Governing the strategic alignment of big data with the use of the COBIT 5 control framework

by

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ABSTRACT

The rapid increase in data, whether in a traditionally structured or unstructured format, has prompted the inception of a new technology trend, namely big data. In order for companies to gain value from their investment, big data must be governed properly. One of the main contributing factors as to why companies that have invested in this trend cannot gain value from big data, is misalignment between their business strategies (business model), the information that has the potential to generate value; i.e. big data (information drivers), and IT (data model).

This research focuses on strategic alignment as an IT governance objective and develops a best practices guide to help companies who have invested in this trend to govern strategic alignment. A three-step methodology is developed to help build the best practices guide.

The benefits of big data are used to identify business imperatives (selected at strategic level) as part of step 1 of the methodology. Step 2 sets out to identify the risks associated with big data. These risks are then rephrased to represent strategic risks. Step 3 provides an understanding of COBIT 5, a comprehensive control framework, in order to identify those COBIT 5 processes which support strategic alignment.

The best practices guide is built by mapping the strategic big data risks (step 2) to those COBIT 5 processes that support strategic alignment (step 3). Companies that have invested in big data and that wish to govern strategic alignment successfully are advised to implement these COBIT 5 processes to address the risks associated with big data at a strategic level.

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OPSOMMING

Die vinnige toename in data, hetsy in ’n tradisioneel gestruktureerde of ongestruktureerde formaat, het gelei tot die ontstaan van ’n nuwe tegnologiese tendens, naamlik ‘big data’. Vir besighede om waarde te kry uit hul belegging moet ‘big data’ reg bestuur word. Een van die hoof bydraende faktore waarom besighede, wat reeds in hierdie tendens investeer het, nie waarde uit die belegging kan genereer nie, is wanbelyning tussen die besigheidstrategieë (besigheidsmodelle), die inligting wat die potensiaal het om waarde toe te voeg, d.w.s. die ‘big data’ (inligtingdrywers) en IT (data-modelle).

Hierdie navorsing plaas fokus op strategiese belyning as IT bestuursdoelwit en ontwikkel ’n gids vir beste praktyke om besighede wat in hierdie tendens belê het te help om die strategiese belyning te bestuur. ’n Drie-stap metodologie is ontwikkel om die gids vir beste praktyke te bou.

Die voordele van ‘big data’ is gebruik, as deel van stap 1 van die metodologie, om die besigheidsimperatiewe (wat op strategiese vlak selekteer is) te identifiseer. Stap 2 poog om die risiko’s wat verband hou met ‘big data’ te identifiseer. Hierdie risiko’s word dan herfraseer om strategiese risiko’s te verteenwoordig. In stap 3 word ’n beter begrip verkry van COBIT 5, ’n omvattende kontrole raamwerk, om daardie prosesse van COBIT 5 te identifiseer wat strategiese belyning ondersteun.

Die gids vir beste praktyke word dan gebou deur die strategiese ‘big data’ risiko’s (stap 2) te karteer teen daardie COBIT 5 prosesse wat strategiese belyning ondersteun (stap 3). Besighede wat investeer het in ‘big data’ en suksesvol wil wees in die bestuur van strategiese belyning, word aangeraai om hierdie COBIT 5 prosesse te implementeer om die risiko’s van ‘big data’ aan te spreek op ’n strategiese vlak.

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TABLE OF CONTENTS

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Stellenbosch University https://scholar.sun.ac.za

LIST OF FIGURES, TABLES AND APPENDICES

List of figures

List of tables

Stellenbosch University https://scholar.sun.ac.za

List of appendices

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CHAPTER 1: INTRODUCTION AND RESEARCH OBJECTIVE

1.1 Introduction and background

Big data is the holistic name given to large sets of data whose volume, velocity and variety challenges businesses to analyse and extract value from this data (Grossman & Siegel, 2014). Businesses today need to store considerable amounts of structured and unstructured data (Anderson & Roberts, 2012). Structured data refers to data that has a pre-defined structure. Each field in a structured data database has a name, and the relationship between fields is defined. Unstructured data is usually not stored in a relational database and does not have a pre-defined structure (Walker, 2012). Examples of unstructured data include social networking data, high-resolution images and video (Tallon, 2013).

When businesses invest in big data they must find innovative processing solutions for new and existing data (whether in a structured, unstructured or semi-structured format) to provide real business benefits. However, the processing of the data alone will not add any value to a business unless it is aligned with business goals and objectives (Gartner, 2012).

A rapid increase in data exposes the shortfalls in appropriate strategy, infrastructure (IT resources, i.e. hardware and software) and organisation (skills) required to use data effectively (Hagen, Evans, Thota, Wall, Seshadri & Khan, 2014). As a result, no value may be derived from an investment in big data. When miscommunication exists between an organisation's senior management (at a strategic level) and IT specialists (at an operational level and those responsible for IT resources), this is generally referred to as the 'IT gap' (Goosen & Rudman, 2013a).

It is therefore important to ensure alignment between business models (the business plan detailing business needs, as implemented by senior management), information drivers (the central, most important data used for decision making to increase productivity or profits, and to gain a competitive advantage) and the data modelling (used to assist with the development and maintenance of data warehousing) in order to govern, and gain value from, big data. Businesses that are successful in aligning their IT and business strategies are more likely to agree on data governance and hence be successful in the implementation of big data (Tallon, 2013).

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1.2 Research problem

Big data is the information gathered by a business from traditional, unstructured or semi-structured formats, which has the potential to generate value. Big data will, however, not be of any value to a business, either for decision making or gaining a competitive advantage, if there is misalignment between business and IT. Misalignment when investing in big data can have dire consequences. A guide is needed to help govern strategic alignment between business and IT in order to gain maximum benefit and value from an investment in big data.

1.3 Research objective and motivation

The determination of how to gain value from big data (together with risk and governance issues) has been identified by organisations who have invested in big data, as the biggest challenge thereof (Gartner, 2014a). This research will address one of the main contributing factors as to why value cannot be derived from big data, that being misalignment between an organisation's business model, information drivers and data modelling, i.e. misalignment between business, data and IT.

The objective of this research is to develop a best practices guide, based on an existing control framework, to help companies govern strategic alignment so that value can be obtained by effectively managing big data. The best practices guide will help companies to govern strategic alignment when they have invested in big data.

1.4 Research methodology

A non-empirical study was conducted by reviewing existing literature from academically published articles in local and international journals, electronic sources, theses, white papers and popular press articles to address the research problem. The following aspects were covered in the literature review:

- IT governance and IT governance objectives,
- The importance of strategic alignment as a governance objective,
- The building blocks for strategic alignment,
- The 'IT gap' and business-IT alignment,
- Control frameworks, and
- Basic business assumptions and business imperatives.

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Based on the literature review, it was possible to develop a three-step methodology which would enable companies investing in big data to govern strategic alignment. The three-step methodology, based on Goosen & Rudman's (2013) integrated control framework, sets out to achieve alignment with IT governance principles at a strategic level.

The three-step methodology focuses on matters at a strategic level. The three-step methodology, that aims to build a best practices guide that governs strategic alignment for a big data investment, is as follows:

Step 1: Identify business imperatives for companies investing in big data and identify the strategic IT risks that apply to these business imperatives.

Step 2: Identify risks associated with big data. Make a link between the risks presented by big data and strategic IT risks (as identified in step 1). Adjust big data's specific risks in terms of the strategic IT risks. The adjusted risks will be referred to as strategic risks for big data.

Step 3: Map the strategic risks for big data (from step 2) to the processes of COBIT 5. Use only those processes of COBIT 5 that specifically address strategic alignment.

The deliverable of this research is thus a best practices guide, which maps strategic risks for big data to strategic alignment processes of COBIT 5. The identified COBIT 5 processes could then be implemented (as part of a company's commitment to IT governance) to address the risks associated with big data at a strategic level.

1.5 Organising the research

Chapter 2 contains a literature review of IT governance, with the primary focus on strategic alignment as an IT governance objective. A three-step methodology is developed in order to build a best practices guide for governing strategic alignment when an investment is made in big data.

Chapter 3 contains an overview of big data, including the trend's characteristics, the parties involved with big data, the benefits and the risks. Step 1 of the three-step methodology is also partly addressed in this chapter.

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Chapter 4 completes the best practices guide by addressing the remaining steps of the methodology. This includes an overview of the COBIT 5 control framework in order to identify the strategic alignment processes of COBIT 5 which will be mapped to strategic risks for big data.

The main deliverable of this research is the best practices guide. Figure 1.1 illustrates how the three-step methodology to build the guide is followed throughout this research.

1.6 Scope limitations

This research is subject to the following limitations:

- International IT governance principles have been categorised into the following areas: strategic alignment, value delivery, risk management, resource management and performance management (Liell-Cock, Graham & Hill, 2009). This research focuses on strategic alignment as an IT governance principle. Value delivery is addressed to a lesser extent. Risk management, resource management and performance management do not form part of this research.
- This research does not include a detailed investigation into technologies associated with processing and analysing big data (examples include Hadoop) (Hagen *et al.*, 2014), and will therefore only address issues 'above' the IT gap.
- This research does not include all possible business imperatives, but only those that were derived from the benefits associated with big data. The business imperatives can change over time, depending on the benefits associated with the technology trend.
- Only the IT-related goals in COBIT 5 were taken into consideration for identifying processes which address strategic alignment. Enterprise and enabler goals were not considered.
- Only those processes of COBIT 5 which were considered to address strategic alignment as their main IT-related goal were used in the best practices guide. Those that address strategic alignment as a subordinate IT-related goal were not included.
- This research does not provide any interpretation as to how the strategic alignment processes of COBIT 5 should be implemented.

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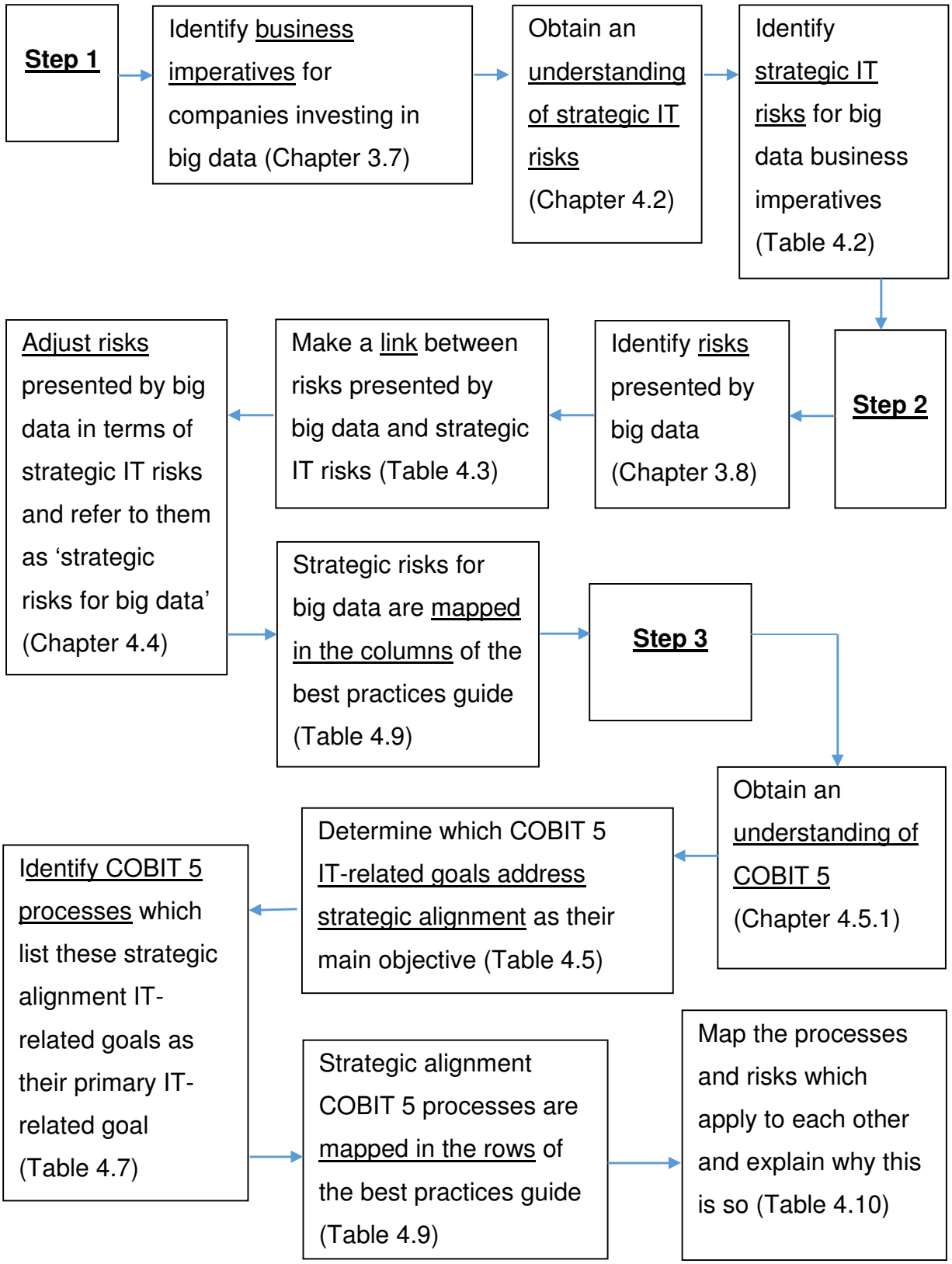
Figure 1.1: Building the best practices guide



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CHAPTER 2: LITERATURE REVIEW

2.1 Background and introduction

Whenever a decision is made to introduce a new technology trend (such as big data) in a business, new risks accompanying the new trend arise and must be addressed (Gerber, 2015). The risks presented by a technology trend, whether new or existing, need to be managed and monitored, i.e. governed.

The 'King III Code for Governance Principles in South Africa' includes a chapter on IT governance principles which stresses the importance of managing IT risks (IODSA, 2009). The King III code, however, does not provide any additional guidance on how the IT governance principles could, or should, be implemented (Goosen & Rudman, 2013a). A number of control frameworks exist to assist businesses in achieving good IT governance, and to address several IT governance objectives.

This chapter will provide an overview of IT governance and will discuss the various IT governance objectives. Focus will primarily be placed on strategic alignment as IT governance objective and an in-depth review will be conducted on the implications of misalignment (or falling into the IT gap). This chapter concludes by providing an understanding of how an existing control framework could be used to build a best practices guide aimed at achieving strategic alignment (as part of IT governance) when a new technology trend is introduced in a business.

2.2 Corporate and IT governance

2.2.1 Background

There are many ways in which an organisation can be governed. Examples of governance mechanisms include strategies, goals, policies, plans and standards. Different governance mechanisms are used to deliver value and minimise risk. Governance has an impact on achieving the strategic goals of an organisation and therefore differs from the managerial function, which aims to achieve operational goals (Liell-Cock *et al*., 2009).

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The King III code applies to all entities in South Africa, regardless of the manner and form of incorporation and whether they are in the public, private or non-profit sectors (IODSA, 2009). Key aspects addressed in the King III code emphasise leadership, sustainability and corporate citizenship as central themes in achieving good governance. These aspects can be summarised as follows:

- Good governance will reveal responsible leaders, who can direct company strategies and operations to such an extent that sustainable economic, social and environmental performance is achieved,
- Sustainability poses great opportunities and risks to businesses and should be understood by decision makers, and
- Corporate citizenship is enacted along with good governance, seeing that companies will operate in a sustainable manner (IODSA, 2009).

2.2.2 Corporate governance

In the past corporate governance has been defined as the structures and relationships which determine corporate direction and performance, with the board of directors typically being pivotal in this process. Apart from the board of directors, other participants of corporate governance include shareholders, management, employees, customers and all other stakeholders (McRitchie, 1999).

Corporate governance should increase accountability in an era where there are many changes in society, including changes in the competitive business environment and new technology trends. The approaches of organisations to corporate governance aim to achieve both effective performance and social accountability and responsibility (Krechovská & Procházková, 2014). IT governance is an essential part of the corporate governance framework and should therefore also be effectively managed to support the corporate direction and performance goals of an organisation (Goosen, 2012).

2.2.3 IT governance

Corporate governance is driven by the goal to ensure that an organisation’s operations are aligned in such a way that they meet shareholder expectations for financial and environmental prudence, gain competitive advantages and perform risk management.

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Accordingly, IT governance would aim to achieve the same goals for its IT accountabilities (Wilkin & Chenhall, 2010). As mentioned previously, IT governance forms an integral part of corporate governance, with the only difference being the resources utilised in achieving business objectives (Liell-Cock *et al.*, 2009).

Van Grembergen and De Haes argue that the involvement of business is crucial in obtaining business value from IT investments and therefore expand the concept of IT governance to 'Enterprise Governance of IT' (Van Grembergen & De Haes, 2009: 3), which is defined as follows:

"Enterprise Governance of IT is an integral part of corporate governance and addresses the definition and implementation of processes, structures and relational mechanisms in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled business investments."

If corporate and IT governance go astray, the results can be destructive. Enron's bankruptcy in 2001 and the enactment of the Sarbanes-Oxley Act in 2002 prove that past events have made IT governance both highly relevant and highly regulated (Ping-Ju Wu, Straub & Liang, 2015). While the fall of Enron cannot solely be blamed on a lack of corporate and/or IT governance, good governance practices might have highlighted issues at an earlier stage. The value generated from an organisation's IT is mainly due to good IT governance. Weill and Ross (2014) argue that, if governance mechanisms are poorly implemented, governance arrangements will fail to yield the desired results. Top performing firms generate returns on their IT investments up to 40 percent higher than their competitors due to the existence of well-designed and communicated IT governance processes (Weill & Broadbent, as cited by Weill & Ross, 2004).

King III defines IT governance as the framework that supports the effective and efficient management of IT resources to help achieve a company's strategic objectives (IODSA, 2009). The King III code lists seven IT governance principles in section 5 of the code which should be implemented as part of good corporate governance. Table 2.1 below lists these seven principles.

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Liell-Cock *et al*. (2009) discuss the alignment between the King III code and IT governance. They conclude that, if IT governance is in place, it will help to ensure strategic alignment, value delivery, risk management, resource management and performance management. These IT governance objectives are defined and explained below:

- **Strategic alignment:** Focus is placed on aligning a business' IT investment with its strategic objectives. By aligning IT and business, the necessary capabilities are built to deliver business value (ITGI, 2003: 22).
- **Value delivery:** Value delivery concentrates on optimising IT expenditure in order to prove the value of IT. The value of IT could be translated into competitive advantage, elapsed time to order/service fulfilment, customer satisfaction and so forth. The actual cost and return on investment of IT need to be managed in order to ensure IT value delivery (ITGI, 2003: 24).
- **Risk management:** Risk management addresses the safeguarding of IT assets and disaster recovery. Risk awareness by senior corporate officers is stressed as a crucial element in risk management (ITGI, 2003: 26).
- **Resource management:** Successful IT performance lies in the optimal investment, use and allocation of IT resources. IT resources does not solely refer to hardware and software, but to people managing IT projects, applications, technologies, facilities and data that serves the needs of the business (ITGI, 2003: 28).
- **Performance management:** Performance management ensures that projects are managed and IT services are monitored (ITGI, 2003:29). Value is not unique to financial performance and should also be measured based on customer responses, process efficiencies and the business' ability to learn and grow.

This research primarily focuses on strategic alignment as an IT governance objective and therefore the IT governance principles (listed in section 5 of King III) which help to address strategic alignment are emphasised, based on the recommended practices in the King III code, as indicated in Table 2.1.

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Table 2.1: King III IT governance principles with a focus on strategic alignment

IT governance principle	Description of the principle	King III-recommended practices that help to achieve strategic alignment
5.1	The board should be responsible for IT governance.	An IT charter and policies should be established and implemented.
5.2	IT should be aligned with the performance and sustainability objectives of the company.	The IT strategy should be integrated with the company's strategic processes.
5.3	The board should delegate to management the responsibility for the implementation of an IT governance framework.	The Chief Information Officer (CIO) should have access to and interact regularly on strategic IT matters with the board.
5.4	The board should monitor and evaluate significant IT investments and expenditure.	Not applicable.
5.5	IT should form an integral part of the company's risk management.	Not applicable.
5.6	The board should ensure that information assets are managed effectively.	The information security strategy should be approved and implemented.
5.7	A risk committee and audit committee should assist the board in carrying out its IT responsibilities.	Not applicable.

Source: (IODSA, 2009)

Table 2.1 highlights the IT governance principles which help to achieve strategic alignment (principles number 5.1, 5.2, 5.3 and 5.6). It is evident that the board of directors (together with senior management, to whom duties are delegated) is ultimately responsible for IT governance as part of their corporate governance duties.

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The research of Weill and Ross (2004) reiterates how alignment can be achieved in an organisation. According to Weill and Ross, companies implement their governance responsibilities by making use of governance mechanisms, which include structures, processes and communications. In their book on IT governance, Weill and Ross depict various common IT governance mechanisms, specifically within the alignment process, which were ranked by Chief Information Officers (CIOs) from 256 enterprises researched in 23 countries, on a scale from 1 to 5 for effectivity (1 being ineffective to 5 being highly effective). The IT governance mechanism which was indicated by the CIOs as being most effective in governing alignment was 'tracking of IT projects and resources consumed' (Weill & Ross, 2004: 87).

This mechanism identified for effective alignment is supported by the King III code principles 5.3 and 5.6, which emphasise the CIO's responsibility of reporting strategic IT matters to the board of directors, and also the board's responsibility of ensuring the effective management of IT assets. Achieving strategic alignment, and doing so effectively, is therefore entirely attainable, provided that an organisation commits to implementing IT governance principles.

2.3 Strategic alignment

2.3.1 Strategic alignment as a governance objective

Strategic alignment is one of the main objectives of IT governance. The concept of strategic alignment was proposed during the early nineties when IT evolved from its traditional task as administrative support, towards a more strategic role in an organisation (Henderson & Venkatraman, 1993). The concept is based on two fundamental assumptions, namely that economic performance is directly related to management's ability to create a link between the organisation's position amongst its competitive product market and an administrative function which provides support to execute plans and produce the results; and also that strategic alignment is not an event, but a process of continuous adaption and change.

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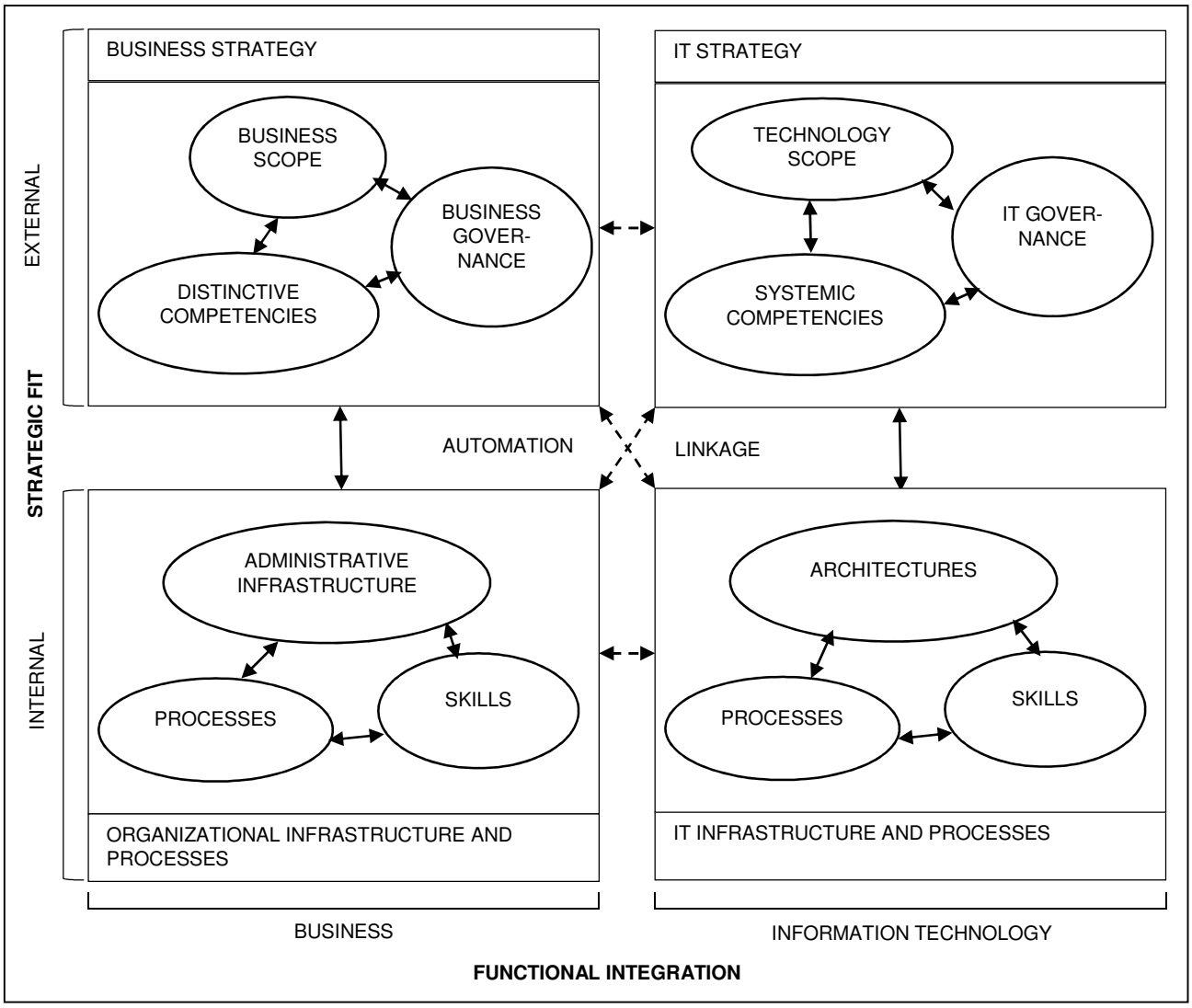
Figure 2.1: Strategic alignment model



Source: (Henderson & Venkatraman, 1993: 476)

Strategic alignment is illustrated by Henderson and Venkatraman in Figure 2.1. The figure shows alignment between the business strategy and the organisational infrastructure (processes and tasks), and, in the same sense, the alignment between the IT strategy and the manner in which the information system infrastructure (hardware and software) supports the IT strategy.

This top to bottom alignment is referred to as 'strategic fit' and recognises both the external domains (how the business and IT is positioned in the marketplace) and the internal domains (how the business and IT should be managed and configured to support the strategies) (Van Grembergen & De Haes, 2009).

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The figure also includes 'functional integration', which is illustrated horizontally (left to right), and depicts the business to IT strategies and infrastructures. The functional integration is divided into strategic integration (which links the business and IT strategies), reflected in the external domain where high-level decisions are made based on competitive markets and visions for the future, and operational integration (which links organisational infrastructure and processes with IT infrastructure and processes), reflected in the internal domain where day-to-day activities are performed.

2.3.2 Creating value from IT through strategic alignment

Since the inception of the concept of strategic alignment it has been evident that a need exists to ensure alignment between information system planning and business goals and objectives. Strategic alignment is also crucial in order to maximise the value of IT, i.e. reaching the business goals and objectives through the use of IT.

Table 2.2: How strategic alignment creates value through IT

Ways to search for value from IT	The King III IT governance principle (which supports strategic alignment) that addresses the value delivery capability of IT
Business strategies, and the role of IT in achieving those business strategies, are clarified.	King III principle 5.2: Making sure IT is aligned with business objectives.
The monetary amount spent on, and the value received from, IT are measured and managed.	King III principle 5.6: Information assets should be managed effectively.
The changes required within an organisation to absorb the benefits from new IT capabilities are managed.	King III principle 5.3: Creating the responsibility (most likely that of the CIO) to report on strategic IT matters.
Organisations learn from every IT implementation and become proficient in how they share and reuse their IT assets.	King III principle 5.3: Constant feedback from the CIO to the board of directors on the performance of IT.

Sources: (Weill & Ross, 2004; IODSA, 2009)

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Weill and Ross (2004) underline the importance of alignment in their book on IT governance, in which they list four ways that top-performing enterprises can search for value from IT. These items are listed in Table 2.2 above. The King III IT governance principles identified to achieve strategic alignment (as highlighted in Table 2.1), are paired with each item listed in the table above to illustrate how strategic alignment as a governance objective helps to create value through IT.

By upholding and adhering to IT governance practices, strategic alignment will be achieved, which will help to ensure that value is obtained from investments in IT.

2.3.3 Consequences of non-alignment or misalignment

Alignment, in its simplest sense, is the degree to which the IT function understands business priorities and then utilises IT resources, undergoes projects and delivers information consistent with the business' priorities (Shpilberg, Berez, Puryear & Shah, 2007). In her thesis on addressing the IT gap by means of comprehensive alignment, Smit investigates the negative impacts on businesses as a result of non- or misalignment (Smit, 2009). The major risks identified for misalignment include:

- business interruption, which might have financial implications and which could also result in loss of confidence in the IT function by staff and customers (Bakari, Tarimo, Yngström, Magnusson & Kowalski, 2007),
- unnecessary IT costs and overheads, due to ineffective use of IT resources (IBM, 2006),
- excessively complex systems, applications and other infrastructure (Shpilberg *et al.*, 2007), and
- insufficient processing and reporting as a result of ineffective and incomplete IT controls (Smit, 2009).

When non-alignment or misalignment occurs, it can doom IT to either irrelevance or failure (Shpilberg *et al.*, 2007).

2.4 Building blocks for alignment

It has been established that value is gained from investments in IT if strategic alignment is governed properly.

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Alignment is achieved when IT in a business is organised and assembled in such a way that it supports the needs and objectives of the business. The business needs and objectives are detailed in a business model. The IT plans and technical build are developed in a data model. The central, most important information used by a business for decision making, and which could have an impact on profitability, is referred to as the information drivers of the business. Therefore, the business model, information drivers and data model must be in sync in order for alignment to be achieved. These aspects form the building blocks for alignment, and are discussed in greater detail below.

2.4.1 Business model

The concept of a business model is not a recent occurrence. The oldest essay on the definition of the business model dates back to 1996 and many different alterations have since been published to help to clarify the meaning over time. The developments and expansions of the concept were not only necessitated by technological advances, but also economic factors, such as the search for shareholder value and regulatory factors. The emergence of the business model concept resulted from a need to explain how any organisation is able to create and capture value (Sahut, Hikkerova & Khalfallah, 2013).

The business model is framed within a global, local or industry context for any organisation, and takes the maturity scale of said organisation into account. The business model includes business assumptions, business strategies, business imperatives, business policies and procedures, as well as business processes (Boshoff, 2014).

A business model is therefore a business plan which details how the business needs will be addressed and how goals can be achieved.

2.4.2 Information driver

Data-driven decision making is a practice explained by Provost and Fawcett as follows: “(Decisions are based) on the analysis of data rather than purely on intuition” (Provost & Fawcett, 2013: 53). The data used in this decision making process, the data that drives profitability and competitive advantage, is collectively referred to as the information drivers of a business.

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Information drivers are derived from the business model and are therefore the central, most important data (or big data sets) used for decision making to increase productivity or profits. Information drivers can also be referred to as the data centricity of an organisation and will differ for each business, depending on the industry and specific business attributes.

The concept of information drivers is best explained with an example of a retail business model. Customer information is essential with regard to normal business activity, such as debt collection. However, customer demographics and sales cannot be used in isolation when making valuable, strategic decisions. This data needs to be used in conjunction with other useful information. Shelf space, school or public holidays and temperature (inside and outside the store) are examples of other useful information for a retailer. Every shelf in a store has specific attributes, such as visibility, product advertising and product turnover. By utilising prime shelf space properly, and according to the data records of sales per shelf space, a business can decide which products to display on these shelves to maximise profits. Similarly, the sales made on school or public holidays cater for specific target markets and the type of products sold could differ depending on the weather. The information drivers of a retailer would thus be ‘shelves’ in conjunction with (and not solely) ‘client’.

Data sources have exploded and therefore sales history alone cannot be used as the only source for analysing customer behaviour and decision making (Franks, 2012).

2.4.3 Data model

The traditional data management techniques have become increasingly inadequate, given that data is now moving into, out of and across organisations very quickly (Hagen *et al.*, 2014). This necessitates a framework or system which is capable of managing data.

Data models are used to assist with the development and ongoing maintenance activities of data warehousing. In these cases, data models are used to ensure sufficient communication between business sponsors (senior management) and the IT development staff (O’Sullivan, Thompson & Clifford, 2014). Modelling is therefore the tool used to build a system surrounding the data, from acquiring the data, to storage, processing and eventually the use thereof for decision making; i.e. a model for managing business processes.

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The data model also needs to take business imperatives into account, whilst still remaining functional to users of the information system.

The research problem originates here: data models are built in such a way that their information drivers (their data focal point) are not aligned with business models. The misalignment results in bad (big) data for decision making.

2.5 'IT gap' and business-IT alignment

When miscommunication exist between those charged with governance and IT specialists, this creates what is commonly referred to as the 'IT gap'. The board of directors is responsible for corporate governance and uses appropriate control frameworks to help address governance issues, but they do not necessarily have the knowledge to determine whether IT control techniques and technologies have been correctly implemented to support strategic goals and objectives. Likewise, IT specialists who implement the IT control techniques and technologies do not necessarily have adequate knowledge of control frameworks, which can result in IT not properly supporting the organisation's strategies (Rudman, 2008).

Matters considered at strategic level are referred to as being 'above' the IT gap. Matters that relate more to the technical aspect at operational level are referred to as being 'below' the IT gap.

If the IT gap exist in any business, strategic alignment cannot be achieved and this will ultimately lead to non-compliance with IT governance principles, as set out in King III. It is therefore important to ensure business-IT alignment to avoid falling in an IT gap situation. The consequences of falling in the IT gap are similar to the consequences set out in section 2.3.3 for non-alignment or misalignment.

Henderson and Venkatraman were the first to clearly describe the interrelationship between business and IT (refer to Figure 2.1). Van Grembergen and De Haes further define business-IT alignment as "the fit and integration among business strategy, IT strategy, business structures and IT structures" (Van Grembergen & De Haes, 2009: 6). They also stress the importance of business-IT alignment to achieve business value through investments in IT. Figure 2.2 below explains this is greater detail:

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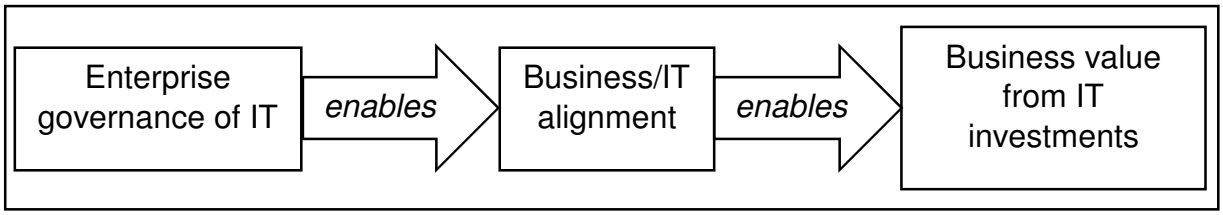
Figure 2.2: Enterprise governance of IT, business-IT alignment and business value from IT investments



Source: (Van Grembergen & De Haes, 2009: 6)

Figure 2.2 emphasises the importance of IT governance as a foundation for alignment which, in turn, helps to realise value from IT. Without the business-IT alignment function in the midst of governance and value delivery, an organisation can fall into the IT gap.

Control frameworks are valuable tools to help establish business-IT alignment.

2.6 Control frameworks

The King III code defines a control framework as “a set of fundamental controls that must be in place to prevent financial or information loss in a company” (IODSA, 2009: 53). A control framework therefore provides a structured approach to organise internal controls so that they address risks and maximise business value. Examples of existing control frameworks include:

- Control Objectives for Information and Related Technology (COBIT),
- The Information Technology Infrastructure Library (ITIL),
- Projects in Controlled Environments (PRINCE2), and
- International Organization for Standardisation (ISO), etc.

The King III code cites COBIT, among others, as a control framework to be considered in addressing IT governance (IODSA, 2009). Steenkamp (2011) concluded that the processes detailed in COBIT are, in fact, well aligned with the IT governance requirements, as set out in King III. COBIT 5 was released by ISACA in 2012 and is the latest version of COBIT. This research will therefore focus on COBIT 5, as an existing control framework, to build a best practices guide which will help to govern strategic alignment when a new technology trend is implemented.

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A distinction must be made between an organisation's basic business assumptions and (strategic) business imperatives before building such a best practices guide (Goosen & Rudman, 2013b). The business imperatives will raise strategic IT risks must be addressed by such a best practices guide in order to avoid the IT gap. The difference between basic business assumptions and business imperatives will now be examined.

2.7 Basic business assumptions and business imperatives

Certain basic elements are essential for the proper functioning of any business. Without these basic elements, a business would not be able to survive. These elements are also referred to as basic business assumptions and include:

- Profit orientation,
- Accounting records for transacting (all business cycles), cash flow management, payroll functionality,
- Regulatory compliance,
- Business continuity, *etc*. (Boshoff, 2014).

Business imperatives differ from basic business assumptions in that they are the crucial elements that need to be executed exceptionally well for a business to succeed in a specific geography, industry or segment and that will create a competitive advantage. Business imperatives are selected at a strategic level and will therefore flow from the business model and form the foundation of the business-IT alignment process (Goosen & Rudman, 2013a).

2.8 Integrated control framework

Senior management is responsible for effectively addressing IT governance principles (refer to section 2.2.3). It is also evident from the literature review that companies are driven by their business imperatives to ensure alignment between business and IT. It can therefore be deduced that IT governance principles are implemented based on the business imperatives, assuming that all operational objectives (basic business assumptions) are already in place.

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Goosen and Rudman (2013b) developed an integrated control framework to address King III's IT governance principles at a strategic level, by combining various control frameworks, models and standards, in order to simplify the overall levels of control in a single framework. They adopted the following methodology to develop an integrated control framework to achieve alignment with IT governance principles at a strategic level:

1. Identify the business imperatives of a company. Consideration should also be given to basic business assumptions, which are assumed to be in place and not integral in establishing alignment.
2. Identify the risks associated with the business imperatives.
3. Identify the control objectives of existing control frameworks and link the risks identified in step 2 to the control objectives in order to mitigate these risks and achieve alignment.

This research will make use of the abovementioned methodology of Goosen and Rudman (2013b), but will adjust their methodology to achieve strategic alignment, specifically when a new technology trend, in this instance big data, has been adopted. The three-step methodology, which will be followed in this research, is set out in Table 2.3.

Table 2.3: Three-step methodology to build a best practices guide for governing strategic alignment of big data with the use of COBIT 5

Step 1	Identify business imperatives for companies investing in big data and identify the strategic IT risks that apply to these business imperatives.
Step 2	Identify risks associated with big data. Make a link between the risks presented by big data and strategic IT risks (as identified in step 1). Adjust big data's specific risks in terms of the strategic IT risks. The adjusted risks will be referred to as strategic risks for big data.
Step 3	Map the strategic risks for big data (from step 2) to the processes of COBIT 5. Use only those processes that specifically address strategic alignment.

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The mapping of strategic risks for big data to COBIT 5 processes which specifically address strategic alignment enables the building of a best practices guide to govern strategic alignment of big data.

Strategic risks for big data will be mapped per column in the best practices guide. COBIT 5 processes that address strategic alignment will be mapped per row in the best practices guide. If a COBIT 5 process is applicable to a strategic big data risk (i.e. the process will help to address the risk), it will be indicated in the corresponding block in the grid. Companies that wish to achieve strategic alignment from an investment in big data could then implement the identified COBIT 5 processes. Figure 1.1 depicts how, and where, this research will address the three steps of the methodology in order to build the best practices guide.

2.9 Conclusion

The purpose of this literature review was to gain an understanding of IT governance with an emphasis on strategic alignment as an IT governance objective. Strategic alignment was studied to establish how it helps to create value from IT. The consequences of not governing strategic alignment, thus falling into the IT gap, were also explored.

This chapter continued with the definition and importance of business imperatives as the foundation of the business-IT alignment process. The identification of business imperatives is part of the first step of building a best practices guide for governing strategic alignment when an investment has been made in big data. This chapter concluded with the three-step methodology which will be followed in this research to build such a best practices guide.

Chapter 3 will aim to provide a detailed overview of big data, including the benefits and risks associated with big data. The benefits of big data will help to identify business imperatives for the technology trend (part of step 1 of the three-step methodology to build the best practices guide). The risks of big data, as identified in Chapter 3, form part of step 2 of the methodology. The remaining steps of the methodology will be addressed in Chapter 4. Also refer to Figure 1.1, which depicts exactly how the best practices guide is built throughout this research.

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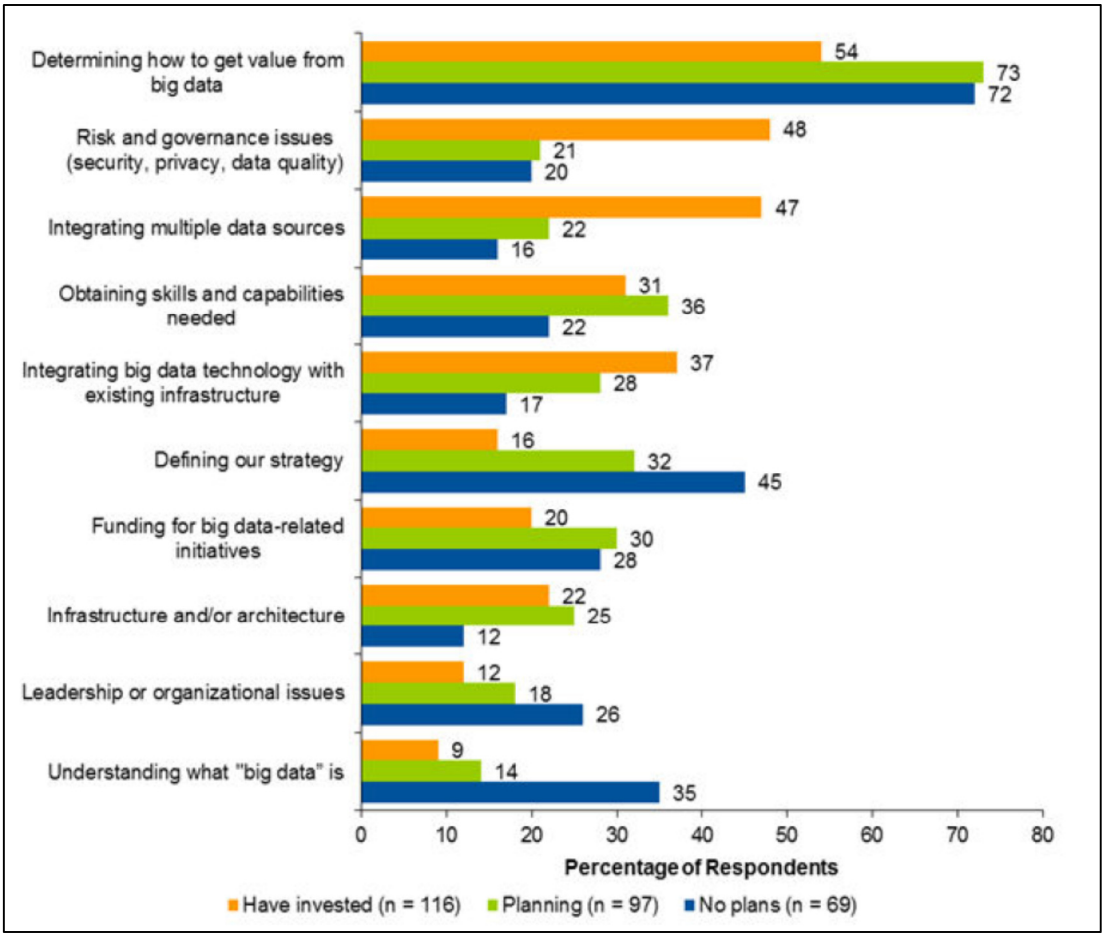
CHAPTER 3: BIG DATA

3.1 Introduction

Extensive research has been conducted on big data as a trend. The primary focus has shifted away from an explanation of the trend, towards deployment issues presented by big data, investing in big data, and transparency as it relates to big data analytics. The focus has thus shifted to determining how value can be derived from big data (Gartner, 2014b). A survey analysis performed by Gartner on big data investments in 2014 found that the investment in big data and related technologies continues to expand. The biggest challenges that businesses face with big data are evolving from the conceptual (such as defining how to get value from big data) to the practical (data governance, security and risk) aspects (Gartner, 2014a).

Figure 3.1: Big data challenges identified by surveyed participants



Source: (Gartner, 2014a: 11)

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Figure 3.1 illustrates the response from organisations who participated in the survey. Surveyed participants ranged from organisations who had invested in big data, to organisations planning to invest and also organisations who did not have plans to invest in big data. The biggest concern for all respondents was determining how to get value from big data.

It is estimated that US$610 billion in annual productivity and cost savings could be generated by big data analytics (specifically in four large sectors, namely retail, manufacturing, health care and government) (Lund, Manyika, Nyquist, Mendonca & Ramaswamy, 2013). This highlights the fact that big data could be a key source of a firm's competitive advantage (Kshetri, 2014).

Research has also been published on strategic information systems planning (SISP), where computer-based applications are identified to help an organisation reach its business goals (Lederer & Sethi, 1988). Strategic (information system) alignment is the correlation between the business plan and information system plan to such an extent that the content in each reflects the other (Newkirk, Lederer & Johnson, 2008).

It is evident from the literature review conducted in Chapter 2 that there is scope for research which can form a link between the adoption of a new technology trend (such as big data) and the importance of strategic alignment as an IT governance objective. Strategic alignment between business and IT systems will help to ensure that value can be derived from the new trend, and that the risks are addressed properly. This chapter aims to provide an insight into big data in order to identify the benefits and risks associated with the trend. Business imperatives for big data will also be identified in this chapter, based on the benefits associated with the trend. The business imperatives and risks associated with big data will be used in Chapter 4 to continue with the construction of the best practices guide for governing strategic alignment.

3.2 Background and definition

The McKinsey Global Institute published a paper in 2011 highlighting interesting facts regarding the amount of data that was available at that time (Manyika, Chui, Brown, Bughin, Dobbs, Roxburgh & Hung Byers, 2011). One of the most interesting examples published was the fact that it would have cost $600 to buy a disk drive to store all of the world's music at that stage.

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Another example revealed that 30 billion pieces of content were shared on Facebook every month (Manyika *et al*., 2011). The vast data growth since the McKinsey publication is evident in various popular web sources, where the growth is being interpreted in measurable and comparable intervals. The Data Never Sleeps 2.0 infographic published the following data statistics in 2014:

Every minute approximately -

- 2.5 million pieces of content are shared by Facebook users,
- 300,000 tweets are sent,
- 220,000 new photos are posted on Instagram,
- 72 hours of new video content is uploaded by YouTube users,
- 50,000 applications are downloaded by Apple users,
- 200 million messages are emailed, and
- $80,000 in online sales is generated by Amazon (James, 2014).

The idea of big data originated when engineers had to update and improve their existing tools used for data analysis. This was necessitated since the volume of information had become too large for the existing memory that computers used for processing (Mayer-Schönberger & Cukier, 2013). The McKinsey paper went on to define big data formally as: "…datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse" (Manyika *et al*., 2011: 1) This definition implies that technological advances will influence the size of datasets and therefore increase big data over time. This is also evident from the Data Never Sleeps 2.0 blog entry, from which it is clear that the amount of data generated has grown, and continues to grow, exponentially (James, 2014).

Big data is not only about quantity. Big data also has complexity, variety and velocity (i.e. the speed at which data is transmitted and received) compared to data sources of the past (Franks, 2012). The promise of big data is not just that more and better ciphering can be carried out on large volumes of traditional structured data sources, such as transactions. Rather, big data suggests that significant operational efficiency and insight can be obtained by combining these traditional sources with other new, unstructured data sources (O'Sullivan *et al*., 2014).

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3.3 Structured, unstructured and semi-structured data

Bill Franks addresses the three types of data structures in his book, titled 'Taming the Big Data Tidal Wave' (Franks, 2012). The data structures are explained as follows:

- **Structured data:** originates from traditional data sources. Traditional sources have clear, defined formatting, which includes specific details such as date format (DD/MM/YYYY), 12-digit numeric format, preselected symbols with three- to five-digit character fields, and so on. The format and order in which data is presented is fixed, which makes it easy to extract and analyse.
- **Unstructured data:** sources are those over which the business has no, or little, control. Text data, video data and audio data all fall into this classification. Every picture has pixels which are set up in rows, but the manner in which those pixels fit together to create the image is different for every unit.
- **Semi-structured data:** is defined by Franks as data with a logical flow and format, which can be understood, even though the format is not easily extracted or analysed. There could be unnecessary data entangled within the fragments of high value data, meaning that analysing the information would not be simple. It is, however, possible to read semi-structured data. This is done by employing complex rules which are necessary to determine how to proceed after reading each piece of information.

Big data is often described as unstructured. When it is, however, possible to develop a relationship between pieces of data so that it could be incorporated into an analytical process, it would be considered semi-structured. When data is semi-structured it can be used by analysts and will provide information of value, to be used at strategic level.

It is important to understand the various types of data sources in order to identify the central and most important data for decision making. This central data will be the information driver and needs to be aligned with the business and data models in order for it to deliver maximum value to the business (refer to section 2.4.2). Big data is also more manageable to handle if focus is placed on the most important pieces of the data (Franks, 2012).

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3.4 Characteristics of big data

"Big data is high-volume, -velocity and –variety information assets that demand cost-effective innovative forms of information processing for enhanced insight and decision-making" (Gartner, 2012). Big data is most often characterised by the three Vs: volume, velocity and variety. SAS, a company considered to be the leader in business analytics and business intelligence software, includes variability and complexity as two more characteristics of big data (sas.com, 2013). Other specialists believe that data value could be listed as a defining characteristic of big data (Kaisler, Armour, Espinosa & Money, 2013). This research will discuss big data value as part of the benefits encompassed by the trend in section 3.5 and not as part of the characteristics of big data. The five characteristics of big data are briefly explained in Table 3.1:

Table 3.1: Characteristics of big data

Characteristic	Explanation
Volume	A huge amount of data is created from a wide range of sources (Kshetri, 2014).
Velocity	Velocity refers to the speed, the higher rate of data arrival and/or consumption (Gartner, 2012; Kaisler *et al.*, 2013).
Variety	Variety of data refers to the different types of information in multiple forms, types and structures (Gartner, 2012). The huge variety of data presents one of the biggest obstacles from an analytical perspective (Kaisler *et al.*, 2013).
Variability	Unstructured data presents an added challenge (in addition to increasing velocity and variety of data) due to the highly inconsistent flow of data (sas.com, 2013).
Complexity	Data originates from multiple sources. Data from these sources must be linked, matched, clarified and transformed (sas.com, 2013). Data complexity is then measured by the degree of interconnectedness and interdependence in the big data structures (Kaisler *et al.*, 2013).

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3.5 Parties involved with big data

The parties involved with big data originate from the board of directors that, in turn, delegates IT governance matters to a Chief Information Officer (CIO). The CIO, will then be primarily responsible for strategic IT matters, which includes the decision to invest in big data (refer to Table 2.1 for King IT governance principles). The CIO has a reporting duty and functions at strategic level, 'above' the IT gap.

The implementation of big data will require IT professionals to build data models which can support the decision to invest in big data. They will be able to determine which data sources are available and suitable for use in analytical programmes (technologies such as 'Hadoop') in building the data model. IT professionals therefore have a duty to analyse available data and they function 'below' the IT gap. The analytical programmes used to analyse data will become more powerful (intricate and expensive) as the size and scale of data collections increase. This makes it even more important to ensure that the IT professionals make informed decisions regarding which tools to use for analysing the data (Mayer-Schönberger & Cukier, 2013).

The summary in Table 3.2 depicts the different responsibilities for parties 'above' and 'below' the IT gap.

Table 3.2: Reporting vs analysis

Reporting	**Analysis**
Provides data	Provides answers
Provides what is asked for	Provides what is needed
Is typically standardised	Is typically customised
Does not involve a person (to the extent that a template for reporting exists)	Involves a person
Is fairly inflexible	Is extremely flexible

Source: (Franks, 2012: 183)

The table also illustrates how misalignment could exist when there is no coherence or proper communication between the parties involved with the decision, and implementation, of an investment in big data.

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3.6 Benefits of big data

Mayer-Schönberger and Cukier believe that big data will be a source of new economic value and innovation (2013). Big data benefits are not solely for decision making, but can also generate deeper business insight and can optimise, automate or design new processes (Gartner, 2014c). When business processes need to be adjusted in order to ensure optimum value from big data, the business model will be brought into review. This is done with reference to the applicable data that generates value (information drivers), and eventually the data model will be rebuilt to accommodate the insights on how value is derived. This top to bottom approach (by starting with the business model, then taking information drivers into account and eventually the data modelling) will ensure alignment and address the IT gap (refer to sections 2.4 and 2.5).

Alignment is highlighted by Mayer-Schönberger and Cukier. According to them, the value of data has shifted from its primary use of supporting transactions, to big data's potential future uses where data itself become the 'good' that is being traded. This shift in value that data generates has profound consequences and it may force companies to change their business models (Mayer-Schönberger & Cukier, 2013).

The benefits of big data lie in the value it can create. Value from big data will arise if the data is analysed properly and it provides information that could be used by the business (Kaisler *et al*., 2013). The technical literature in the research performed by Kaisler *et al*. suggested the following ways in which value can be created from big data:

- Big data establishes transparency if it is used to analyse business or functional aspects, such as quality, lower costs, time to market and so forth.
- Business decisions or approaches could be tested by extrapolating data and using it for experimental analysis.
- Market analysis could be better defined with the help of big data, based on customer information.
- Sophisticated analysis of customer tendencies could provide real-time information for decision making.
- Product innovation could be aided, based on customers' reactions to products (Kaisler *et al*., 2013).

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3.7 Business imperatives for big data

As noted in Chapter 2, business imperatives are crucial in establishing business-IT alignment. These imperatives are the fundamental principles that need to be executed exceptionally well for a business to succeed and are selected at a strategic level. Business imperatives will be different for each business, depending on their unique business model and they are considered to be the drivers of the business (Boshoff, 2014).

Business imperatives must be identified for companies investing in big data to ensure that they gain a competitive advantage from the investment in the new technology trend. Identifying business imperatives for companies investing in big data is also part of step 1 of the three-step methodology (refer to Table 2.3) in building a best practices guide for governing strategic alignment of big data.

Each imperative listed below was identified specifically for businesses investing in big data, based on the benefits and opportunities presented by big data, as well as previous research conducted on the topic. Refer to Table 3.3, which links business imperatives to the benefits of big data, as identified in section 3.5.

Table 3.3: Business imperatives for big data based on the benefits of big data

Benefit of big data	**Business imperative**
Establish transparency	Collaboration
Experimental analysis by testing business decisions	Agility, Up-skilled workforce
Market analysis	Innovation, Pro-active management, Scalability
Sophisticated analysis of real-time information for decision-making	Pro-active management, Up-skilled workforce
Product innovation	Innovation

Source: (Adapted from Kaisler *et al.*, 2013)

The business imperatives identified for big data in this research are based on the benefits identified, and are not considered to be an exhaustive list of business imperatives. This research will focus on the following business imperatives: agility, collaboration, innovation, pro-active management, scalability and up-skilled workforce.

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Although business imperatives are considered to be fundamental in establishing business-IT alignment, all six business imperatives listed in Table 3.3 do not place equal emphasis on achieving strategic alignment as an IT governance objective.

Each imperative will now briefly be defined and explained with regard to big data. After each definition, the business imperatives' strategic alignment attributes are discussed, based on the explanation provided.

Agility

Defined for big data	IT agility is defined as the "ability to 'pivot' and change direction in response to market pressure or to create market opportunity. It requires distinct patterns of IT capabilities, with specific positioning in the enterprise" (Zhu, 2013). The improved predictability and ingenuity resulting from big data analysis helps organisations to anticipate, and respond to, such change (Smeda, 2015).
Strategic alignment attributes	Big data predictability addresses strategic alignment to the extent that the changes that occur result in strategic business objectives being altered and the data therefore supporting these new objectives.

Collaboration

Defined for big data	When information and knowledge is shared between a company and its suppliers, customers and (particularly) its employees and management, this is generally referred to as collaboration (Goosen & Rudman, 2013b). Collaboration and effective communication between all parties involved with big data are necessary to understand each other's (management and IT) needs, availabilities and goals in order to ensure actionable and transparent data (Sauer, 2015).
Strategic alignment attributes	Strategic alignment will therefore inevitably be attained if collaboration and effective communication exist between management (parties involved with big data 'above' the IT gap) and IT (parties involved with big data 'below' the IT gap).

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Innovation

Defined for big data	Innovation is the ability to develop new products or services based on existing data in competitive environments, where there is little to no difference between products offered to clients. Innovation, therefore, gives companies a competitive advantage (Goosen & Rudman, 2013b). The analysis capabilities offered by big data provide the necessary tools to drive innovation.
Strategic alignment attributes	Although big data has the potential to drive innovation, it needs to be linked with business goals and objectives to truly unlock the innovative value of the data. Strategic alignment is therefore pivotal for innovation as a business imperative.

Pro-active management

Defined for big data	A pro-active management team will ensure that real-time information is available for analysing customer behaviour, financial data or other sources of information to make informed decisions (Goosen & Rudman, 2013b). Real-time analysis of big data could give companies a competitive advantage when it is analysed quickly and efficiently.
Strategic alignment attributes	A pro-active management team will deliver value if there is proper alignment between the management team's objective (real-time information), and the IT function that delivers the data for decision making.

Scalability

Defined for big data	The concept of scalability refers to the ability of a system to flexibly deal with increasing amounts of data (Géczy, 2014). Big data is the analysis of larger volumes of structured, unstructured or semi-structured data and will therefore require a scalable system in order to be efficient.

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Strategic alignment attributes	Scalability addresses strategic alignment to a lesser extent, given that the concept depends on the ability to build and process increased amounts of data. The quality of data obtained and processed in a scalable system will, however, support alignment if the data can be used by management for decision making.

Up-skilled workforce

Defined for big data	The decision to invest in big data will require IT specialists to implement big data analysis tools and programmes, within the existing data model, to ensure that the correct data is leveraged for decision making. The integration of a new power user tool (big data analytics programme) into an existing data model, efficiently and effectively, is no easy task and will require the skill set of a specialist to avoid possible disasters, such as data loss. The survey analysis performed by Gartner in 2014 supports this imperative, as it was noted that 31% of respondents (out of 116 who had already made an investment in big data) listed the need for proper skills as one of their top challenges faced with regard to big data (Gartner, 2014a).
Strategic alignment attributes	The ability to establish a link between the available data and business objectives and the ability to view business problems from a data point of view, requires a sophisticated skill set (Provost & Fawcett, 2013). If this skill is properly utilised by a business investing in big data, strategic alignment will duly be achieved and big data will deliver the intended value.

It is evident from the explanations of the big data business imperatives and the imperatives' strategic alignment attributes that they all address this IT governance objective, to varying degrees.

This research attempts to build a best practices guide to govern strategic alignment of big data, in particular. All six identified business imperatives will therefore be considered in terms of their impact on the IT environment and the associated strategic IT risks. This consideration will be addressed in Chapter 4.

3.8 Risks of investing in big data

Once the benefits of big data have been considered, it is important - as with the introduction of any new trend or technology to a business - to perform a risk analysis before implementing the new trend or technology. Risks are identified to determine whether the new trend or technology is sustainable and suitable for the company. The identified risks need to be addressed before investment in, and implementation of, the new trend or technology. Table 3.4 provides issues and risks to be considered before investing in big data.

Table 3.4: Risks of investing in big data

Risk	Risk explained
High cost	The high cost of capturing and analysing big data, possibly before an organisation knows what to do with it or how to analyse it, can present a big risk for big data adopters (Franks, 2012).
Idle or unutilised data	Big data can be so overwhelming that it is not utilised properly and no value is therefore obtained (Franks, 2012). This risk relates to the fact that businesses could have been deceived by, or did not properly evaluate, the value that big data can represent (Mayer-Schönberger & Cukier, 2013).
Insufficient infrastructure	Gathering and processing big data requires sufficient storage and transmission capabilities (Géczy, 2014). Extensive processing of large volumes of data will require new analytical algorithms and extensive parallel processing solutions to provide information timeously so that it can be acted upon as soon as possible (Kaisler *et al*., 2013). Existing IT infrastructures might not be sufficient in supporting the decision to invest in big data.

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Management of data	A major stumbling block for businesses using various sources and types of data relates to issues surrounding access, utilisation, updating, governance and referencing (Kaisler *et al.*, 2013). When data is collected manually, proper protocols are often followed to ensure that the data is accurate and valid. Digital data collection, and especially the vast amounts of data collected through big data, does not necessarily happen in such a methodical way.
Privacy, security and misuse of data	Big data may be used to make predictions about people's behaviours. Given the sensitive nature of many sources of big data, privacy of information and security pose a very big risk. It should be noted, however, that not all data that is generated includes personal information (Franks, 2012; Mayer-Schönberger & Cukier, 2013). If security breaches, privacy violations and/or the misuse of data occur, it could have severe consequences, such as reputational damage, legal liabilities and employees being discouraged (Kshetri, 2014; Mayer-Schönberger & Cukier, 2013).

Surveys have proved that the privacy and security issues presented by big data are some of the main risks to take into account. The survey analysis performed by Gartner (2014a) on big data investments in 2014 underlines these risks. A total of 48% of the 116 participants who had already invested in big data chose 'risk and governance issues' (which include security, privacy and data quality) as one of their top hurdles or challenges with regard to big data, whilst 37% chose 'integrating big data technology with existing infrastructure'.

Data privacy and security risks are further emphasised by Kshetri (2014). He summarised the findings of surveys conducted with businesses and consumers regarding their perceptions of, and responses to, big data between 2012 and 2014. It is evident from the surveys' findings that businesses and consumers (including SAP and ISACA, to name a few) are highly concerned about data security and privacy issues (Kshetri, 2014).

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Mayer-Schönberger and Cukier (2013) believe that the more important question regarding the privacy risk of big data relates to whether the risk changes as a result of big data and not whether big data increase the risk to privacy (as it does). “If the threat is larger, then the laws and rules that protect privacy may still work in the big data age. On the other hand, if the problem changes, we may need new solutions” (Mayer-Schönberger & Cukier, 2013: 153).

The risks of big data (as identified in Table 3.4) are now classified according to big data characteristics (as identified in Table 3.1). These characteristics will be used in the chapter to follow, where big data risks are adjusted in terms of their strategic IT risk traits as part of step 2 in the three-step methodology.

Table 3.5: Risks of big data classified per big data characteristic

Big data risks	Big data characteristics
High cost	Velocity, Variety, Complexity
Idle or unutilised data	Volume, Complexity
Insufficient infrastructure	Volume, Velocity, Variety, Variability and Complexity
Management of data	Variety, Variability
Privacy, security and misuse of data	Variety

3.9 Conclusion

The purpose of this chapter was to perform a literature review on the topic of big data. An understanding of the technology trend, the parties involved to advance strategic alignment and the benefits and risks associated with big data were discussed in detail.

This chapter identified the business imperatives and risks associated with big data, based on the benefits and nature of the trend. The business imperatives and risks of big data are important elements in building the best practices guide to govern strategic alignment when an investment is made in big data. The remaining steps of the best practices guide will be addressed in Chapter 4.

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CHAPTER 4: BEST PRACTICES GUIDE FOR GOVERNING THE STRATEGIC ALIGNMENT OF BIG DATA BY THE USE OF AN APPROPRIATE EXISTING CONTROL FRAMEWORK

4.1 Background

Chapter 2 discussed the importance of strategic alignment as an IT governance objective and also established a three-step methodology on how to build a best practices guide. The guide will aim to govern the strategic alignment when an investment is made in big data. Chapter 3 went on to explain big data, together with the benefits and risks associated with the new technology trend. Chapter 3 also partially addressed steps 1 and 2 of the three-step methodology, by identifying the business imperatives and risks of big data.

The objective of this chapter is to complete the remaining steps of the three-step methodology in order to develop a best practices guide for governing the strategic alignment when an investment is made in big data. Refer to Figure 1.1, which depicts exactly how the three-step methodology is followed throughout this research.

4.2 Strategic IT risks

The goal of IT is to deliver value (whilst considering the associated risks with regard to the board of directors' willingness to take on risk) which supports the strategic objectives of a company (ISACA, 2012a). Strategic risks are defined as the internal and external events that can impede a company's ability to achieve its strategic objectives (Frigo & Anderson, 2011).

Apart from identifying business imperatives, step 1 of the three-step methodology goes on to require the identification of strategic IT risks for business imperatives. Business imperatives are the drivers of business-IT alignment (refer to section 2.7), and which also take strategic goals into consideration. Strategic IT risks are then considered to be the risks which impact on business imperatives. Only those strategic IT risks that apply to big data business imperatives will be used in the remaining steps of the methodology. Strategic IT risks, as identified by Boshoff (2014), are obsolescence, integration, interoperability, security, scalability and retrofit. These risks are explained in Table 4.1.

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Table 4.1: Explanation of strategic IT risks

Risks	Explanation
Obsolescence (O)	A technology is obsolete when it becomes out of use (the technology is no longer accepted by the users thereof) or out of date (the physical components, i.e. the hardware and software of the technology no longer support the objective of its use) (Pantano, Iazzolino & Migliano, 2013).
Integration (Ig)	Integration risk is the risk when introducing a new technology to the current system that this merger does not take place seamlessly (Smeda, 2015).
Interoperability (Io)	Interoperability refers to the ability to transfer or share data in a meaningful way, typically in conjunction with other data (Freedman, 2007). Being closely linked with integration, interoperability is further defined in terms of big data by Smeda (2015). She concludes that interoperability also involves skilled employees to manage the implementation of big data, as well as ensuring that big data is compatible with existing data formats.
Security (Se)	Security risks, particularly those associated with information technology, are considered to be “the risk related to the loss of confidentiality, integrity and availability of information or IT resources” (Ross, as cited by Brand, 2013: 13).
Scalability (Sc)	Taking the definition of scalability into account (see section 3.6 above), the risk of scalability relates to the fact that a system might not be able to, or might not be modifiable to, meet the processing demands caused by expanding data (Géczy, 2014).
Retrofit (R)	Retrofit risk is the risk that a system can become obsolete when a new technology is introduced (Smeda, 2015). An organisation’s existing systems may have been modified to manage the existing data flow and data needs. When the modifications to a system are so extensive that it is not able to handle any new or innovative technology, this is referred to as retrofit risk.

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4.3 The IT impact and strategic IT risks of big data business imperatives

The impact that the business imperatives have on an IT environment must first be considered before determining which strategic IT risks are associated with the business imperatives. Once strategic IT risks for big data business imperatives have been identified, step 1 of the three-step methodology has been completed.

Table 4.2: Impact of business imperatives on the IT environment and the associated strategic IT risks

Business imperative	Impact on the IT environment	Strategic IT risks					
		O	Ig	Io	Se	Sc	R
Agility	IT must be positioned so that it is able to adapt to changes when they occur.	✔	✔	✔	✔	✔	✔
Collaboration	An efficient database management system is needed to ensure collaborative computing, whilst connectivity is maintained.	✔	✔	✔	✔		
Innovation	IT will require the optimisation of data warehousing and data analysis tools in order to develop new products or services.	✔	✔	✔	✔	✔	✔
Scalability	A flexible system, which can accommodate increasing amounts of data, is required.					✔	✔
Pro-active management	The IT system must be able to provide real-time information so that users can react immediately in order to gain a competitive advantage.	✔	✔	✔	✔		
Up-skilled workforce	Power user tools are needed for professionals to enable them to analyse data, which will enable decision making for a competitive advantage.	✔	✔	✔	✔	✔	✔
✔ The strategic IT risk applies to the business imperative.							

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It is evident from Table 4.2 that the business imperatives identified for big data lead to strategic IT risks in all categories.

The risks presented by big data (refer to section 3.8) will now be taken into consideration in terms of their relationship with strategic IT risks in order to commence with step 2 of the three-step methodology in building the best practices guide. Big data characteristics associated with each big data risk (as identified in Table 3.5) will be taken into account when identifying strategic IT risk relationships.

Table 4.3: Identifying strategic IT risk relationships with big data risks

Risk presented by big data	Strategic IT risks					
	O	Ig	Io	Se	Sc	R
High cost					✔	✔
Idle or unutilised data					✔	
Insufficient infrastructure	✔	✔	✔			
Management of data			✔			
Privacy, security and misuse of data				✔		
✔ The big data risk falls within this strategic IT risk category.						

4.4 Strategic risks for big data

The risks presented by big data were categorised into strategic IT risks in Table 4.3. These big data risks will now be adjusted and rephrased in terms of the strategic IT risks that they represent in order to conclude step 2 of the three-step methodology to build the best practices guide.

Table 4.4: Strategic risks for big data

Risk 1	**Obsolescence**
a)	Existing IT infrastructures might be out of date and therefore not supportive of the investment in big data. (Insufficient infrastructure)
Risk 2	**Integration**
a)	The new analytical algorithms and/or extensive parallel processing solutions (required to analyse, and obtain value, from the technology trend) might not integrate with the existing system. (Insufficient infrastructure)

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Risk 3	**Interoperability**
a)	New tools required to analyse big data might not be managed properly by employees (who are not skilled to deal with the new tools) or the new unstructured or semi-structured data sources introduced by big data may not be compatible with the existing data sources. (Insufficient infrastructure)
b)	New sources and new types of big data might be difficult to manage. (Management of data)
Risk 4	**Security**
a)	Big data could potentially contain confidential information and, if breached, could lead to huge security risks. A loss of integrity will occur if the analysis produced by big data is misused, or used without authorisation, to portray inaccurate, incomplete or false information. (Privacy, security and misuse of data)
Risk 5	**Scalability**
a)	An excess of big data, provided too quickly, will escalate costs before it is known how the data could be used to create value. (High cost)
b)	The current system might not be able to meet the increasing (processing) demands of big data and the data could therefore become idle or unutilised. (Idle or unutilised data)
Risk 6	**Retrofit**
a)	The introduction of big data, before an organisation knows whether their existing system can sustain such massive amounts of data, can render a system obsolete and spike costs before value is obtained. (High cost)

4.5 Best practices guide

In order to build the best practices guide for governing the strategic alignment of big data, a three-step methodology was identified in section 2.8. The final step in building the guide involves the mapping of big data strategic risks to control objectives (or processes) of an existing control framework. Control frameworks were discussed in section 2.6, where it was decided that this research will make use of COBIT 5 as a basis for the best practices guide.

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4.5.1 COBIT 5

COBIT 5 is a generic, holistic, comprehensive framework that assists enterprises in achieving their objectives for the governance and management of enterprise IT (ISACA, 2012a). COBIT originated when members of ISACA in the financial and IT audit communities identified the need to execute IT audit assignments with the help of a framework, in an increasingly automated environment. A connection therefore exists between COBIT and IT assurance. Since its inception, COBIT has transitioned towards a broader IT governance and management framework with COBIT 5, the latest version released in 2012 by ISACA, having enterprise governance of IT as its foundation (ISACA, 2012a; De Haes, Van Grembergen & Debreceny, 2013).

ISACA identified five key principles on which COBIT 5 is based (ISACA, 2012a). They are briefly explained below:

Principle 1: Meeting stakeholder needs

COBIT 5 provides processes to help organisations create business value through the use of IT; finding the balance between realising benefits for stakeholders, whilst managing risks and resources.

Principle 2: Covering the enterprise end-to-end

COBIT 5 integrates IT governance into the broader spectrum of corporate governance, including everything and everyone (internal and external) that is relevant to governance and management of enterprise information and related IT, and also all functions and processes within an organisation.

Principle 3: Applying a single, integrated framework

COBIT 5 aligns with other relevant standards and frameworks to provide an overarching framework for governance and management of enterprise IT.

Principle 4: Enabling a holistic approach

This principle provides a set of enablers to help an organisation achieve its objectives and to support the implementation of a comprehensive governance and management system for enterprise IT by taking several interacting components into account.

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The seven categories of enablers are:

- Principles, policies and frameworks,
- Processes,
- Organisational structures,
- Culture, ethics and behaviour,
- Information,
- Service, infrastructure and applications, and
- People, skills and competencies.

Principle 5: Separating governance from management

Governance and management encompass different types of activities, require different organisational structures and serve different purposes. ISACA (2012a: 14) provides the following definitions:

"Governance ensures 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.

Management plans, builds, runs and monitors activities in alignment with the direction set by the governance body to achieve the enterprise objectives."

The governance and management process of enterprise IT is split into five domains. The first domain (EDM) focuses on governance and the remaining four domains (APO, BAI, DSS and MEA) focus on management responsibility areas of planning, building, running and monitoring activities.

The five domains are listed and explained below (Qualified Audit Partners, 2010; ISACA, 2012a; Sahd, 2014):

- **Evaluate, Direct and Monitor (EDM)** (includes five processes) ensures that enterprise objectives are achieved by evaluating stakeholder needs; setting direction through decision making and monitoring performance.
- **Align, Plan and Organise (APO)** (includes 13 processes) addresses the use of IT and how it helps to achieve strategic goals and objectives.
- **Build, Acquire and Implement (BAI)** (includes 10 processes) covers the IT life cycle, from identifying IT requirements, to acquiring them and implementing IT within the current business process.

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- **Deliver, Service and Support (DSS)** (includes six processes) focuses on delivery of IT services, addressing the day-to-day operational activities.
- **Monitor, Evaluate and Assess (MEA)** (includes three processes) focuses on the company's strategy in assessing company needs and whether or not IT meets these objectives. The effectiveness of the IT system is also addressed to determine whether it meets business objectives.

All 37 processes from the five domains, together with process descriptions as provided by COBIT 5 (ISACA, 2012b), are included in Appendix A.

4.5.2 Strategic alignment as an IT-related goal

Only the processes in COBIT 5 that relate to the IT governance objective of strategic alignment will be used in the best practices guide. It is therefore necessary to determine which processes in COBIT 5 address strategic alignment.

Principle 1 of COBIT 5 sets out to meet stakeholder needs. COBIT 5 translates stakeholder needs into specific, actionable and customised enterprise goals, information and related technology (IT-related) goals and enabler goals (ISACA, 2012b). These enterprise, IT-related and enabler goals form the basis of the 37 processes in the COBIT 5 governance and management domains. These goals (based on stakeholder needs) can therefore be achieved through the optimal use and execution of the 37 processes (ISACA, 2012a).

For the purposes of building the best practices guide in this research, only the IT-related goals will be considered in the identification of those COBIT 5 processes which address strategic alignment.

There are 17 IT-related goals in COBIT 5 (ISACA, 2012a). It is important to note that all the IT-related goals aim to achieve the IT governance objectives of strategic alignment, value delivery, risk management, resource management and performance management (refer to section 2.2.3). However, it is possible for these goals to have a main IT governance objective, and/or subordinate objectives. The 17 IT-related goals from COBIT 5 are included in Table 4.5, where they are reviewed for their main and/or subordinate objective to meet and enhance strategic alignment.

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Table 4.5: Identifying the IT-related goals in COBIT 5 which address strategic alignment as their main or subordinate IT governance objective

No.	IT-related goals	Strategic alignment M / S	Main (M) IT governance objective	Subordinate (S) IT governance objective
01	Alignment of IT and business strategy	M	Strategic alignment	Value delivery
02	IT compliance and support for business compliance with external laws and regulations		Risk management	Value delivery
03	Commitment of executive management for making IT-related decisions	S	Performance management	Strategic alignment
04	Managed IT-related business risk	S	Risk management	Strategic alignment
05	Realised benefits from IT-enabled investments and services portfolio		Value delivery	Resource management
06	Transparency of IT costs, benefits and risk		Resource management	Value delivery
07	Delivery of IT services in line with business requirements	M	Strategic alignment	Performance management
08	Adequate use of applications, information and technology solutions		Resource management	Risk management
09	IT agility	M	Strategic alignment	Value delivery

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No.	IT-related goals	Strategic alignment M / S	Main (M) IT governance objective	Subordinate (S) IT governance objective
10	Security of information, processing infrastructure and applications		Risk management	Resource management
11	Optimisation of IT assets, resources and capabilities		Value delivery	Resource management
12	Enablement and support of business processes by integrating applications and technology into business processes	S	Resource management	Strategic alignment
13	Delivery of programmes delivering benefits, on time, on budget, and meeting requirements and quality standards		Performance management	Resource management
14	Availability of reliable and useful information for decision making	M	Strategic alignment	Resource management
15	IT compliance with internal policies	S	Risk management	Strategic alignment
16	Competent and motivated business and IT personnel		Performance management	Resource management
17	Knowledge, expertise and initiatives for business innovation	S	Performance management	Strategic alignment

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Table 4.6 provides a summary of the IT governance objectives and how they relate to the COBIT 5 IT-related goals as either their main or subordinate objective.

Table 4.6: IT governance objectives addressed by COBIT 5 IT-related goals

IT governance objective	As main IT-related goal	As subordinate IT-related goal	Total
Strategic alignment	4	5	**9**
Value delivery	2	4	**6**
Risk management	4	1	**5**
Resource management	3	6	**9**
Performance management	4	1	**5**
	17	**17**	**34**

All 37 processes in COBIT 5 aim to achieve IT-related goals. Only the IT-related goals that were considered to address strategic alignment as their main IT governance objective were chosen to be used in the best practices guide. These IT-related goals (as determined in Table 4.5) are:

- Number 1: Alignment of IT and business strategy,
- Number 7: Delivery of IT services in line with business requirements ,
- Number 9: IT agility, and
- Number 14: Availability of reliable and useful information for decision making.

4.5.3 Identifying applicable COBIT 5 processes

It has been established that the 37 processes in COBIT 5 all have IT-related goals. The IT-related goals that were identified to have strategic alignment as their main IT governance objective were included in section 4.5.2. The 37 processes will now be scrutinised to determine which of the 37 COBIT 5 processes include those IT-related goals that this research has identified as main contributors towards governing strategic alignment.

COBIT 5 identifies the primary IT-related goal for each of the 37 processes (ISACA, 2012b). Table 4.7 provides a complete list of the 37 processes and indicates which of the processes list IT-related goals number 1, 7, 9 or 14 as their primary IT-related goal.

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Table 4.7: **COBIT 5 processes that address strategic alignment through their primary IT-related goal**

Domain	Process	IT-related goals			
		01	07	09	14
Evaluate, Direct and Monitor (EDM)	EDM01 Ensure Governance Framework Setting and Management	✔	✔		
	EDM02 Ensure Benefits Delivery	✔	✔		
	EDM03 Ensure Risk Optimisation				
	EDM04 Ensure Resource Optimisation			✔	
	EDM05 Ensure Stakeholder Transparency		✔		
Align, Plan and Organise (APO)	APO01 Manage the IT Management Framework	✔		✔	
	APO02 Manage Strategy	✔	✔		
	APO03 Manage Enterprise Architecture	✔		✔	
	APO04 Manage Innovation			✔	
	APO05 Manage Portfolio	✔			
	APO06 Manage Budget and Costs				
	APO07 Manage Human Resources	✔			
	APO08 Manage Relationships	✔	✔		
	APO09 Manage Service Agreements		✔		✔
	APO10 Manage Suppliers		✔	✔	
	APO11 Manage Quality		✔		
	APO12 Manage Risk				
	APO13 Manage Security				✔

Build, Acquire and Implement (BAI)	BAI01 Manage Programmes and Projects	✔			
	BAI02 Manage Requirements Definition	✔	✔		
	BAI03 Manage Solutions Identification and Build		✔		
	BAI04 Manage Availability and Capacity		✔		✔
	BAI05 Manage Organisational Change Enablement				
	BAI06 Manage Changes		✔		
	BAI07 Manage Change Acceptance and Transitioning				
	BAI08 Manage Knowledge			✔	
	BAI09 Manage Assets				
	BAI10 Manage Configuration				✔
Deliver, Service and Support (DSS)	DSS01 Manage Operations		✔		
	DSS02 Manage Service Requests and Incidents		✔		
	DSS03 Manage Problems		✔		✔
	DSS04 Manage Continuity		✔		✔
	DSS05 Manage Security Services				
	DSS06 Manage Business Process Controls		✔		
Monitor, Evaluate and Assess (MEA)	MEA01 Monitor, Evaluate and Assess Performance and Conformance		✔		
	MEA02 Monitor, Evaluate and Assess the System of internal Control				
	MEA03 Monitor, Evaluate and Assess Compliance with External Requirements				

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A total of 28 processes were identified that have IT-related goal number 1, 7, 9 or 14 as their primary IT-related goal. These four IT-related goals were specifically identified for their strategic alignment contribution and will therefore be used in the best practices guide. They are listed in Table 4.8.

Table 4.8: COBIT 5 processes addressing strategic alignment

EDM01	APO04	APO13	BAI10
EDM02	APO05	BAI01	DSS01
EDM04	APO07	BAI02	DSS02
EDM05	APO08	BAI03	DSS03
APO01	APO09	BAI04	DSS04
APO02	APO10	BAI06	DSS06
APO03	APO11	BAI08	MEA01

4.5.4 Mapping COBIT 5 strategic alignment processes to big data strategic risks

Step 3 of the three-step methodology to build the best practices guide for governing strategic alignment of big data can now commence. The COBIT 5 processes that were identified to address strategic alignment are now mapped to big data strategic risks. Each risk is considered for every strategic alignment process, based on various factors, such as the risk's attributes regarding current or future uses, being technology-driven, the involvement with people, its encumbering value or its link with big data business imperatives. Refer to Table 4.10 for brief explanations on the rationale for mapping (or not mapping).

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Table 4.9: Mapping big data strategic risks to COBIT 5 strategic alignment processes

COBIT 5 processes	Risk 1	Risk 2	Risk 3		Risk 4	Risk 5		Risk 6
	a)	a)	a)	b)	a)	a)	b)	a)
EDM01	✔	✔	✔	✔	✔	✔	✔	✔
EDM02	✔					✔	✔	✔
EDM04	✔	✔	✔	✔	✔	✔	✔	✔
EDM05			✔	✔	✔			
APO01			✔	✔	✔			
APO02	✔	✔	✔			✔	✔	✔
APO03	✔	✔	✔			✔	✔	✔
APO04	✔	✔	✔	✔	✔	✔	✔	✔
APO05	✔	✔	✔	✔	✔	✔	✔	✔
APO07			✔		✔			
APO08			✔	✔	✔			
APO09			✔		✔			
APO10*								
APO11			✔	✔	✔			
APO13					✔			
BAI01	✔	✔	✔	✔		✔	✔	✔
BAI02	✔	✔						✔

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COBIT 5 processes	Risk 1	Risk 2	Risk 3		Risk 4	Risk 5		Risk 6
	a)	a)	a)	b)	a)	a)	b)	a)
BAI03			✔			✔	✔	
BAI04	✔	✔	✔			✔	✔	✔
BAI06	✔	✔	✔	✔	✔	✔	✔	✔
BAI08	✔	✔	✔	✔	✔			
BAI10	✔	✔	✔			✔	✔	✔
DSS01			✔	✔	✔			
DSS02	✔	✔	✔	✔	✔			
DSS03	✔	✔	✔	✔	✔	✔	✔	✔
DSS04	✔	✔	✔	✔		✔	✔	✔
DSS06			✔	✔	✔			
MEA01			✔	✔	✔	✔	✔	✔

*It was noted that ‘APO10 Manage suppliers’ is not applicable for companies investing in big data.

Table 4.10: Brief explanations as to why risks were mapped to certain COBIT 5 processes

COBIT 5 process	Contributing reasons for mapping the strategic big data risk to the process
EDM01	This process stresses the importance of ensuring IT governance and, specifically, business-IT alignment. Governance of IT is important when implementing (and throughout the process of) a new technology trend.
EDM02	The strategic risks that hinder value delivery when an investment in big data has been made were mapped to this process. For purposes of this process, obsolescence, integration and interoperability were considered to be risks associated with the decision to invest in big data.
EDM04	All risks apply, seeing that the process revolves around the optimisation of people, processes and IT resources.
EDM05	The transparency of IT performance and compliance relate to the people involved with, and working with, big data. Interoperability and security risks involve the users of big data.
APO01	This process relates to the management and use of information by people and, hence, interoperability (skilled employees to analyse and manage big data) and security risks (misusing information and maintaining the privacy of confidential information) were mapped.
APO02	This process involves the current and future architectural building blocks (how IT systems are built), which help to align business and IT strategies. Risks that relate to IT architectural components were mapped.
APO03	This process relates to IT architectures and therefore the same risks apply as those identified in APO02.
APO04	This process relates to the business imperative of 'innovation' for opportunities that could be created by emerging technologies, as well as through existing established technologies. Risks for this imperative, as identified in Table 4.2, were used as a guideline.

COBIT 5 process	**Contributing reasons for mapping the strategic big data risk to the process**
APO05	This process relates to the business imperative of 'agility' and therefore strategic risks for this imperative, as identified in Table 4.2, were used as a guideline.
APO07	This process addresses the human resources aspect, specifically the approach of employing and managing competent and motivated people. The risks mapped are those specifically related to human involvement.
APO08	This process involves the relationship between the business and IT personnel. Risks mapped relate to people involved with big data, when an investment in big data has been made.
APO09	This process relates to service level agreements for IT-related services. Strategic big data risks identified in Table 4.4 relate mostly to businesses implementing big data themselves and not outsourcing the function. The risks mapped therefore only relate to the people involved with handling the analysed data.
APO10	This process relates to the management of suppliers and is therefore not applicable to big data.
APO11	This process relates to the quality of processes and procedures in a business and not the quality of data. Risks that apply to this process relate to human involvement in such processes and procedures where an investment in big data has been made.
APO13	This process is self-explanatory and relates to information security, hence security strategic risks apply.
BAI01	This process relates to any investment in projects and ensuring that the process is aligned with the business strategy from the start of the project to a post-implementation review. Risks relating to the decision to invest in big data, up to the implementation thereof, were mapped to this process.

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COBIT 5 process	**Contributing reasons for mapping the strategic big data risk to the process**
BAI02	This process relates to analysing requirements before acquisition of new solutions to ensure that they are in line with strategic requirements. The risks relating to the decision to invest in big data, i.e. the risks relating to whether big data will 'fit in' with the business, were mapped to this process.
BAI03	This process relates to managing configuration and testing of the solutions identified in BAI02. Risks mapped are those that relate to where an investment in big data has been made and is now being tested.
BAI04	This process takes current and future needs into account, based on the business requirements and an analysis of business impact, so that the identified requirements can be reached. A combination of the risks identified in BAI02 and BAI03 were mapped, where requirements were analysed and the business impact was tested.
BAI06	This process also relates to the business imperative of 'agility', where changes in a system must be managed. Strategic risks for this imperative, as identified in Table 4.2, were used as a guideline.
BAI08	This process relates to the business imperative of 'pro-active management', where reliable and relevant knowledge (information) helps to facilitate decision making. Risks of big data that address this imperative, as identified in Table 4.2, were used as a guideline.
BAI10	This process relates to key resources and capabilities required to deliver IT services. Risks that relate to the IT configuration were mapped to this process.
DSS01	This process relates to execution of standard operating procedures for internal IT services and hence how big data will be used, and whether this will be in accordance with procedure. Risks mapped relate to the people using the data.

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COBIT 5 process	**Contributing reasons for mapping the strategic big data risk to the process**
DSS02	This process relates to the business imperative of 'pro-active management' and therefore strategic risks for this imperative, as identified in Table 4.2, were used as a guideline.
DSS03	Managing problems will be a central concern for businesses investing in big data and this should therefore be monitored throughout the entire life cycle of big data. All risks apply to this process.
DSS04	This process revolves around business continuity. Risks were mapped that could hinder business continuity resulting from the incompatibility of big data with the business and/or current IT systems.
DSS06	Business and information processing controls should be in place. Risks relating to information processing were mapped to this process, considering that an investment in big data has been made.
MEA01	This process relates to monitoring of performance against pre-set goals. Risks were mapped to processes where it was considered that an investment in big data could prevent the attainment of goals.

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4.6 Conclusion

The aim of this chapter was to continue with the remaining steps of the three-step methodology in building a best practices guide for governing strategic alignment when an investment is made in big data.

Step 1, which was partially addressed in Chapter 3, involved the identification of business imperatives associated with big data. Step 1 also required strategic IT risks to be identified, based on the business imperatives for big data. An understanding was obtained of strategic IT risks, and those that relate to the business imperatives of big data were identified in Chapter 4. It was noted that the six business imperatives of big data are impacted by strategic IT risks from all six categories.

Step 2 involved the identification of the risks associated with big data and the adjustment of these risks in terms of strategic IT risks, as identified in step 1. The risks of big data were identified in Chapter 3. Risks were adjusted and rephrased in terms of strategic IT risks in Chapter 4, after an understanding was obtained of strategic IT risks.

The last step of the three-step methodology entailed mapping strategic big data risks to an existing control framework. COBIT 5 was identified as an appropriate control framework for the best practices guide. The processes of COBIT 5 that address strategic alignment were identified in this chapter, based on their primary IT-related goal.

This chapter was concluded with the mapping of strategic big data risks to processes of COBIT 5 which address strategic alignment. The mapping resulted in a best practices guide for governing strategic alignment of big data, thereby addressing the research problem.

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CHAPTER 5: CONCLUSION

It has become evident that “more data is not just more data”, but that “more data is different” (Kaisler *et al.*, 2013: 1003). Big data has the potential to unlock great benefits for companies who have invested in this technology trend. Decision making for such companies will be based on analysed data from non-traditional sources which could lead to a great competitive advantage. However, no value will be obtained from an investment in big data if there is no alignment between the business, the (big) data and IT. This research proposes to help companies who have invested in big data to govern strategic alignment, to avoid the IT gap and subsequently obtain value from their investment in this technology trend.

Goosen and Rudman (2013b) developed an integrated control framework to address IT governance principles at a strategic level. The research presented in this paper adapted the methodology proposed by Goosen and Rudman and developed a three-step methodology to build a best practices guide which can help companies who have invested in big data to govern strategic alignment. The IT gap is thus avoided and strategic alignment, as IT governance objective, is managed.

By considering the impact that they have on the IT environment, business imperatives (specifically identified for big data) raised strategic risks for big data. These risks are mitigated by the use of an existing control framework (COBIT 5). Only the control objectives (processes) in COBIT 5 which specifically address strategic alignment were chosen to be used in the best practices guide to mitigate the strategic risks for big data.

The best practices guide thus encompass the findings of this research (that is the COBIT 5 strategic alignment processes) and address the research objective.

Companies that have invested in big data, and that wish to govern strategic alignment successfully, are advised to implement the COBIT 5 processes identified in the best practices guide to address the risks associated with big data at a strategic level. By implementing these processes a company will ensure that alignment is not only a matter being discussed between business and IT managers at strategic level, but also considered at an organisational, as well as IT, infrastructure and processes level.

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Areas for possible further research include: a study which help to govern other IT governance principles (value delivery, risk management, resource management and performance management) when an investment is made in big data; and also a study to address big data risks at an operational level which is related to big data technologies and the IT architectural components.

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LIST OF REFERENCES

Anderson, R. & Roberts, D. 2012. *Big Data: Strategic Risks and Opportunities*. [Online]. Available: https://www.crowehorwath.net/uploadedfiles/crowe-horwath-global/tabbed_content/big data strategic risks and opportunities white paper_risk13905.pdf [2015, April 18].

Bakari, J.K., Tarimo, C.N., Yngström, L., Magnusson, C. & Kowalski, S. 2007. Bridging the gap between general management and technicians – A case study on ICT security in a developing country. *Computers & Security*. 26(1):44–55. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S0167404806001568 [2015, June 26].

Boshoff, W.H. 2014. Masters in Commerce (Computer Auditing). Unpublished lecture slides (Computer Auditing 871). Stellenbosch: Stellenbosch University.

Brand, J.C. 2013. The governance of significant enterprise mobility security risks. Unpublished Masters of Commerce (Computer Auditing) thesis. Stellenbosch: Stellenbosch University.

De Haes, S., Van Grembergen, W. & Debreceny, R.S. 2013. COBIT 5 and Enterprise Governance of Information Technology: Building Blocks and Research Opportunities. *Journal of Information Systems*. 27(1):307–324.

Franks, B. 2012. *Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics*. Hoboken, New Jersey: John Wiley & Sons, Inc.

Freedman, I. 2007. What Does “Interoperability” Really Mean? *Health Management Technology*. 28(10):50–51.

Frigo, M.L. & Anderson, R.J. 2011. *What Is Strategic Risk Management?* [Online]. Available: http://web.b.ebscohost.com.ez.sun.ac.za/ehost/pdfviewer/pdfviewer?vid=7&sid=f57f0747-8023-4a92-a830-f6316aecd388%40sessionmgr110&hid=128 [2015, June 29].

Stellenbosch University https://scholar.sun.ac.za

Gartner. 2012. *The Importance of "Big Data": A Definition*. [Online]. Available: http://www.gartner.com/document/2057415?ref=TypeAheadSearch&qid=e67c07483c5f865c520a4840a5b7a847 [2015, April 16].

Gartner. 2014a. *Survey Analysis: Big Data Investment Grows but Deployments Remain Scarce in 2014*. [Online]. Available: http://www.gartner.com/document/2841519?ref=QuickSearch&sthkw=survey analysis%3A big data&refval=150061020&qid=4af1952609d3790588d6900dc9a42308 [2015, April 16].

Gartner. 2014b. *Predicts 2015: Big Data Challenges Move From Technology to the Organization*. [Online]. Available: http://www.gartner.com/document/2928217?ref=QuickSearch&sthkw=big data&refval=151878095&qid=194d9ef72652abd6bcaee211694ae29d [2015, June 03].

Gartner. 2014c. *Answering Big Data's 10 Biggest Vision and Strategy Questions*. [Online]. Available: http://www.gartner.com/document/2822220?ref=TypeAheadSearch&qid=e2379a7fc8c77405617519d16561ab5a [2015, June 05].

Géczy, P. 2014. *Big data characteristics*. [Online]. Available: http://macrotheme.com/yahoo_site_admin/assets/docs/8MR36Pe.97110828.pdf [2015, July 02].

Gerber, P. 2015. Addressing the incremental risks associated with social media by using the COBIT 5 control framework. Unpublished Masters of Commerce (Computer Auditing) thesis. Stellenbosch: Stellenbosch University.

Goosen, R. 2012. The development of an integrated control framework in order to implement IT governance principles at strategic and operational level for medium-to-large sized South African businesses. Unpublished Masters of Commerce (Computer Auditing) thesis. Stellenbosch: Stellenbosch University.

Stellenbosch University https://scholar.sun.ac.za

Goosen, R. & Rudman, R. 2013a. An Integrated Framework To Implement IT Governance Principles At A Strategic And Operational Level For Medium-To Large-Sized South African Businesses. *International Business & Economics Research Journal (IBER)*. 12(7):835–854.

Goosen, R. & Rudman, R. 2013b. The development of an integrated framework in order to address King III's IT governance principles at a strategic level. *South African Journal of Business Management*. 44(4):91–103.

Grossman, R.L. & Siegel, K.P. 2014. Organizational models for big data and analytics. *Journal of Organization Design*. 3(1):20-25.

Hagen, C., Evans, H., Thota, B., Wall, D., Seshadri, A. & Khan, K. 2014. *IT's Challenge: Bringing Structure to the Unstructured World of Big Data - Paper - A.T. Kearney*. [Online]. Available: http://www.atkearney.com/paper/-/asset_publisher/dVxv4Hz2h8bS/content/id/5152447 [2015, April 16].

Henderson, J.C. & Venkatraman, N. 1993. Strategic alignment: Leveraging information technology for transforming organizations - ProQuest. *IBM Systems Journal*. 32(1):472–484.

IBM. 2006. *Igniting innovation through business and IT fusion.* [Online]. Available: https://www-935.ibm.com/services/fr/cio/flexible/flex_wp_gts_fusion_business_it.pdf [2015, June 25].

IODSA. 2009. *King Code of Governance Principals for South Africa (King III)*. [Online]. Available: http://www.iodsa.co.za/?page=KingIII [2015, June 09].

ISACA. 2012a. *COBIT 5: A Business Framework for the Governance of Enterprise IT*. United States of America.

ISACA. 2012b. *COBIT 5: Enabling Processes*. United States of America.

Stellenbosch University https://scholar.sun.ac.za

ITGI (IT Governance Institute). 2003. *Board Briefing on IT Governance (Second Edition)*. [Online]. Available: http://www.isaca.org/restricted/Documents/26904_Board_Briefing_final.pdf [2015, July 07].

James, J. 2014. *Data Never Sleeps 2.0*. [Online]. Available: https://www.domo.com/blog/2014/04/data-never-sleeps-2-0/ [2015, June 24].

Kaisler, S., Armour, F., Espinosa, J. & Money, W. 2013. Big Data: Issues and Challenges Moving Forward. *46th Hawaii International Conference on System Sciences (HICSS)*. 995–1004.

Krechovská, M. & Procházková, P.T. 2014. Sustainability and its Integration into Corporate Governance Focusing on Corporate Performance Management and Reporting. *Procedia Engineering*. 69:1144–1151.

Kshetri, N. 2014. Big data's impact on privacy, security and consumer welfare. *Telecommunications Policy*. 38(11):1134–1145.

Lederer, A.L. & Sethi, V. 1988. The Implementation of Strategic Information Systems Planning Methodologies. *MIS Quarterly*. 12(3):445–461.

Liell-Cock, S., Graham, J. & Hill, P. 2009. *IT Governance aligned to KING III*. [Online]. Available: http://lgict.org.za/sites/default/files/documents/2009/liell-cock-graham-hill-2009-it-governance-aligned-king-iii.pdf [2015, April 16].

Lund, S., Manyika, J., Nyquist, S., Mendonca, L. & Ramaswamy, S. 2013. *Game changers: Five opportunities for US growth and renewal*. [Online]. Available: http://www.mckinsey.com/insights/americas/us_game_changers [2015, July 06].

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. & Hung Byers, A. 2011. *Big data: The next frontier for innovation, competition, and productivity*. [Online]. Available: http://www.mckinsey.com/insights/business_technology/big_data_the_next_frontier_for_innovation [2015, June 24].

Stellenbosch University https://scholar.sun.ac.za

Mayer-Schönberger, V. & Cukier, K. 2013. *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. Boston, New York: Houghton Mifflin Harcourt.

McRitchie, J. 1999. *Corporate Governance Defined*. [Online]. Available: http://www.corpgov.net/library/corporate-governance-defined/ [2015, June 03].

Newkirk, H.E., Lederer, A.L. & Johnson, A.M. 2008. Rapid business and IT change: drivers for strategic information systems planning? *European Journal of Information Systems*. 17(3):198–218.

O'Sullivan, P., Thompson, G. & Clifford, A. 2014. Applying data models to big data architectures. *IBM Journal of Research and Development*. 58(5/6):18:1–18:11.

Pantano, E., Iazzolino, G. & Migliano, G. 2013. Obsolescence risk in advanced technologies for retailing: A management perspective. *Journal of Retailing and Consumer Services*. 20(2):225–233.

Ping-Ju Wu, S., Straub, D.W. & Liang, T.-P. 2015. How information technology governance mechanisms and strategic alignment influence organizational performance: Insights from a matched survey of business and IT managers. *MIS Quarterly*. 39(2):497–518.

Provost, F. & Fawcett, T. 2013. Data Science and its Relationship to Big Data and Data-Driven Decision Making. *Big Data*. 1(1):51–59.

Qualified Audit Partners. 2010. *COBIT domains and processes*. [Online]. Available: http://www.qualified-audit-partners.be/index.php?cont=463 [2015, June 23].

Rudman, R. 2008. IT governance: A new era. *Accountancy SA,* March 2008*:* 12–14.

Sahd, L.-M. 2014. A structured approach to the identification of the significant risks related to enterprise mobile solutions at a mobile technology component level. Unpublished Masters of Commerce (Computer Auditing) thesis. Stellenbosch: Stellenbosch University.

Stellenbosch University https://scholar.sun.ac.za

Sahut, J.M., Hikkerova, L. & Khalfallah, M. 2013. Business Model and Performance of Firms. *International Business Research*. 6(2):64–76.

sas.com. 2013. *Big data: What is it and why it matters.* [Online]. Available: http://www.sas.com/en_us/insights/big-data/what-is-big-data.html [2015, July 06].

Sauer, C. 2015. Taking charge of big data. *Credit Union Magazine*. 81(1):34–37.

Shpilberg, D., Berez, S., Puryear, R. & Shah, S. 2007. Avoiding the Alignment Trap in Information Technology. *MIT Sloan Management Review*. 49(1):51–58.

Smeda, J. 2015. Benefits, business considerations and risks of big data. Unpublished Masters of Commerce (Computer Auditing) thesis. Stellenbosch: Stellenbosch University.

Smit, S. 2009. Defining and reducing the IT gap by means of comprehensive alignment. Unpublished Masters of Commerce (Computer Auditing) thesis. Stellenbosch: Stellenbosch University.

Steenkamp, G. 2011. The applicability of using COBIT as a framework to achieve compliance with the King III Report's requirements for good IT governance. *Southern African Journal of Accountability and Auditing Research*. 11:1–8.

Tallon, P.P. 2013. Corporate Governance of Big Data: Perspectives on Value, Risk, and Cost. *Computer*. 46(6):32-38.

Van Grembergen, W. & De Haes, S. 2009. *Enterprise Governance of Information Technology: Achieving Strategic Alaignment and Value*. New York: Springer Science + Business Media.

Walker, M. 2012. *Structured vs. Unstructured Data: The Rise of Data Anarchy*. [Online]. Available: http://www.datasciencecentral.com/profiles/blogs/structured-vs-unstructured-data-the-rise-of-data-anarchy [2015, April 17].

Weill, P. & Ross, J.W. 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. Boston: Harvard Business School Press.

Stellenbosch University https://scholar.sun.ac.za

Wilkin, C.L. & Chenhall, R.H. 2010. A Review of IT Governance: A Taxonomy to Inform Accounting Information Systems - ProQuest. *Journal of Information Systems*. 24(2):107–146.

Zhu, P. 2013. *How to Define IT Agility? ~ Future of CIO*. [Online]. Available: http://futureofcio.blogspot.com/2013/10/how-to-define-it-agility.html [2015, July 07].

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Appendix A: COBIT 5 processes

Domain	Process	Description
Evaluate, Direct and Monitor (EDM)	EDM01 Ensure Governance Framework Setting and Management	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.
	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.
	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.
	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.
	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.

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Domain	Process	Description
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.
	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.
	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.
	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.

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Domain	Process	Description
Align, Plan and Organise (APO)	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.
	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.
	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.

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Domain	Process	Description
Align, Plan and Organise (APO)	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.
	APO09 Manage Service Agreements	Align IT-enabled services and service levels with enterprise needs and expectations, including identification, specification, design, publishing, agreement, and monitoring of IT services, service levels and performance indicators.
	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.
	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.
	APO12 Manage Risk	Continually identify, assess and reduce IT-related risk within levels of tolerance set by enterprise executive management.
	APO13 Manage Security	Define, operate and monitor a system for information security management.

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Domain	Process	Description
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.
	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.
	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.
	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.

Domain	Process	Description
Build, Acquire and Implement (BAI)	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.
	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.
	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.
	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.
	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.

Domain	Process	Description
	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.
Deliver, Service and Support (DSS)	DSS01 Manage Operations	Co-ordinate and execute the activities and operational procedures required to deliver internal and outsourced IT services, including the execution of pre-defined standard operating procedures and the required monitoring activities.
	DSS02 Manage Service Requests and Incidents	Provide timely and effective response to user requests and resolution of all types of incidents. Restore normal service; record and fulfil user requests; and record, investigate, diagnose, escalate and resolve incidents.
	DSS03 Manage Problems	Identify and classify problems and their root causes and provide timely resolution to prevent recurring incidents. Provide recommendations for improvements.
	DSS04 Manage Continuity	Establish and maintain a plan to enable the business and IT to respond to incidents and disruptions in order to continue operation of critical business processes and required IT services and maintain availability of information at a level acceptable to the enterprise.
	DSS05 Manage Security Services	Protect enterprise information to maintain the level of information security risk acceptable to the enterprise in accordance with the security policy. Establish and maintain information security roles and access privileges and perform security monitoring.

Domain	Process	Description
	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.
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.
	MEA02 Monitor, Evaluate and Assess the System of internal Control	Continuously monitor and evaluate the control environment, including self-assessments and independent assurance reviews. Enable management to identify control deficiencies and inefficiencies and to initiate improvement actions. Plan, organise and maintain standards for internal control assessment and assurance activities.
	MEA03 Monitor, Evaluate and Assess Compliance with External Requirements	Evaluate that IT processes and IT-supported business processes are compliant with laws, regulations and contractual requirements. Obtain assurance that the requirements have been identified and complied with, and integrate IT compliance with overall enterprise compliance.