in the above section, the COBIT 5 framework, specifically the processes presented in Table 4.2, specifically addresses the alignment between software capabilities and business requirements at a strategic and operational level. However, many authors have recognised that generic control frameworks, including COBIT 5, do not provide organisations in different industries with practical guidance for how to achieve this alignment within their own specific context (De Haes, *et al*., 2013b:312; Ahriz *et al*., 2018:94).

According to COBIT 5, the starting point for the alignment between software capabilities with business requirements should be to define and align organisational goals with IT-related goals (De Haes *et al*., 2013b:312). Boshoff (2014) and Tallon (2007:229) support this view by suggesting that organisations should identify and apply their unique business imperatives as the drivers for aligning software capabilities with business requirements and, ultimately, the business strategy.

Based on the above, 17 potential business imperatives were identified in this section that can assist organisations in identifying their own unique business imperatives and act as a starting point for aligning software capabilities with business requirements. To further assist organisations in achieving this alignment, a list of recommended software requirements, needed to achieve each particular business imperative, was identified. Based on the findings of the above procedures, a matrix was compiled, presented in Table 4.3, linking each business imperative to the recommended software requirements that may be needed to achieve the particular business imperative. This matrix can assist organisations in two ways: Firstly, by identifying their unique business imperatives and secondly, by using the matrix as a starting point for determining the software requirements needed to achieve their business strategy.

Each of the 17 identified business imperatives (BI1 to BI17) and the related software requirements, presented in Table 4.3, are discussed in detail in the remainder of this section.

BI1: Affordability

In certain industries, especially highly competitive industries, providing products and services at lower costs than competitors, without undermining quality, is critical for achieving a competitive advantage (Ortega, 2008:1274). Such organisations with a low-cost strategy typically aim to reduce costs by focusing on processes that enable mass production and standardisation (Tallon, 2007:228).

Application software requirements:

- Off-the-shelf software, such as ERP systems, can support a low-cost strategy and improve organisational efficiency by providing integrated, low-cost transaction systems and by enabling the redesign and streamlining of business processes through best practices and functionality embedded in these systems (Rahimi *et al*., 2016:151).
- Applications that provide automation and integration of the supply chain are required for increasing productivity in terms of production throughput or service volumes (Tallon: 2007:233).
- The potential benefits and value provided by software should exceed the cost of investment and ownership (Boshoff, 2014). A basic, low-cost transaction system, such as an off-the-shelf package, can lead to lower costs of acquisition, implementation and maintenance, while a high-cost system requiring innovative technologies can reduce profitability if it only delivers marginal returns on the investment (Boshoff, 2014; Interaction Design Foundation, 2017).
- Excessive modification and customisation of software by changing the source code should be avoided as it significantly increases the time and costs of implementation and may lead to problematic future updates, maintenance issues and the requirement of software patches (Rahimi *et al*., 2016:149; Shiang-Yen *et al*., 2013:63).
- Centralised deployment of software can improve cost efficiency and productivity of IT resources through managing tasks such as updates, new software installations and security patches from one location. It is also cost-effective in terms of negotiating software licensing and support contracts for the organisation as a whole (Borowski, n.d).
- Scalable software is required to enable an organisation to adapt to future changes and growth without significant additional cost (Boshoff, 2014). Scalability refers to an application's ability, in terms of performance and cost, to adapt to increasing workloads

such as number of users, number of transactions or storage capacity, without redesigning the system (Farias, 2017; Gartner, n.d.). This requires coding that reduces the overall complexity of the codebase and allows for modifications without unnecessary effort or degrading of the application architecture (Farias, 2017; Boshoff, 2014).

- User-friendly interface design and simple workflows can improve the ease of use of software and require a lower level of skills to operate (Boshoff, 2014).
- Cloud-based software can provide benefits such as increased flexibility and cost reduction versus on-premises software (MarketsandMarkets, 2018).

BI2: Productivity and efficiency

Operational efficiency refers to the productive use of resources in a manner that streamlines operations, eliminates wastage and reduces costs (Sorescu, A., Frambach, R.T., Singh, J., Rangaswamy, A. & Bridges, C., 2011:S7). Organisations often use business process management (BPM) as a technique to enable the continuous optimisation of an organisation's business processes (Rahimi *et al*., 2016:142). The innovative and effective management of IT-enabled business processes can enable organisations with advanced technological capability to achieve efficiency gains, cost savings and improvements in firm performance (Rahimi *et al*., 2016:142; Ortega, 2008: 1275). Organisations may obtain further productivity- and efficiency gains by providing employees with access to information from multiple locations (Boshoff, 2014).

Application software requirements:

- Cloud-based deployment of software can provide organisations with increased flexibility and real-time access to data by employees, regardless of their location, that can improve productivity and efficiency (MarketsandMarkets, 2018).
- ERP systems can provide increased flexibility and efficiency gains through wide application architecture and best practices for business process management and workflows embedded in the system (Boshoff, 2014; Shiang-Yen *et al*., 2013:63).
- Applications enabling the automation of processes traditionally performed by employees can lead to significant efficiency gains (Sorescu *et al.*, 2011:S7). This includes the automation of business processes through rule-driven online transaction processing (OLTP) and innovations such as self-service technologies to reduce the number of

employees involved in the execution of business processes (Boshoff, 2014; Sorescu *et al.*, 2011:S13).

- Ubiquitous applications that integrate seamlessly across multiple platforms, such as mobile or cloud, can improve productivity by allowing employees to access information and execute tasks from any location (FinancesOnline, 2018).
- Workflow applications contain certain capabilities, such as open configuration, customisation and the linking of on-premise systems with cloud- and mobile platforms, which can streamline tasks and eliminate redundant tasks that reduce productivity (FinancesOnline, n.d.).
- High-performance technologies, such as the Internet of Things (IoT), can drive business process innovation to improve productivity and efficiency (Boshoff, 2014).

BI3: Availability and reliability of software

In certain environments, system downtime can cause significant disruptions in business operations, which can in turn have a negative impact on customer satisfaction and firm performance (Boshoff, 2014). Organisations in retail, e-commerce or manufacturing environments can for instance lose sales if systems are not available. Similarly, in customer-centric environments, excellent service quality and availability is critical for creating value for customers (Tallon, 2014:232).

Application software requirements:

- Redundancy and backup measures should be built into applications to increase the system's resiliency and the ability to route around possible system failure. Business requirements, such as an organisation's recovery time objective, should guide the cost and complexity of building redundancy into systems (Microsoft, 2018).
- Cloud-based solutions can enable the backup and recovery of applications and data on secondary storage (MarketsandMarkets, 2018).
- Decentralised or distributed systems can increase organisational redundancy (Borowski, n.d).
- Control- and security measures built into software can mitigate the risks of information security breaches (Boshoff, 2014).

BI4: Collaboration and end-to-end supply chain optimisation

Collaboration and sharing of information between employees and business units can provide organisations with a competitive advantage (Boshoff, 2014). The integration of an organisation's complicated network of corporate relationships is a critical imperative for ensuring success in emerging competitive environments (Lambert, 2014:2). In a global marketplace where competition has moved from brand versus brand to supply chain (SC) versus SC, SC network management is an important strategy for gaining a competitive advantage (Lu, Trappey, Chen & Chang, 2013:1510). Lambert (2014:2) corroborates this view by defining present-day SC management as the management of relationships in a network of organisations, stretching from end users through to original suppliers, while utilising core cross-functional business processes to create value for customers and stakeholders. While the traditional objective of SC management was to provide cost-savings and efficiency benefits, digital transformation is driving organisations to implement SC management as an important, value-adding strategic asset (PwC, n.d.).

Application software requirements:

- SC management software can support critical business processes in the SC, such as improving production planning and scheduling, developing accurate predictive capability and supporting the collaboration with appropriate partners (Lu *et al.*, 2013:1510).
- Centralised deployment of applications can prevent information silos and improve knowledge-sharing and collaboration across departments (Borowski, n.d).
- Central, cloud-based applications can provide user access from multiple locations at any point in time to improve knowledge-sharing (Borowski, n.d).
- Software should support the integration and interoperability between various applications within the supply chain. Enterprise application integration (EAI) can enable the integration of both inter-organisational and intra-organisational applications to support collaboration across departments and organisations (He & Xu, 2014:35).

BI5: Added value through improved quality of products or services

Organisations can achieve higher profitability by delivering products or services of exceptional quality to consumers, which in turn can lead to higher sales and increased profit margins (Boshoff, 2014). According to Drury (2015:576), the continuous improvement of quality management and the availability of information relating to the quality of products or services are crucial processes for organisations to meet customer demands and remain competitive. Business process governance can provide a critical foundation to ensure value creation for all stakeholders by monitoring the continuous improvement and operating performance of critical business processes (Rahimi *et al*., 2016:146).

Application software requirements:

- Reliable systems and robust applications can improve service quality by avoiding system downtime, which can result in a loss in revenue and decreased customer satisfaction.
- Applications are required that contain embedded rules and support the required level of detail for data to monitor the quality of products or services (e.g., data fields that contain information regarding customer returns per product) (Boshoff, 2014).
- High-performance technologies, such as IoT, can drive business process innovation to improve an organisation's response time in meeting customer demands (Boshoff, 2014).
- Applications that enable the automation of processes through OLTP and support innovation, such as self-service technologies, can improve the quality of customer service (Boshoff, 2014; Sorescu *et al.*, 2011:S13).

BI6: Reduction in time to market or service delivery time

Organisations with a high turnover rate of products, such as mass-market retail chains, or organisations with faster service delivery time that competitors can achieve a competitive advantage through higher transaction volumes and increased customer satisfaction (Boshoff, 2014). Tallon (2014:266) identifies the improvement of production throughput or service volumes as critical business activities for increasing operational efficiency. Technological innovations, increased global competition and rapidly changing customer demands have intensified the pressure on organisations to decrease product life cycles. According to Drury (2015:11), a product's life cycle is the period from initial research and development expenditure to the time when customer support ceases. As a result, introducing products to the market later than competitors can have a dramatic impact on an organisation's profitability (Drury: 2015:11).

Application software requirements:

- Software supporting effective IT-enabled business process management can enable organisations to optimise critical business processes and achieve efficiency gains (Rahimi *et al*., 2016:142; Ortega, 2008: 1275).
- Applications that support the automation of business processes through rule-driven OLTP and support innovation, such as self-service technologies, can increase operational efficiency and improve the delivery of products or services (Boshoff, 2014; Sorescu *et al.*, 2011:S13).
- Flexible and adaptable applications are required to respond to changing customer demands with agility. Such systems require loose coupling of components to enable subsequent changes in configuration data and coding without rebuilding the application (Boshoff, 2014).
- High-performance technologies, such as IoT, can drive business process innovation to improve an organisation's response time in meeting customer demands (Boshoff, 2014).

BI7: Growth and innovation

Rising customer expectations and fierce competition are constantly challenging organisations to innovate their business models to create value for consumers, harness value from markets and maintain a sustainable competitive advantage (Sorescu *et al.*, 2011:S3). The ability of organisations to create future platforms for growth through innovation is vital for ensuring exceptional long-term performance (Sinha, 2016:35). A recent survey conducted by Gartner (2018b) supports this view by indicating that growth is at the top of the list of CEO business priorities in 2018 and 2019 and that CEO's are focusing on gaining a better understanding of the digital business evolution to achieve growth. Furthermore, innovation of products and marketing techniques can differentiate an organisation from competitors in the industry (Ortega, 2008:1274).

Application software requirements:

- The scalability of software is a critical consideration for enabling organisations to adapt to a rapidly changing marketplace and accommodate future growth (Farias, 2017; Boshoff, 2014).

- Centralised deployment of applications provides more scalability than decentralised and disparate systems that are difficult to scale and integrate in the long-term (Borowski, n.d).
- Excessive modification and customisation of software should be avoided as it can lead to a retrofit risk (i.e. the inability to successfully update software in the future) and inhibit the organisation's growth (Rahimi *et al*., 2016:149; Shiang-Yen *et al*., 2013:63).
- High-performance technologies, such as IoT, artificial intelligence (AI) and blockchain, drives and supports innovation (Boshoff, 2014).
- High-performance technologies require software with loose coupling of components and event-driven architecture (EDA) built into the design of applications to execute tasks in response to certain event notifications (Gartner, n.d.).

BI8: Rapid adaptability

Organisations require flexible and adaptive business processes to respond to significant changes in their business environments, such as globalisation, product innovations and new compliance requirements (Rosemann, Recker & Flender, 2008:2). Furthermore, organisations are increasingly challenged to decrease the time-to-market and time-to-customer of products and services to maintain their competitive advantage (Rosemann *et al*., 2008:2). In certain environments, organisations also require flexible and adaptive business processes to respond to non-standard or unique scenarios to maintain uninterrupted business operations (Boshoff, 2014).

Application software requirements:

- Cloud-based deployment of software can provide organisations with increased flexibility and scalability required for responding to changes in information requirements and future growth (MarketsandMarkets, 2018).
- Flexible and adaptable application software, which requires loose coupling of components, are needed to respond efficiently to non-standard scenarios and changes in information requirements (Boshoff, 2014).
- Applications supporting high-performance technologies (e.g., IoT, AI and blockchain), which requires EDA and loose coupling of components to respond to certain events with more agility (Gartner, n.d.).

- A decentralised IT organisational structure, allowing organisations to deploy various disparate applications, can improve an organisation's agility in responding to new IT trends (Borowski, n.d).

BI9: Proactive management / real-time response

In certain industries, access to real-time information can optimise the performance of an organisation by providing vital business insights to drive the decision-making process and to enable real-time responses to changes in the business environment (Boshoff, 2014). The emergence of power technologies, such as AI and IoT, significantly amplifies the need for technologies that provide access to real-time information and enable real-time responses from organisations (DataCore Software, 2017).

Application software requirements:

- Cloud-based deployment of application software can provide access to real-time data by employees (MarketsandMarkets, 2018).
- Applications supporting high-performance technologies (e.g., IoT, AI and blockchain), which requires EDA and loose coupling of components to respond to certain events with more agility or in real-time (Gartner, n.d.).
- Applications should support business intelligence capabilities, such as rule-driven online analytical processing (OLAP), to enable proactive or real-time decision-making (Boshoff, 2014).

BI10: Diverse products or business lines

Organisations with diverse products or business lines need to successfully manage and coordinate different business models, business processes and activities, while also adapting to changing customer demands associated with such products or business lines (Boshoff, 2014). The global e-commerce retailer Amazon has, for instance, obtained a competitive advantage by continually introducing new products and services to the market through flexible technological platforms, which are adapted to each unique offering, to meet customer demands better and faster than competitors (Robischon, 2017).

Application software requirements:

- The master data, data fields and report writing capabilities of applications should support the levels of detail required for multiple products or business units. This is needed for capturing and analysing data (e.g., comparing budget versus actual results) for multiple diverse products or business units (Strong & Volkoff, 2010:747).
- Flexible and adaptable applications are required to support the addition of new products or changes in products or business lines (Boshoff, 2014).
- Specialised applications are required to support the unique technical requirements and business processes associated with diverse products or business lines (Boshoff, 2014).
- Decentralised deployment of software can allow organisations to tailor the selection and configuration of software to the requirements of different business lines (Borowski, n.d).
- Software should support the integration and interoperability between various specialised applications through, for example, EAI (He & Xu, 2014:35).

BI11: Lower level of skills required or available

Organisations operating in environments with a low-skilled workforce, such as developing countries with lower availability of skilled workers, should design processes in a manner that enables ease-of-use and support employees in performing tasks more effectively and efficiently (Boshoff, 2014). Organisations can, however, counterbalance a low availability of skills by using technological advancements, such as automation, to execute a growing number of tasks traditionally executed by humans. In the past, such automation was primarily applicable to routine tasks, such as bookkeeping, reporting and clerical work. However, the rapid increase in computer power, driven by high-performance technologies such as AI and IoT, are increasingly likely to enable the automation of even non-routine tasks (OECD, 2017).

Application software requirements:

- Applications with basic toolsets, that do not require specialised knowledge to operate, is required (Boshoff, 2014).
- User-friendly workflow and interface design are required to improve the usability of software (Boshoff, 2014). Quesenbery (2004:4) describes usability as the characteristic

of software that enables users to meet their specific goals in a manner that is appropriate to them within their specific environment or context.

- Applications that enable the automation of business processes and the use of high-performance technologies (e.g., IoT and AI) can minimise the role of employees in executing tasks (OECD, 2017).

BI12: Highly skilled workforce

In an environment where highly skilled employees are required, organisations need to ensure that they have systems in place to enable those employees to leverage their skills and increase their productivity and efficiency (Boshoff, 2014).

Application software requirements:

- Applications with complex toolsets, such as ERP systems, require specialised knowledge to operate. These systems can additionally leverage skills and increase productivity by, for instance, providing employees with specialised report writing capabilities to support decision-making (Boshoff, 2014).
- Power user tools and workflow applications can assist highly qualified employees in improving their efficiency by leveraging their skills and improving collaboration between employees (Boshoff, 2014).

BI13: Integration of disparate or distributed applications

Industry environments are becoming progressively heterogeneous due to changes such as mergers and acquisitions, corporate restructuring, adoption of new technologies, outsourcing or upgrades to infrastructure. As a result, organisations may acquire multiple disparate systems and applications over the years, often developed or supplied by different vendors, to support their business requirements. The automated integration of applications can enable interoperability and lead to significant efficiency gains, reduced errors and the elimination of time-consuming and non-value adding manual procedures to transfer data between these systems (Iqbal, Shah, James & Cichowicz, 2013:1480). The integration and interoperability of these various distributed systems are therefore essential for achieving business objectives and strengthening an organisation's competitiveness (He & Xu, 2014:35).

Application software requirements:

- Applications should support complex integration between modules and disparate applications (He & Xu, 2014:35). The following methods, tools and applications can enable this integration:
  - EAI can enable the achievement of quality integration and interoperability between applications with different formats and protocols by using methods and tools to integrate business processes, data and user interfaces (He & Xu, 2014:35).
  - Middleware applications and related technologies are often used by organisations to support EAI. Organisations should consider the portability, configurability, scalability and interoperability of middleware solutions to fit their business requirements (He & Xu, 2014:38).
  - Web services, including its underlying foundation of service-oriented architecture (SOA), is a suitable type of middleware to support web-based distributed applications and enable middleware-to-middleware integration. SOA integrates various heterogeneous- and middleware applications by organising software as services (He & Xu, 2014:35).
  - EAI, application-specific middleware and SOA approaches can enable the integration of the following technologies with an organisation's existing software (He & Xu, 2014:39):
    - OLAP, data mining capabilities and data sources for decision support; and
    - mobile applications, smart embedded devices and embedded systems.
- Robust data security measures surrounding integrated applications are required to prevent information security vulnerabilities, especially in a web-based environment (He & Xu, 2014:39).

BI14: Multi-location branches

Organisations with multiple stores or branches where mostly uniform tasks are executed, such as point-of-sale operations at retail outlets, should have systems in place that standardise operations to facilitate the efficient expansion and growth of the organisation (Boshoff, 2014).

Application software requirements:

- Applications should be portable and facilitate the implementation of replicas of the original application at multiple locations. Applications that are replicable and portable can increase efficiency by standardising processes associated with system implementations (e.g., user training and system updates) (Boshoff, 2014).
- Scalable solutions are required to support the effective implementation of applications at additional branches (Boshoff, 2014).

BI15: Customer-centric

Organisations are progressively challenged to respond to rapidly changing customer expectations and create new markets to gain a sustainable competitive advantage (Sorescu *et al.*, 2011:S3). As a result, organisations have broadened their focus from merely selling products to engaging and empowering customers to create satisfying customer experiences. Organisations in the retail industry should, for instance, interact with customers by using innovative approaches such as mass customisation technologies, inventive customer interfaces across various platforms and the streamlining of the supply chain to align products or services with customer demands (Sorescu *et al*., 2011:S3).

Application software requirements:

- Applications require user-friendly customer interface design to promote ease-of-use and effortless customer experiences (Boshoff, 2014).
- Multiplicity and innovative design of applications and customer interfaces can enable organisations to interact with customers via multiple channels (e.g., e-commerce, self-service terminals or mobile applications) (Sorescu *et al*., 2011:S6).
- Integrated applications are required to enable seamless coordination between the various online and offline applications required for multichannel customer interaction (Boshoff, 2014; Sorescu *et al*., 2011:S6). This requires, for instance, EAI and SOA approaches to enable the integration of mobile applications and e-commerce platforms

with an organisation's ERP system (He & Xu, 2014:39; Boshoff, 2014; Sorescu *et al*., 2011:S6).

- EAI and application-specific middleware software can be used to integrate OLAP, data mining capabilities and data sources for identifying market trends and improving forecast trends (He & Xu, 2014:39; Tallon, 2007:266).
- Applications that support business intelligence capabilities, such as rule-driven OLAP, and data mining capabilities can enable the identification of new market trends and improve an organisation's forecasting abilities (Boshoff, 2014; He & Xu, 2014:39; Tallon, 2007:266).
- Customer Relationship Management (CRM) systems can improve performance and customer service by providing integrated transaction systems and analytical tools that enable the identification of new customer segments (Rahimi *et al*., 2016:151).
- Central, cloud-based applications may provide employees with access to customer information from any location, which can improve customer service and support (Borowski, n.d).

BI16: Sustainability

The adoption of more sustainable practices is becoming increasingly crucial for organisations to retain their social legitimacy and competitive advantage (Network for Business Sustainability, 2012:8). Companies are widely considered as the main contributors to social and environmental problems and a lack of sustainability in society. This perception has lead to increased external governance and various sustainability innovations developed by leading firms, such as the development of environmentally and socially superior production processes, services and products (Schaltegger & Wagner, 2010:223). According to Evans, Vladimirova, Holgado, Van Fossen, Yang, Silva & Barlow (2017:605), organisations can respond to growing social, environmental and economic demands for sustainability by developing more appropriate and sustainable business models.

Application software requirements:

- Applications that contain embedded rules and checks and business intelligence tools can be applied to analyse the environmental impact of an organisation's business operations (Boshoff, 2014).

- Cloud computing, especially public cloud models, can lead to sustainability benefits, such as lower energy consumption, by providing greater scalability and facilitating the sharing of infrastructure and demand-based consumption (Simmons, 2014).

BI17: Regulatory compliance (industry specific)

Compliance with industry-specific laws and regulations can have a significant impact on the continuity and brand reputation of organisations, especially in highly regulated sectors and companies operating in various countries (Boshoff, 2014). Sadiq and Governatori (2015:1) define compliance as ensuring that business practice, processes and operations are in accordance with an agreed or prescribed set of norms. Compliance requirements may originate from legislation or regulatory bodies, such as the Sarbanes-Oxley Act and Hazard Analysis and Critical Control Points (HACCP), codes of practice as well as contracts with business partners (Sadiq & Governatori, 2015:1).

Application software requirements:

- Application software should support the complex processes associated with regulatory compliance (Boshoff, 2014).
- As generic, packaged software may not support specific complex processes associated with regulatory compliance, specialised compliance-related software and business intelligence tools may be required to monitor compliance (Sadiq & Governatori, 2015:2).
- Compliance-related software should be flexible to support changes in legislation and compliance requirements (Sadiq & Governatori, 2015:2).
- Embedded rules and checks in software and can enable the automated detection of non-compliance (Sadiq & Governatori, 2015:2).
- The centralised deployment of applications is effective for supporting certain legal requirements and industry-specific regulations regarding data-security (Borowski, n.d).

Table 4.3: A matrix for aligning business imperatives with recommended software requirements to achieve business/IT alignment in software projects

Business imperative (section 4.3)	Suggested application software requirements (section 4.3)
BI1: Affordability	• Off-the-shelf software (e.g. ERP systems) that provide low-cost transaction systems and embedded best practices; • software that enables automation and integration of the supply chain; • benefit and value provided by software should exceed the cost of investment and ownership; • avoid excessive modification and customisation of software; • centralised deployment of software; • scalable software (avoid overly complex codebase); • user-friendly interface design and simple workflows; and • cloud-based software.
BI2: Productivity and efficiency	• cloud-based software that provides increased flexibility and real-time access to data; • ERP systems that provide embedded best practices and wide application architecture; • software that enables the automation of processes (e.g., OLTP and self-service technologies); • ubiquitous applications that provide seamless integration across multiple platforms; • workflow applications that streamline tasks and eliminate redundant activities; and • High-performance technologies (e.g., IoT).

Business imperative (section 4.3)	Suggested application software requirements (section 4.3)
BI3: Availability and reliability of software	• Increased software resiliency by building redundancy and backup measures into applications; • cloud-based software that enables backup on secondary storage; • decentralised deployment of software to increase redundancy; and • control- and security measures built into software can mitigate the risks of information security breaches.
BI4: Collaboration and end-to-end supply chain optimisation	• SC management software to support critical business processes in the supply chain; • centralised deployment of software to improve collaboration; • cloud-based software to provide user sign-on from multiple locations and improve knowledge-sharing; and • software that supports the integration and interoperability between various applications within the supply chain.
BI5: Added value through improved quality of products or services	• Reliable and robust applications can improve service quality; • software that contains embedded rules and supports the required level of detail for data to monitor the quality of products or services; • high-performance technologies (e.g., IoT) to drive business process innovation; and • software that enables the automation of processes (e.g., OLTP and self-service technologies).
BI6: Reduction in time to market or service delivery time	• Software should support effective business process management and enable the optimisation of processes;

Business imperative (section 4.3)	**Suggested application software requirements (section 4.3)**
BI6: Reduction in time to market or service delivery time (continued)	• software that enables the automation of processes (e.g., OLTP and self-service technologies); • Flexible and adaptable software to improve agility in responding to customer demands; and • high-performance technologies (e.g., IoT) to drive business process innovation.
BI7: Growth and innovation	• Scalability to accommodate growth; • centralised deployment of software to support scalability; • avoid excessive modification and customisation of software; • high-performance technologies (e.g., IoT, AI and blockchain); and • software with loose coupling of components and EDA built into the design.
BI8: Rapid adaptability	• Cloud-based software to provide increased flexibility and scalability; • flexible and adaptable software (requiring loose coupling of components) to improve agility; • high-performance technologies (e.g., IoT, AI and blockchain); • software with loose coupling of components and EDA built into the design; and • a decentralised IT organisational structure, which supports the deployment of disparate applications.
BI9: Proactive management / real-time response	• Cloud-based software, which can provide access to real-time data; • high-performance technologies (e.g., IoT, AI and blockchain); • software with loose coupling of components and EDA built into the design; and

Business imperative (section 4.3)	**Suggested application software requirements (section 4.3)**
BI9: Proactive management / real-time response (continued)	• software that supports business intelligence capabilities (e.g., OLAP).
BI10: Diverse products or business lines	• The master data, data fields and report writing capabilities of applications should support the levels of detail required by diverse products; • flexible and adaptable software to support changes and additions to products or business lines; • specialised applications to support the unique requirements and business processes of diverse products; • decentralised deployment of applications to enable the tailoring of software selection and configuration that is appropriate for each different business unit; and • software that supports the integration and interoperability between various specialised applications.
BI11: Lower level of skills required or available	• Software with basic toolsets (i.e. not requiring specialised knowledge); • user-friendly workflow and interface design; and • software that enables automation and utilises high-performance technologies to minimise the role of employees in the execution of tasks.
BI12: Highly skilled workforce	• Applications with complex toolsets (e.g., ERP systems) to leverage skills and improve productivity; and • the utilisation of power user tools and workflow applications to improve efficiency and collaboration.

Business imperative (section 4.3)	Suggested application software requirements (section 4.3)

BI13: Integration of distributed environments	• Applications should support complex integration between modules, disparate applications, mobile applications, smart embedded devices and data mining capabilities through the utilisation of the following:
	  ○ EAI; and
	  ○ Middleware applications (including web services based on SOA).
	• Robust data security measures surrounding integrated applications is required to prevent information security vulnerabilities.

BI14: Multi-location branches	• Portable software to facilitate the implementation of replicas at multiple locations; and • scalable software to support the implementation of systems at additional branches.
BI15: Customer-centric	• Software with user-friendly customer interface design to promote ease-of-use; • multiplicity and innovative design of applications and customer interfaces to enable interaction with customers via multiple channels; • integrated applications to enable coordination between various online and offline applications and platforms used for customer interaction; • applications that provide business intelligence tools and data mining capabilities to identify new market trends and improve forecasting; • CRM systems that provide integrated transaction systems and analytical tools to improve customer service; and • centralised, cloud-based deployment of software to enable real-time access to customer information.

Business imperative (section 4.3)	Suggested application software requirements (section 4.3)
BI16: Sustainability	• Applications with embedded rules and business intelligence tools to analyse the environmental impact of the business; and • cloud-based applications, especially public cloud models, to improve energy consumption, provide scalability and facilitate the sharing of infrastructure.
BI17: Regulatory compliance (industry specific)	• Applications that support complex processes associated with regulatory compliance; • specialised, compliance-related applications and business intelligence tools to monitor compliance; • flexible applications to adapt to changes in legislation and compliance requirements; • rules and checks, embedded in software, to enable the automated detection of non-compliance; and • centralised deployment of software to support legal requirements and regulations regarding data-security.

4.4 Summary and conclusion

The identification and understanding of the potential failure factors that can contribute to software project failure can assist organisations in addressing and mitigating the risks of such failure. A review of the detailed processes of COBIT 5 was performed to determine which processes specifically address software project failure. The applicable COBIT 5 processes, presented in the Appendix, were then applied to identify potential failure factors associated with software project failure. A matrix, presented in Table 4.2, was developed for aligning the identified software project failure factors with the applicable COBIT 5 processes to address software project failure at a strategic and operational level. This matrix can assist organisations in practically applying IT governance principles, based on the COBIT 5 framework, to address and mitigate the risks of software project failure at a strategic and operational level.

Although the applicable COBIT 5 processes, presented in Table 4.2, specifically address the alignment of IT capabilities with business requirements at both a strategic and operational level, the COBIT 5 framework does not provide practical guidance for how organisations in different industries can align software capabilities with their own business requirements. To address this lack of guidance, a second matrix was compiled, presented in Table 4.3, which links a generic list of business imperatives, which may be applicable to a particular organisation, to the recommended software requirements that may be needed to achieve each business imperative. This matrix can assist organisations in firstly identifying their own unique business imperatives and, secondly, in determining the related software requirements needed to achieve their business requirements.

In conclusion, the structured approach developed in this chapter can ultimately provide organisations with a set of practical guidelines for mitigating the risks of software project failure by applying IT governance principles to achieve alignment, at both a strategic and operational level, between their business requirements and the capabilities of software needed to achieve those business requirements.

CHAPTER 5: CONCLUSION

Software projects continue to fail at significant rates, despite extensive research performed on the subject and the attempts of organisations to implement methodologies and management techniques to prevent these failures. Based on an extensive literature review, it was found that software project failure can mainly be attributed to the misalignment between an organisation's business requirements, which are driven by the business strategy, and the capabilities of the selected and implemented software needed to support those business requirements. This failure is also referred to as the IT gap (Boshoff, 2014).

Past research regarding software project failure has strongly emphasised the role of project management methodologies in addressing IT project failure. This approach was, however, found to be inadequate in addressing the IT gap. It was further found that the implementation of IT governance principles plays an integral role in the achievement of business/IT alignment between software capabilities and business requirements. While it is apparent that control frameworks can provide a critical foundation for implementing IT governance, these frameworks often lack guidance on how to practically interpret and implement IT governance principles at a strategic and operational level to address software project failure.

The objective of this study was to develop a structured approach, based on IT governance principles, to provide organisations with practical guidance for addressing software project failure by achieving alignment between software capabilities and business requirements at a strategic and operational level. In broad terms, this was achieved as follows:

- The detailed processes of COBIT 5 were reviewed to identify which processes are applicable to software project failure. These applicable COBIT 5 processes were then applied to identify failure factors associated with software project failure. The findings were used to develop a matrix that aligns the identified failure factors, at a strategic and operational level, with the applicable COBIT 5 processes that may be used to address those failure factors.
- To address the lack of practical guidance for how organisations can align software capabilities with their own business requirements, a second matrix was compiled that links a generic list of business imperatives, which may be applicable to different organisations in various industries, to the recommended software requirements that may be needed to achieve each particular business imperative.

The structured approach described above can assist organisations in practically applying IT governance principles, based on the COBIT 5 framework, to address and mitigate the risks of software project failure at a strategic and operational level. Furthermore, as the guidance provided by existing control frameworks is generic, the above two matrixes can provide organisations, operating in a wide range of different industries and business contexts, with practical guidelines for aligning software capabilities with their business requirements to ultimately support their business strategy.

Additionally, the structured approach developed in this study can be used to facilitate communication and establish accountability between all stakeholders, including senior management and IT specialists, involved in software projects. All stakeholders can use the structured approach as practical guidance to engage in the selection, design and implementation of software to ultimately support the strategic objectives of the organisation and mitigate the risks of software project failure.

Potential future research may include the following areas, which were not addressed in this study:

- The application of the structured approach developed in this study in organisations to assess the practical results of its application to software projects.
- The identification of the detailed processes required to address the failure factors applicable to specific application software. These detailed processes may include the requirements for the build, setup, configuration, operation and maintenance of specific application software to support an organisation’s business requirements.

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Appendix: Extract from the COBIT 5 framework (including the relevant IT governance domains, processes, process descriptions and process purpose statements) (ISACA, n.d.) mapped to software project failure factors

The table below shows the applicable COBIT 5 processes and the detailed considerations (as stated in the process description and process purpose statement) for the identification of software project failure factors (presented in table 4.1) and the alignment of those failure factors with the applicable COBIT 5 processes. As described in section 4.2.1, the COBIT 5 processes that do not specifically address the misalignment between software capabilities and business requirements were not included in this Appendix.

Process ID	Process	Process Description	Process Purpose Statement	Mapped to failure factors
Governance domain: Evaluate, Direct and Monitor (EDM)				
EDM01	Ensure Governance Framework Setting and Maintenance	Analyse and articulate the requirements for the governance of enterprise IT, and put in place and maintain effective enabling structures, principles, processes and practices, with clarity of responsibilities and authority to achieve the enterprise's mission, goals and objectives.	Provide a consistent approach integrated and aligned with the enterprise governance approach. To ensure that IT-related decisions are made in line with the enterprise's strategies and objectives, ensure that IT-related processes are overseen effectively and transparently, compliance with legal and regulatory requirements is confirmed, and the governance requirements for board members are met.	F1, F2, F3, F4, F5, F6, F7

EDM02	Ensure Benefits Delivery	Optimise the value contribution to the business from the business processes, IT services and IT assets resulting from investments made by IT at acceptable costs.	Secure optimal value from IT-enabled initiatives, services and assets; cost-efficient delivery of solutions and services; and a reliable and accurate picture of costs and likely benefits so that business needs are supported effectively and efficiently.	F3, F8, F9
EDM03	Ensure Risk Optimisation	Ensure that the enterprise's risk appetite and tolerance are understood, articulated and communicated, and that risk to enterprise value related to the use of IT is identified and managed.	Ensure that IT-related enterprise risk does not exceed risk appetite and risk tolerance, the impact of IT risk to enterprise value is identified and managed, and the potential for compliance failures is minimised.	F10, F11, F12
EDM04	Ensure Resource Optimisation	Ensure that adequate and sufficient IT-related capabilities (people, process and technology) are available to support enterprise objectives effectively at optimal cost.	Ensure that the resource needs of the enterprise are met in the optimal manner, IT costs are optimised, and there is an increased likelihood of benefit realisation and readiness for future change.	F3, F8, F9, F13, F14, F15, F16
EDM05	Ensure Stakeholder Transparency	Ensure that enterprise IT performance and conformance measurement and reporting are transparent, with stakeholders approving the goals and metrics and the necessary remedial actions.	Make sure that the communication to stakeholders is effective and timely and the basis for reporting is established to increase performance, identify areas for improvement, and confirm that IT-related objectives and strategies are in line with the enterprise's strategy.	F5, F6, F16, F20

Management domain: Align, Plan and Organise (APO)				
APO01	Manage the IT Management Framework	Clarify and maintain the governance of enterprise IT mission and vision. Implement and maintain mechanisms and authorities to manage information and the use of IT in the enterprise in support of governance objectives in line with guiding principles and policies.	Provide a consistent management approach to enable the enterprise governance requirements to be met, covering management processes, organisational structures, roles and responsibilities, reliable and repeatable activities, and skills and competencies.	F1, F6, F18, F19, F20, F21, F22, F23, F46
APO02	Manage Strategy	Provide a holistic view of the current business and IT environment, the future direction, and the initiatives required to migrate to the desired future environment. Leverage enterprise architecture building blocks and components, including externally provided services and related capabilities to enable nimble, reliable and efficient response to strategic objectives.	Align strategic IT plans with business objectives. Clearly communicate the objectives and associated accountabilities so they are understood by all, with the IT strategic options identified, structured and integrated with the business plans.	F2, F3, F4, F5, F6, F7, F10, F15, F20, F23

APO03	Manage Enterprise Architecture	Establish a common architecture consisting of business process, information, data, application and technology architecture layers for effectively and efficiently realising enterprise and IT strategies by creating key models and practices that describe the baseline and target architectures. Define requirements for taxonomy, standards, guidelines, procedures, templates and tools, and provide a linkage for these components. Improve alignment, increase agility, improve quality of information and generate potential cost savings through initiatives such as re-use of building block components.	Represent the different building blocks that make up the enterprise and their inter-relationships as well as the principles guiding their design and evolution over time, enabling a standard, responsive and efficient delivery of operational and strategic objectives.	F4, F5, F6, F7, F8, F9, F10, F12, F13, F14, F20, F23, F24, F25, F26
APO04	Manage Innovation	Maintain an awareness of information technology and related service trends, identify innovation opportunities, and plan how to benefit from innovation in relation to business needs. Analyse what opportunities for business innovation or improvement can be created by emerging technologies, services or IT-enabled business innovation, as well as through existing established technologies and by business and IT process innovation. Influence strategic planning and enterprise architecture decisions.	Achieve competitive advantage, business innovation, and improved operational effectiveness and efficiency by exploiting information technology developments.	F2, F3, F4, F5, F6, F9, F10, F12, F13, F23, F40, F41, F45

APO05	Manage Portfolio	Execute the strategic direction set for investments in line with the enterprise architecture vision and the desired characteristics of the investment and related services portfolios, and consider the different categories of investments and the resources and funding constraints. Evaluate, prioritise and balance programmes and services, managing demand within resource and funding constraints, based on their alignment with strategic objectives, enterprise worth and risk. Move selected programmes into the active services portfolio for execution. Monitor the performance of the overall portfolio of services and programmes, proposing adjustments as necessary in response to programme and service performance or changing enterprise priorities.	Optimise the performance of the overall portfolio of programmes in response to programme and service performance and changing enterprise priorities and demands.	F1, F2, F3, F4, F7, F8, F9, F10, F11, F14
APO06	Manage Budget and Costs	Manage the IT-related financial activities in both the business and IT functions, covering budget, cost and benefit management, and prioritisation of spending through the use of formal budgeting practices and a fair and equitable system of allocating costs to the enterprise. Consult stakeholders to identify and control the total costs and benefits within the context of the IT strategic and tactical plans, and initiate corrective action where needed.	Foster partnership between IT and enterprise stakeholders to enable the effective and efficient use of IT-related resources and provide transparency and accountability of the cost and business value of solutions and services. Enable the enterprise to make informed decisions regarding the use of IT solutions and services.	F3, F5, F6, F8, F9, F14, F20

APO07	Manage Human Resources	Provide a structured approach to ensure optimal structuring, placement, decision rights and skills of human resources. This includes communicating the defined roles and responsibilities, learning and growth plans, and performance expectations, supported with competent and motivated people.	Optimise human resources capabilities to meet enterprise objectives.	F6, F14, F15, F16, F17, F18, F19, F20, F21, F40, F41, F43, F44
APO08	Manage Relationships	Manage the relationship between the business and IT in a formalised and transparent way that ensures a focus on achieving a common and shared goal of successful enterprise outcomes in support of strategic goals and within the constraint of budgets and risk tolerance. Base the relationship on mutual trust, using open and understandable terms and common language and a willingness to take ownership and accountability for key decisions.	Create improved outcomes, increased confidence, trust in IT and effective use of resources.	F1, F5, F6, F17, F20, F21, F23, F24
APO10	Manage Suppliers	Manage IT-related services provided by all types of suppliers to meet enterprise requirements, including the selection of suppliers, management of relationships, management of contracts, and reviewing and monitoring of supplier performance for effectiveness and compliance.	Minimise the risk associated with non-performing suppliers and ensure competitive pricing.	F15, F16, F20, F23, F24
APO11	Manage Quality	Define and communicate quality requirements in all processes, procedures and the related enterprise outcomes, including controls, ongoing monitoring, and the use of proven practices and standards in continuous improvement and efficiency efforts.	Ensure consistent delivery of solutions and services to meet the quality requirements of the enterprise and satisfy stakeholder needs.	F4, F15, F19, F22, F23, F24, F25, F29, F32, F46

APO12	Manage Risk	Continually identify, assess and reduce IT-related risk within levels of tolerance set by enterprise executive management.	Integrate the management of IT-related enterprise risk with overall ERM, and balance the costs and benefits of managing IT-related enterprise risk.	F10, F11, F12
APO13	Manage Security	Define, operate and monitor a system for information security management.	Keep the impact and occurrence of information security incidents within the enterprise's risk appetite levels.	F10
Management domain: Build, Acquire and Implement (BAI)				
BAI01	Manage Programmes and Projects	Manage all programmes and projects from the investment portfolio in alignment with enterprise strategy and in a co-ordinated way. Initiate, plan, control, and execute programmes and projects, and close with a post-implementation review.	Realise business benefits and reduce the risk of unexpected delays, costs and value erosion by improving communications to and involvement of business and end users, ensuring the value and quality of project deliverables and maximising their contribution to the investment and services portfolio.	F1, F2, F3, F5, F6, F8, F9, F10, F11, F14, F20, F22, F23, F24, F40, F46
BAI02	Manage Requirements Definition	Identify solutions and analyse requirements before acquisition or creation to ensure that they are in line with enterprise strategic requirements covering business processes, applications, information/data, infrastructure and services. Co-ordinate with affected stakeholders the review of feasible options including relative costs and benefits, risk analysis, and approval of requirements and proposed solutions.	Create feasible optimal solutions that meet enterprise needs while minimising risk.	F2, F3, F4, F5, F6, F7, F9, F12, F23, F24, F25

BAI03	Manage Solutions Identification and Build	Establish and maintain identified solutions in line with enterprise requirements covering design, development, procurement/sourcing and partnering with suppliers/vendors. Manage configuration, test preparation, testing, requirements management and maintenance of business processes, applications, information/data, infrastructure and services.	Establish timely and cost-effective solutions capable of supporting enterprise strategic and operational objectives.	F5, F12,F15, F16, F20, F23, F24, F25, F26, F27, F28, F29, F30, F31, F32, F33, F34, F35, F36, F37, F38, F39, F42
BAI04	Manage Availability and Capacity	Balance current and future needs for availability, performance and capacity with cost-effective service provision. Include assessment of current capabilities, forecasting of future needs based on business requirements, analysis of business impacts, and assessment of risk to plan and implement actions to meet the identified requirements.	Maintain service availability, efficient management of resources, and optimisation of system performance through prediction of future performance and capacity requirements.	F4, F10, F46
BAI05	Manage Organisational Change Enablement	Maximise the likelihood of successfully implementing sustainable enterprisewide organisational change quickly and with reduced risk, covering the complete life cycle of the change and all affected stakeholders in the business and IT.	Prepare and commit stakeholders for business change and reduce the risk of failure.	F13, F20, F21, F37, F41, F43, F44, F45
BAI06	Manage Changes	Manage all changes in a controlled manner, including standard changes and emergency maintenance relating to business processes, applications and infrastructure. This includes change standards and procedures, impact assessment, prioritisation and authorisation, emergency changes, tracking, reporting, closure and documentation.	Enable fast and reliable delivery of change to the business and mitigation of the risk of negatively impacting the stability or integrity of the changed environment.	F22, F24, F27, F29, F41

BAI07	Manage Change Acceptance and Transitioning	Formally accept and make operational new solutions, including implementation planning, system and data conversion, acceptance testing, communication, release preparation, promotion to production of new or changed business processes and IT services, early production support, and a post-implementation review.	Implement solutions safely and in line with the agreed-on expectations and outcomes.	F20, F40, F42, F43, F44, F45, F47
BAI08	Manage Knowledge	Maintain the availability of relevant, current, validated and reliable knowledge to support all process activities and to facilitate decision making. Plan for the identification, gathering, organising, maintaining, use and retirement of knowledge.	Provide the knowledge required to support all staff in their work activities and for informed decision making and enhanced productivity.	F31, F32, F33, F34, F35, F36, F39
BAI09	Manage Assets	Manage IT assets through their life cycle to make sure that their use delivers value at optimal cost, they remain operational (fit for purpose), they are accounted for and physically protected, and those assets that are critical to support service capability are reliable and available. Manage software licences to ensure that the optimal number are acquired, retained and deployed in relation to required business usage, and the software installed is in compliance with licence agreements.	Account for all IT assets and optimise the value provided by these assets.	F3, F4, F9, F10, F27, F29, F46
BAI10	Manage Configuration	Define and maintain descriptions and relationships between key resources and capabilities required to deliver IT-enabled services, including collecting configuration information, establishing baselines, verifying and auditing configuration information, and updating the configuration repository.	Provide sufficient information about service assets to enable the service to be effectively managed, assess the impact of changes and deal with service incidents.	F22, F24, F27

Management domain: Deliver, Service and Support (DSS)				
DSS03	Manage Problems	Identify and classify problems and their root causes and provide timely resolution to prevent recurring incidents. Provide recommendations for improvements.	Increase availability, improve service levels, reduce costs, and improve customer convenience and satisfaction by reducing the number of operational problems.	F40, F46
DSS06	Manage Business Process Controls	Define and maintain appropriate business process controls to ensure that information related to and processed by in-house or outsourced business processes satisfies all relevant information control requirements. Identify the relevant information control requirements and manage and operate adequate controls to ensure that information and information processing satisfy these requirements.	Maintain information integrity and the security of information assets handled within business processes in the enterprise or outsourced.	F27, F28, F29, F30, F31, F32, F33, F34, F35, F36, F37, F38, F39
Management domain: Monitor, Evaluate and Assess (MEA)				
MEA01	Monitor, Evaluate and Assess Performance and Conformance	Collect, validate and evaluate business, IT and process goals and metrics. Monitor that processes are performing against agreed-on performance and conformance goals and metrics and provide reporting that is systematic and timely.	Provide transparency of performance and conformance and drive achievement of goals.	F3, F5, F9, F40, F46