Developing a budgetary control framework for a multinational company using Industry 4.0 technologies

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ABSTRACT

TITLE: Developing a budgetary control framework for a multinational company using Industry 4.0 technologies

KEYWORDS: Corporate governance, multinational companies, Industry 4.0, mining sector, stewardship theory, management accounting, internal auditing, corporate culture, budgeting methods, action design research.

Multinational companies form part of our day-to-day existence. The increase in these companies is leading to people of different cultures having to work together to ensure that the company is a success. In the past, multinational companies were unable to ensure that growth is being achieved in the best way possible. Consequently, this has led to goal divergence between employees and management, weak communication channels and weak internal governance processes. To be able to ensure that multinationals reach its full potential, the internal governance process has to be improved.

Additionally, when corporate employees feel included and part of the decision-making in the company, it will possibly lead to goal convergence instead of goal divergence. This strategy is referred to as the stewardship theory, and depicts management and employees as working together towards achievement of the strategic goals of the company.

An activity that should lead to goal convergence between employees and management, is budgeting. Due to the structure of multinational companies, however, this can lead to goal divergence. This goal divergence could harm the company by limiting its progress towards completion of projects, leading to overspending, both of which reflect poor internal governance. A case study company within the mining sector was selected for this study. Within this sector – similar to other sectors – cost savings are a priority area to ensure sustainability. It was therefore necessary to develop an improved method of budgeting.

New technologies were recently designed as part of the fourth industrial revolution. These technologies – termed Industry 4.0 technologies – can possibly aid in solving the budgeting problem in the selected multinational company selected for this case study. To determine whether this would be possible, an action design research approach was followed. Action design research is a research method used to solve practical problems (practice inspired) by using a theoretical framework (theory ingrained). An artefact is designed and then tested by going through a number of iterations so that it can become clear how this artefact can aid in solving the problem identified in practice.

In this study an artefact was developed through conducting both a literature and an empirical study. The aim of the literature study was to firstly identify the best method and guidelines for budgeting. Secondly, the literature study examined the different Industry 4.0 technologies to determine what the possible benefits and drawbacks of each technology are. After the literature study has been done, a first iteration of a possible Industry 4.0 budgeting framework was designed. The budgeting framework was then refined by conducting semi-structured interviews with seven manager-level employees of the selected multinational company. The aim was to understand the corporate environment, as well as the challenges and needs of the current budgeting system so that an appropriate budgeting framework, using Industry 4.0 technologies, could be designed.

This study concluded that it was possible to use Industry 4.0 technologies, such as big data, simulation and cyber physical systems, to design a budgeting framework in order to improve the internal governance of the company and which could lead to employees and managers working towards the same strategic goals.

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CHAPTER 1

1 INTRODUCTION

1.1 Multinational Companies

Multinational companies are the frontrunners in the supply of goods and services to a global market as they have subsidiaries in countries around the world (Maria, 2018:72). Beugelsdijk and Jindra (2018) explain that the success of multinational companies can largely be attributed to their ability of accumulating knowledge and resources from different sources and combining them to deliver a high-quality product. Casanova and Miroux (2018) indicate that, in 2018, it was reported that more than 40% of companies across all sectors who participated in this survey, had a global presence. This could be an indicator that multinational companies are on the increase. According to Maria (2018:73), they are key contributors to the global economy's growth and stability. This increased power and influence that multinational companies now have, fuels a concern on how these companies manage their power and influence (Maria, 2018:74). Beugelsdijk and Jindra (2018) state that multinational companies can be seen as a social network of different cultures with different capabilities. These concerns are of critical importance, since the misuse of this power can lead to catastrophic events such as the fall of Enron, Steinhoff, KPMG, Tongaat Hulett and Ricoh India. The latter will be discussed later in this study (refer section 1.2).

According to Business Insider SA (2020), some of the greatest financial scandals that South Africa has faced over the last few years include KPMG, Tongaat Hulett and Steinhoff. This article reports that Steinhoff conducted deals from which the Chief Executive Officer (CEO) Markus Jooste, personally benefitted financially. These deals included bypassing accounting procedures to overstate income and forging documents. In the case of KPMG, it was discovered that the company had illicit ties to the Gupta family—a family linked to state capture in South Africa. The problem with this relationship between KPMG and the Gupta family, was that it led to KPMG restating costs relating to a Gupta family wedding as an unspecified tax-deductible cost (Business Insider SA, 2020). The most recent accounting scandal was that of Tongaat Hulett (Business Insider SA, 2020). Tongaat Hulett admitted that some of their past accounting practices did not accurately reflect the business performance. This inaccurate reporting included the overstatement of the company's equity by almost R3.5 billion.

Jennings (2003) reports on the events that lead to the fall of Enron and concluded that the unethical behaviour could be allotted to a few weaknesses within the company. Jennings (2003) lists the following frailties as weak: 1) board of directors, 2) internal auditing, and 3) communication channels. Conflicting personal cultures is another weakness. Jennings (2003) states that these frailties created a perfect storm that could make any ship sink, since no control or governance existed.

Maria (2018:74) affirms that, as this power can be so greatly misused, a need arises for appropriate and acceptable governance that provides assurance to all stakeholders within multinational companies.

1.1.1 Defining corporate governance and its related theories

"Corporate governance is deemed a systemic provision of some measure of control over the actions of agents such as managers and subcontractors" (L'Huillier, 2014:301).

Agency theory is mostly used to illustrate the relationship between principals and agents in the workplace – this links to the role of corporate governance. Heath and Norman (2004: 249) agree by explaining this theory as a principal party wanting to influence an agent party to act in a certain way. Li and Harrison (2008:610) concur by stating that the stakeholder theory illustrates that management should act in a way to adhere to the requirements of the shareholders of a company. Li and Harrison (2008:610) continue to explain that the problem is that various countries have shareholders or managers without the same socio-cultural characteristics and values.

This gives rise to the anomaly that acceptable principles in one country do not meet the requirements of another country, leading to increased difficulty in governance (Li & Harrison, 2008:611). McKeon (2017:492) describes this anomaly by stating that the world is messy and difficult to govern, since all people are strongly influenced by social and racial hierarchies.

From the above it can be seen that a problem arises when using the agency theory to implement governance in a multinational company. Mioara (2018:702) is of the opinion that corporate governance is defined as a method or system to manage all types of organisations in a healthy way. Filatotchev *et al.* (2018) examined family-owned businesses and concluded that corporate governance should be seen as a family working closely together to reach a goal that benefits all members of the family. As previously discussed, members of multinational companies are not always in close proximity to one another and to management or family members and could be

separated by great distances. L'Huillier (2014:308) endeavoured to form a dynamic definition of what corporate governance on a global scale is. This task is quite difficult, since there is firstly a difference between what academics and practitioners classify as governance. These differences, according to L'Huillier (2014:309), are due to conflicts in philosophical and cultural roots. Secondly, the needs and expectations of stakeholders of various nationalities do not align and lead to goal divergence between the agents and principal parties of multinational companies (L'Huiller, 2014:311). Li and Harrison (2008:612) explain that global corporate governance should not be defined from the viewpoint of a unified firm that works towards the same goal, but rather as a method or system to enable a group of people with unique opinions to work towards the same goal.

Li and Harrison (2008:612) restructured the thinking process of what corporate governance should be, by not focusing on trying to erase the differences between the stakeholders of a company, but by finding a method that could enforce a certain response to certain actions. L'Huillier (2014:315) is of the opinion that corporate governance can be defined as a process to see to it that the actions of agents are directed at achieving the combined objectives of the most important stakeholders. In this definition, L'Huillier (2014: 316) states that corporate governance should not be underlined by the agency theory, but rather by the stewardship theory, which avers that people should be motivated to add to the success of the team instead of that of the individual.

When stakeholder theory is used to implement corporate governance, the focus is mainly, as Balakrishnan *et al.* (2017) emphasise, on how the most important stakeholders of the company will benefit from decisions made. Balakrishnan *et al.* (2017) continue to explain that the main characteristics of stakeholder theory include the following: the management of the stakeholders supplying them with the highest possible value, focusing on the organisational needs and having few individuals engaged in decision-making. Marcoux (2003) supports the above authors by stating that it is impossible for this theory to act in a moral way towards all stakeholders and ensure that a trust environment among all stakeholders, internal and external, is created.

Snippert *et al.* (2015:574) explain what the benefits are of having a stewardship approach in a company. Stewardship will firstly lead to goal alignment, since the emphasis is on behaviour that benefits the company and not the individual. Secondly, stewardship leads to a trust relationship instead of a control environment by implementing autonomy and giving away responsibility. Thirdly, stewardship will lead to a unified culture, since stewardship reduces the focus on legalistic contracts and enforces certain behaviour. Stewardship lastly creates a repetitive model that can

be used to measure performance and progress towards the completion of tasks. Balakrishnan *et al.* (2017) elaborate that, by having a stewardship approach, the focus is on the long term welfare of the company by investing in individuals, and which shapes ethical and moral behaviour by all members.

In response to the discussion above, it can clearly be seen that corporate governance in a multinational company needs to be controlled by implementing a control framework that is focused on autonomy which is underlined by stewardship theory. This will lead to goal alignment and the delegation of responsibility so that the specifications of all stakeholders can be met.

1.1.2   The fourth industrial revolution and corporate governance of a multinational company

Industrial revolutions helped us to shape the future and to reach new grounds that have never seemed possible, as commented by Duarte *et al.* (2018). There had already been three previous revolutions that helped the world move forward significantly. These revolutions, as reported by Griffiths and Ooi (2018), are water and steam power, electricity and thirdly semiconductor technology (or digital technology). These revolutions are summarised as follows (Griffiths & Ooi, 2018):

- The water and steam power revolution were an initiative to increase the productivity of factories by including giant water wheels to help power or move items along the production line. Later, theses water wheels were replaced by having steam powered wheels that was able to move faster.

- The electrical revolution replaced the steam powered wheels with electrically powered wheels leading to an increase in productivity. This revolution also included the use of electricity to power lightbulbs and telephones.

- The semiconductor revolution where the transistor was invented which replaced vacuum tubes since these transistors where more efficient and cheaper to manufacture. These devices included insulators and resistors making it possible to power devices of different electrical requirements.

Griffiths and Ooi (2018) continue to inform about the next revolution that is currently happening – which is called Industry 4.0 – as named by a German presenter at the Hannover fair in 2011 for the first time.

Mohelska and Sokolova (2018:2228) aver that Industry 4.0 can be defined as the combination of people, gadgets and systems working together in real time to solve problems and deliver solutions. Sunil and Kumar (2018:169) elaborate on the definition of Industry 4.0 by stating that the goal is to develop sustainable concepts that innovatively improve everyday tasks. This innovation is gained by using concepts such as 3D printing, Internet of Things (IoT), Big Data Analytics and data-driven services. Basl (2018:3) expands this definition by stating that the concept is the integration of industrial processes which is guided by information technology and include automation, data sharing and continuous communication between different platforms.

Duarte *et al.* (2018) support the above and state that Industry 4.0 technologies will give rise to cyber physical systems where physical systems will be integrated with technology and monitored by data management. Griffiths and Ooi (2018) emphasise the importance of data within this revolution. These authors highlight that, by having effective data management systems in place, wasted time and resources within companies can be reduced by as much as 48%.

Dalenogare *et al.* (2018) conducted a study to determine the possible benefits of Industry 4.0 on a company, and the findings can be illustrated using Figure 1-1.

Figure 1-1: Benefits of Industry 4.0

Improvement	Optimization	Efficiency	Reduction
• Product customization • Product quality • Decision making process • Sustainability	• Automation process • Productivity • Safety • Process control	• Energy efficiency • Planning • Task allocation • Supervision	• Operational costs • Labor disputes • Skills needed by each employee
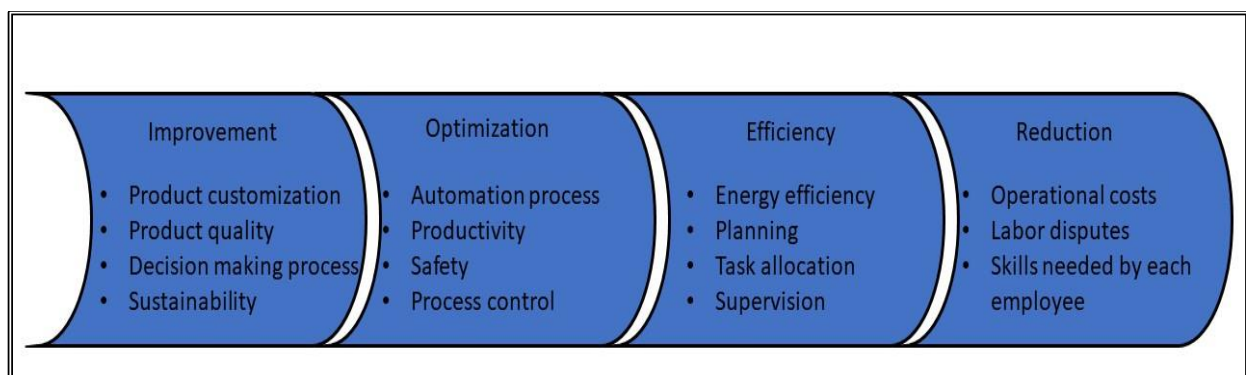
Source: Dalenogare *et al.* (2018)

Figure 1-1 indicates that Industry 4.0 can enable companies to improve and have more flexible business processes to optimise strategic and operational decision-making, which will lead to a

data-driven culture within the company (Dalenogare *et al.*, 2018:384). Griffiths and Ooi (2018) remark that Industry 4.0 is set to transform the way we live and work by bringing new insights that can reshape our complete thinking process about certain processes that we follow.

Mioara (2018:703) argues that the process of corporate governance can be described as the methods and procedures used to manage companies on a behavioural and normative level. The behavioural level refers to interaction of stakeholders, while the normative level refers to adherence to certain regulations. Mundzir (2016:88) defines corporate culture as the dominant values and behaviour of the company. A link can therefore be seen between corporate governance and culture, since both are influenced by the behaviour of the members of the company. This is confirmed by Ntongho (2016:535) who avers that the culture of a company is a strong determinant of how corporate governance is applied.

Mohelska and Sokolova (2018:2228) are convinced that the corporate culture of a company will drastically be adjusted by Industry 4.0 which, as discovered above, will also affect the corporate governance of such a company. Accordingly, it can be assumed from the above that by implementing Industry 4.0 technologies, the company will theoretically have a corporate governance framework that is improved, optimised and more efficient - as illustrated in Figure 1-1.

1.1.3   Introduction to case study

The multinational company which will be considered in this study is a recognised world leader in the drilling industry and provides expert services to a wide range of different mines, in South Africa as well as abroad. The company is listed on the JSE and has shown continual growth since the start of the company.

The strategy of this company is to deliver a service that is an adaptive and innovative one-stop solution. To succeed in this strategy, the company established entities in different countries to manage the operations of contracts in the specific countries. Each entity must manage the complete value chain associated with the operations and drilling methods performed in their respective countries.

This company is classified as a multinational company as it has entities in South Africa, upper Africa, Canada, North America, South America, Europe and China. The company forms part of the mining industry of South Africa. According to Singh (2017), the mining sector of South Africa is in jeopardy due to the increase in operational costs and stricter regulations. He is, however, of

the opinion that there is great possibility for further development and growth in the South African mining sector if the correct technologies are implemented. Vaidya *et al.* (2018: 235) support Singh (2017) by affirming that the mining sector is a perfect example of where new technologies, such as Industry 4.0 technologies, can be used to optimise both the manufacturing process and the supporting activities thereof.

Currently this company does not have an adequate method to gain visibility through autonomy over the spending allowed – referred to as the budget – per drilling project in different countries and regions. The reason for this, as exposed by the information above, is that different cultures, as well as great distances between the parties involved in the projects, lead to a lack of effective communication and understanding. Furthermore, there is a need that the budgeted allowances should be visible to all parties as close as possible to real time, so that the decisions made will not be based on outdated data resulting in sub-optimal judgements.

1.2   Motivation of topic actuality

Sabar *et al.* (2018:1090) give account of an encumbering fact that there is an increased need for corporate governance procedures to be implemented in multinational companies. There has been an increase in financial collapses of such companies due to weak control systems and corruption.

Some of these recent corporate governance failures within multinational companies include Steinhoff and Ricoh India. Steinhoff, a multinational company, was among the top 10 companies on the JSE stock exchange, as reported by Rossouw and Styan (2018). These authors continue to explain that even though the details of what happened are still unclear, the dangers of poor governance and an all-powerful chief executive can be seen. The case of Ricoh India is very similar. Ricoh India, as reported by Goyal and Dhamija (2018), is a multinational company which originated in Japan. This company was found guilty in 2016 for falsifying their accounts to show fictitious growth.

In the last few years, there has been a drastic increase in research on the problem of governance in multinational companies, yet few studies have been done on designing practical solutions to improve poor governance (Filatotchev *et al.*, 2018). Sabar *et al.* (2018:1098) add that, if the financial failure of multinational companies continues, the public will lose complete trust in them which could lead to a backslide in the economic development gained by multinational companies.

AlQadasi and Abidin (2018) make a very important comment that needs to be understood. They state that there is a big difference between external and internal corporate governance within a company. They continue to explain that external governance focuses on mechanisms that is used to govern the company to meet the needs of stakeholders such as governments, shareholders and external auditors. Internal governance focuses on implementing mechanisms that is used to govern the employees in the company to meet the needs of the executive management of the company. This study will focus on issues that arise from poor internal corporate governance.

Chikwiri and De la Rossa (2015) recommend that internal corporate governance should be enforced by an internal audit function acting as gatekeeper to how a company's members should act. They sadly report that the best governance can be achieved when it is possible to continually "look over the employee's shoulder". Rodrigue and Roussy (2015) partially support the statement that governance was traditionally enforced by an overseeing internal audit function within a company and that it is impossible for this function to be aware of every unethical act that happens.

Chikwiri and De la Rossa (2015) posit that, even though internal auditing is assisting in the governance of a company, this function should also assist management by investigating costs that could have been avoided with the aim of improving the overall performance of a company. The problem is that the above is not in the scope and role of what internal auditors do (Sabar *et al.*, 2018:1091). Rodrigue and Roussy (2015) elaborate that the internal audit function has become a defensive mechanism to keep the company in line and aggressively enforces acceptable practice principles. In contradiction to the above, Sabar *et al.* (2018:1093) are of the opinion that internal auditors should not only be defensive, but should also enable the company to make better decisions to reduce risks and increase operational performance. Rodrigue and Roussy (2015) explain that the reason why the internal audit function is not performing as expected, could be attributed to the impossibility to govern all activities of a company when a backward-looking viewpoint is used. Cikwiri and De la Rossa (2015) make a bold statement, namely that the internal audit function in practice is not contributing to the effective management of the company, as it should highlight errors instead of changing the system to exclude the risk of these errors happening again. Chikwiri and De la Rossa (2015) highlight that the true value of an internal audit function can be applied to the benefit of a company if this function can shift towards a forward-looking approach by implementing a control framework that can eliminate possible risks.

Zuca and Tinta (2018) conducted a study on how information technologies can influence auditing techniques and discovered that with enough data of what is happening in a company, it is possible to change the view of an auditing function from backwards looking to forward looking. Sago (2018) supports these authors in her comment that with a well-developed and trusted data system, predictions and quicker problem solving are some of the benefits and results that can be expected.

There is therefore a need for an improved approach to manage the governance within a multinational company by using the resources at hand, such as Industry 4.0 technologies. This need can possibly be addressed by developing and implementing a control framework. Bragg (2019) defines a control framework as the basis for designing a set of controls for a company. He continues by mentioning that these set of controls should have the goal to minimise risks by using corporate practices and procedures in a coordinated way.

Uwadiae (2015) explained utilising the Committee of Sponsoring Organizations of the Treadway Commission's (COSO) framework, that a control framework should have the goal to help businesses establish, assess and enhance their internal control. He argues that the importance of a control framework should not be underestimated. This framework, if implemented and used, has the ability to provide a foundation for assurance to users that the output of the framework can be relied upon.

From the above discussion, it can be assumed that to effectively ensure effective corporate internal control, a control framework must be designed to address the specific needs and requirements of such company. Sago (2018) contributes to this argument by positing that a control framework that uses industry 4.0 technologies, will lead to a more complete and robust framework.

There is therefore a need for an improved approach on managing the governance within a multinational company by using the resources at hand, such as Industry 4.0 technologies.

1.3 Problem Statement

Currently there is a shortage of practical solutions to govern the operations of multinational companies due to the large differences in cultures and values in different countries. This problem leads to increased risk of financial distress, or even corporate failure. A gap between the acknowledgement of a governance control framework and the effective enforcement of such a framework can therefore be identified.

This gives rise to the research problem, questioning whether multinational companies are effectively governed and proposing that a more effective method – using Industry 4.0 technologies – should be designed and implemented.

This predicament is also found in the selected multinational company in the form of limited visibility in the monitoring of budgeted allowances of the projects in the various countries. There is a need for the development, implementation and enforcement of an artefact that can monitor and present the progression of the budgeted allowances for each project as close as possible to real time.

1.4 Objectives

The objectives comprise a main objective which is supported by secondary objectives.

1.4.1 Main Objective

The main purpose of this study is to develop an internal corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems (referred to later as a budgeting control framework).

1.4.2 Secondary objectives

The secondary objectives of this study will aid in gathering information that will give enough evidence so that a suitable solution to the main objective can be developed. These are:

1. To present the appropriate research design and methodology followed in this study to answer the set research objective (Chapter 2);

2. To identify and evaluate the different types of Industry 4.0 technologies and budgeting systems in the context of the budgeting process at the chosen multinational company (Chapter 3);

3. To gather qualitative data to determine the current status and future requirements for the budgeting system by conducting semi-structured interviews (Chapter 4);

4. To design a final internal corporate governance control framework that aids in the budgeting process – based on gathered qualitative data (Chapter 5); and

5.   To conclude the study by making practical recommendations, identifying limitations and areas for future research (Chapter 6).

1.5   Research Design/Method

1.5.1   Literature Study

A literature study will be undertaken to help understand the environment that this study encompasses and to gain insight into different Industry 4.0 technologies. The literature study will consist of the study of textbooks, academic articles in peer-reviewed journals and internet articles.

1.5.2   Empirical Research

The empirical research will follow a case study approach. The data for this study will be extracted from actual data within the selected multinational company. Qualitative data from drilling site managers gained through semi-structured interviews will be used.

The solution to the research problem can be addressed by following a theoretical approach, such as a literature study. However, the testing of a theory that is derived from such a theoretical approach in a real-life environment will contribute to solving the problem. The expectations and limitations of this real-life environment can then be evaluated to determine how a framework should be designed so that it is able to help in the budgeting process.

The process described above is defined by Mullarkey and Hevner (2015) as an action design research (ADR) model used in information systems (I/S). Kaul (2014) reports that ADR is a lens or set of analytic techniques used to conduct research in a certain environment that leads to the creation of new knowledge through the design of artefacts using information technology. According to Peffers *et al.* (2007), this research design aims to establish a working model solution to a complex problem within practice, by using theoretical principles. The possible artefacts that can be designed and used are classified by Mullarkey and Hevner (2015) into constructs, models, methods and instantiations.

In order to identify what artefact will be utilised, an understanding of the different types of artefacts are required. Constructs are defined by Mullarkey and Hevner (2015) as the informal conceptualisation of a problem and solution. Models, on the other hand, according to Kaul (2014), are an abstract representation of high-level details of the environment that needs to be investigated. Methods are defined by Kaul (2014) as guidelines that explain how to perform a task

in the real word. Lastly, Mullarkey and Hevner (2015) define instantiations as the operational output of methods and models that can be used to demonstrate their feasibility and effectiveness.

In this study, a method type artefact will be developed using Industry 4.0 technologies which form part of information systems. The focus in this study will not be on the information systems, but rather on how these systems can be used to better manage the internal corporate governance environment of the chosen company. The reason for this choice of artefact is to align to the main objective of the study of designing a budgeting control framework for a multinational company using Industry 4.0 technologies.

Sein *et al.* (2011) argue that it is important that the researcher and the practitioner work closely together in each stage of ADR to develop an artefact that contributes to the research field and real-life environment of the practitioner by producing a solution to a complex problem. These stages can be seen in Figure 1-2 below.

Figure 1-2: ADR stages
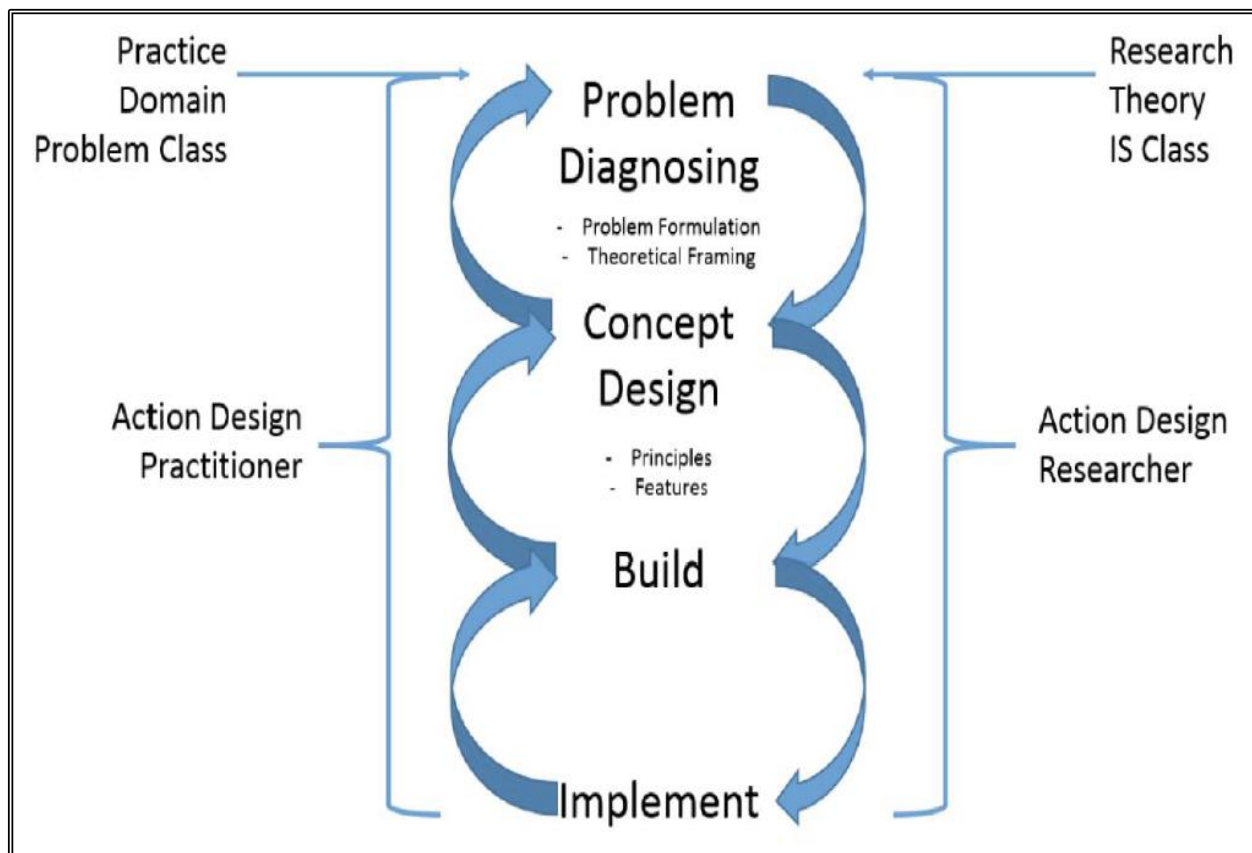
Source: Mullarkey and Hevner (2015)

1.6   Paradigmatic assumptions and perspectives

1.6.1   Ontological assumptions

This study will develop a budgeting control framework from information gathered within the selected multinational company environment. The budgeting control framework will be created based on the author's interpretation of this data and the interpretation of literature on the optimal use of Industry 4.0 technologies. An interpretivist approach will therefore be followed, since the intuition or imagination of the author is a critical part of the solution.

1.6.2   Epistemological assumptions

For the purpose of this study, an inductive view will be chosen as the epistemological approach. The ADR method aims to change the way the world is viewed by developing a new budgeting control framework that can solve a specific problem. For this reason, this paradigm will best fit the study since a new theory or possible solution will be created to address the research problem.

1.6.3   Methodological assumptions

In this study, the corporate governance and visibility of a budgeting allowances system in the selected multinational company will be analysed. This information is not numerically quantifiable and thus a qualitative approach should be followed. The data collection technique of semi-structured interviews, as discussed in 1.5.2, will be used.

ADR will be the chosen vehicle within which the methodology will function so that an acceptable budgeting framework can be created. The chosen data sources and gathering methods will aid in diagnosing the problem, designing a concept, and building the framework of a budgeting artefact that is able to display allowances as close as possible to real time (refer to Figure 1-2).

1.7   Terms of reference

In this previous chapter, concepts were used that can possibly be interpreted differently than intended for purposes of this study. For this reason, a terms of reference – in the context of this study – was compiled based on the interpretation of the researcher.

- Method: A logical, orderly or systematic way of accomplishing a task.

- Control system: A set of principles or procedures that function together in ensuring a certain outcome, or preventing certain outcomes.
- Corporate governance: A collection of mechanisms or techniques used to direct and manage a company in an acceptable way.
- Internal control: An organisational process that provides assurance that the desired objectives are met effectively and efficiently.
- Internal governance: A set of structures, procedures or rules established internally and that regulates how the company achieves acceptable internal control.
- Corporate governance procedures: A series of actions conducted in a certain manner to create an environment in which employees can function optimally.

1.8 Layout of the study

The flow of the argument of this study will be guided by the following chapters:

- Chapter 1: Introduction and background

This chapter will aim to provide background to the study by addressing the problem that gave rise to this study. Secondly, this chapter will present the objectives of this research and how these objectives will solve the research problem. This chapter will lastly present the intended research design and approach to meet the objectives of this study.

- Chapter 2: Design and methodology review

This chapter will discuss the research design and methodology that will be followed. This will provide a presentation of how ADR will be utilised in this study. The chapter will also elaborate on how the data collection method, namely semi-structured interviews, will aid in reaching data saturation and lead to the completion of the objectives of this study. Lastly, this chapter will discuss the case study approach that will be followed.

- Chapter 3: Literature review of budgeting and Industry 4.0 technologies

This chapter will conduct a literature review of Industry 4.0 technologies and budgeting methods and guidelines. Furthermore, this chapter will entail the evaluation of the available Industry 4.0 technologies in the context of the case study. The goal is to move towards selecting an appropriate method to develop the budgeting artefact by eliminating methods that are not applicable to this study.

- Chapter 4: Feedback on empirical study

This chapter will explain the process that was followed when conducting the interviews with the participants. The chapter will then also discuss the comments made by the respondents and identify possible themes that can aid in developing a budgeting framework for a multinational company using Industry 4.0 technologies.

- Chapter 5: Design of internal corporate governance control artefact framework

This chapter will firstly give feedback on the data that was gathered through the semi-structured interviews. Secondly, the chapter will explain the chosen design and specifications of the budgeting artefact, based upon the conclusions made in the previous chapter and the data gathered.

- Chapter 6: Conclusion and recommendations

In this chapter a conclusion will be made based on the data collected. This chapter will also include the recommendations, the accepted limitations of the study and the areas identified for further research.

The next chapter will present the research design and methodology of this study.

CHAPTER 2

2   DESIGN AND METHODOLOGY REVIEW

2.1   Introduction

The aim of this chapter is to address the first secondary objective as set in Chapter 1 (section 1.4.2, page 10), which is to present the appropriate research design and methodology followed in this study, and to discuss in detail how this chosen method will be used to address the objectives. This chapter will begin by giving an introduction of the different aspects of design and methodology that will be addressed. Secondly, this chapter will focus on discussing what action design research is and why this method was chosen. Subsequently, the chapter will evaluate different case study approaches that can be followed to choose an appropriate method. The chapter will then elaborate on the selected data collection technique of semi-structured interviews.

Creswell (2014:31) places focus on three key aspects that must be considered when deciding on a methodology of a study. These three aspects are illustrated by Figure 2-1.

Figure 2-1: Triangle of interconnected research aspects
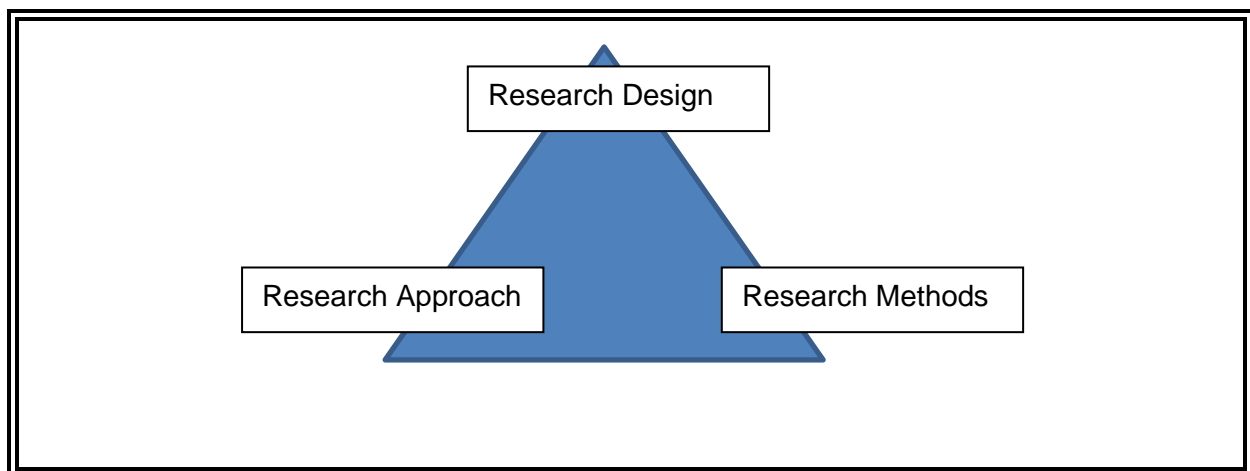
Source: Own compilation based on Creswell (2014:32)

The *research approach* as defined by Creswell (2014:31) is the most logical first step to take, but it is not a must. The research approach as Holden and Lynch (2004:4) aver can be seen as the nature of the study. Leedy and Ormrod (2010:25) state that the approach can be seen as a point of orientation that guides the rest of the study towards a goal.

Creswell (2014:31) explains that these natures can be divided into three core approaches, namely qualitative, quantitative and mixed method.

Qualitative research is used to grasp the phenomenon in its natural environment through the eyes of the direct participants within the phenomenon (Nieuwenhuis, 2007). Qualitative research – as defined by Creswell (2014:32) – aims to explore and understand the meaning of human and social problems. Babbie and Mouton (2008) clarify that a qualitative study is aimed at providing knowledge in an exploratory manner which then leads to comprehension of the unique environment examined. This is upheld by Creswell (2014:32) who confirms that qualitative research is an exploratory design strategy.

In contrast to the above, quantitative research is the study of numerical information which is gathered from a selected sample group (Maree & Pietersen, 2007:145). This sample group is then used, as Maree and Pietersen (2007:145) explain, to generalise the findings from this group to a larger group or universe. Ivankova *et al.* (2007:257) are of the same opinion and state that quantitative research is used to generalise results to a larger spectrum or universe. Quantitative research aims to test variables and is usually numerically quantifiable (Creswell, 2014:32).

Lastly, a mixed method approach will integrate data collected through both qualitative and quantitative methods in order to deliver a more holistic result and to deliver a hybrid product which includes data gathered from people and from analytics (Tashakkori & Teddlie, 2008:101).

Within this study, the research approach was qualitative of nature since the data was not numerically quantifiable and consisted of the opinions of people that worked with the budgeting system of the selected company.

The *research design* is defined by Creswell (2014:31) as the philosophical assumption made within the study. Holden and Lynch (2004:3) explain that this philosophical assumption should be based upon the nature of society and the nature of the science accepted for the specific study. Creswell (2014:35) used the terminology of 'worldview' to describe these assumptions.

Iivari (2007) explains that ontology can be understood by knowing what the world is that the method of research fits into. Iivari (2007) reports that the ADR method can be classified into the worldview that includes humans, institutions and theories. Holden and Lynch (2004) expand on this theory by stating that ontology is the study of what the accepted reality of the researcher is.

These different realities, as explained by Holden and Lynch (2004), can be classified as follows: whether the researcher is relying on reality as human imagination (interpretivism), or as a concrete process (positivism). In this study, an interpretivist reality will be accepted. According to Holden and Lynch (2004), if an interpretivist paradigm is chosen, inductive reasoning will be followed.

The nature of how society acts is also known as ontology (Holden & Lynch, 2004:3). Creswell (2014:54) describes this as the viewpoint from which society or reality is being analysed. Within this study, an interpretivist viewpoint was chosen since that paradigm or worldview rely on the insight and interpretation of the author (Holden & Lynch, 2004:3).

Epistemology, as defined by Holden and Lynch (2004), is the lens chosen to gain information from the selected reality.. Epistemology refers to the way that knowledge is accumulated. An inductive viewpoint will be chosen, since the author will use the knowledge gained to aid in developing a solution to the problem, namely the budgeting system. The researcher is involved in the process, which is one of the aspects of inductive research (Creswell, 2014:54).

The *research method* is the approach that will be followed to gather the data necessary to achieve the objectives of the study, as defined by Creswell (2014:42).

This study will implement a qualitative research approach. According to Leedy and Ormrod (2010:28), qualitative research focuses on characteristics or qualities that are not easily numerically quantifiable. Creswell (2014:24) identifies certain key characteristics of qualitative research, which include: 1) collect data in the natural setting of the field at the place where the participants are; 2) collect qualitative data by doing interviews, observing behaviour or examining documents, and 3) use multiple sources of data to be able to present a holistic view of the phenomenon.

Since this study is qualitative in nature, the possible techniques – as Holden and Lynch (2004:9) inform – are limited to ways that gather data which is not numerically quantifiable, such as interviews and case studies.

Within this study a case study approach was followed, since this was determined as the most suitable approach in Chapter 1 (paragraph 1.1.3, page 6) when the background to this study was discussed. The information needed for the case study was gathered by utilising semi-structured interviews as research method. The goal of using this method was to gather enough information

about the selected company to be able to design a budgeting control framework to improve the current budgeting process.

The information gained from this method was used in an action design research (ADR) process. The goal of this process was to test possible budgeting control framework iterations until an acceptable solution could be found to address the research problem and to adhere to the objectives of this study. The process of how this method was used in the ADR process will now be discussed in detail.

2.2 Action design research (ADR) explained

2.2.1 Background

To understand why the ADR method was developed, it is firstly necessary to examine the origin of this model. According to Sein *et al.* (2011:38), the design science research (DSR) model was originally developed within the information systems research field. Hevner *et al.* (2004:76) explain that information systems are implemented within an organisation with the goal of improving the effectiveness and efficiency of the company. These authors continue to explain that an information system consists of two separate aspects complementing each other. These aspects, confirmed by Peffers *et al.* (2007:47), are theoretical knowledge of what a problem is and secondly the development of a solution that is viable in a real-life environment. These two aspects are classified as the behavioural science and the design science (Hevner *et al.*, 2004:76-77).

According to Iivari (2007), design science is not a new concept since this method has already been used in software engineering for decades. Sein *et al.* (2011:38) explain that design science focuses on designing and constructing a technology artefact. Hevner *et al.* (2004:76) support these statements and add that design science is a problem-solving approach aiming to create innovative solutions to increase effectivity and efficiency of systems.

Behavioural science refers to the process of selecting a theory and improving it so that the theory is more complete and more accurate (Hevner *et al.*, 2004:78). Peffers *et al.* (2007:47) observe that by following this process, the result of the research will be descriptive – that only adds to the literature but struggles to contribute to practice. Sein *et al.* (2011:38) also started to question if the current design science approach is reaching its full potential. These authors state that technology artefacts should be shaped by the interests, values and assumptions that are applicable within a real-life environment. Sein *et al.* (2011:39) continue to explain that it should be

possible to practically test these developments in a real-life environment by developing different iterations until the goal of the system has been reached fully. This process was later named action design research (ADR).

2.2.2 Guidelines of ADR

Peffers *et al.* (2007:48) highlight an important concern by stating that every research method requires a framework so that it would be possible to evaluate whether a study was successful or not. Therefore, it is vital that certain guidelines should be followed within the ADR process as well. Within this study, the guidelines stipulated by Sein *et al.* (2011:40-48) will therefore be used. These guidelines are the following:

The first principle is that practice-inspired research should be performed. Sein *et al.* (2011:40) argue that the research problem should be based upon the intersection of technology and organisational domains. Peffers *et al.* (2007:49) assert that it is vital that the research addresses an actual problem. Within this study, the problem addressed is the budgeting process within a JSE listed company, thus the first principle is adhered to.

The second principle is that the study should focus on a theory-ingrained artefact. Mullarkey and Hevner (2015:127) support this and highlight it that theory should be used in a practical way to lead to optimisation. Within this study the stewardship theory will be used within a JSE listed company to develop a technology artefact (known as the budgeting control framework), as previously discussed in the background to this study (paragraph 1.1.1, page 2). Thus, the second principle is also followed in this study.

The third principle is that the artefact should be shaped by the context and environment of the organisation. Hevner *et al.* (2004:77) state that it is necessary to assess the environment of the organisation in a qualitative way so that adequate knowledge thereof can be gained. Within this study, semi-structured interviews were performed to gather qualitative data and therefore principle three was followed.

The fourth principle is that the different roles should learn from each other. Principle four is followed by using the stewardship theory to shape the artefact and to transfer knowledge to the organisation by providing a way that is able to better govern the budgeting processes in the chosen company.

2.2.3 Implementation of ADR in this study

The ADR method is classified by Mullarkey and Hevner (2015:125) as a continuum that consists of different processes. These authors elaborate that it is possible to enter and exit this continuum at a few points, as illustrated in Figure 2-2 below. In this study, the continuum was entered at the ADR problem formulation process and exited at the end of the concept design process.

Figure 2-2: Continuum of ADR
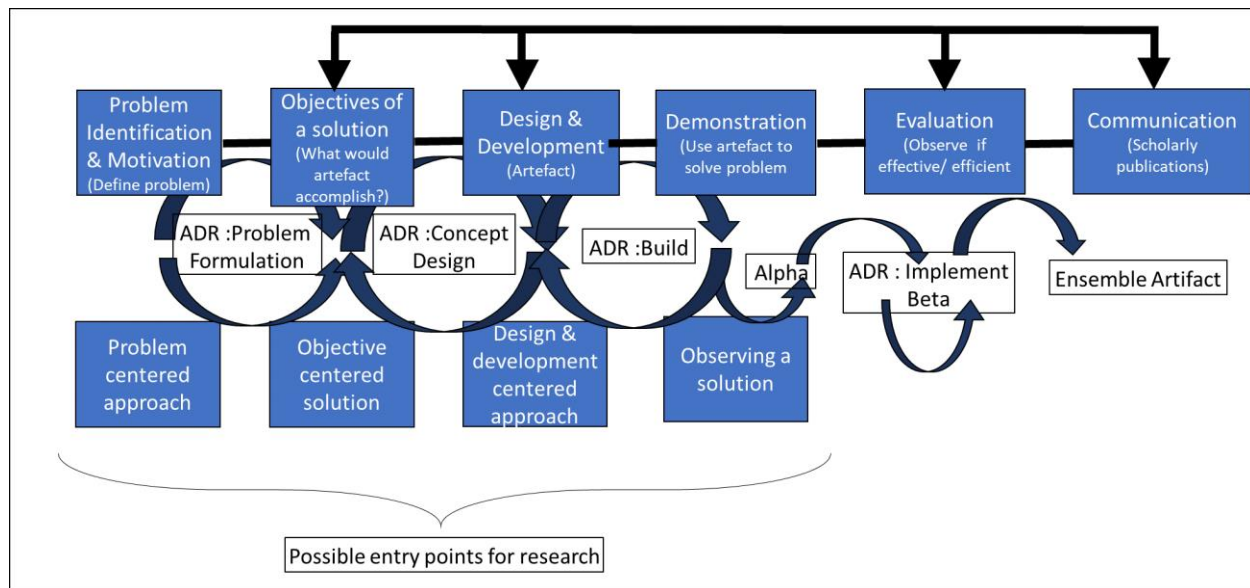
Source: Mullarkey and Hevner (2015:125)

Within this study, the ADR process was guided by a case study approach. The first cycle of ADR, namely problem identification and motivation, was done in Chapter 1 (section 1.5.2, page 11). Here it was uncovered that there was a need for a budgeting control framework that is able to deliver data of the allowable expenditure on a project as close as possible to real time. This problem leads to the formulation of the objective of this study, develop an internal corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems It can therefore be seen that the problem formulation cycle has been completed.

The second cycle shown in Figure 2-2 is the concept design cycle. The concept design firstly focused on evaluating data gathered from a literature study and the empirical research. The literature study provided guidelines on what types of technologies Industry 4.0 technologies

encompass and which of these are applicable to this study. The empirical research that was done consisted of semi-structured interviews with mine managers to evaluate how the current budgeting system works and what shortcomings it has.

Subsequently, the concept design cycle focused on using the data gathered from the above described sources to develop a budgeting control framework that would address the shortcomings of the current system and deliver real-time allowances to the mine managers - which would act as the budgeting tool and provide users with visibility so that optimal decisions can be made. After this budgeting control framework has been built, the objective of the study will be reached.

2.3   Case study explained

Case studies are viewed as a systematic and organised way to gather information about a certain environment, as stated by Cooper and Morgan (2008:160). These authors continue to explain that a case study approach makes it possible to investigate complex and dynamic phenomena and actual practices by explaining the context thereof. A case study also makes it possible to gain a holistic view of an environment, since it is possible to incorporate different disciplines (Tight, 2010:329-330). This author further explains that a case study is used more as a strategy than a method, since case studies have such a wide range of applications. Creswell (2014:246) comments that a case study provides the researcher with a detailed description of the environment that is being investigated. This enables the researcher to do an in-depth analysis of the issues within this environment and to provide solutions that are relevant.

2.3.1   Types of case study approaches

According to existing literature, different types of case studies can be undertaken, depending on the need of the researcher (Tight, 2010:331). These different types have been introduced in literature throughout the years by a variety of authors (Stake, 1995; Yin, 2002; Levy, 2008). Baxter and Jack (2008:546) summarise the viewpoints of some of these authors.

The first type of case study, as examined by Baxter and Jack (2008:546), is the explanatory case study. According to these authors, this method aims to explain what the effects are of implementing a theory within a real-life environment. This type of case study is identified by Levy (2008:5) as a hypothesis-generating case study. It aims to aid in the construction of a theory, and not in implementing it.

The second type of case study, as examined by Baxter and Jack (2008:546), is the exploratory case study. This type of study, as the authors state, aims to explore areas within a certain case where intervention is needed. Levy (2008:4) elaborates that this type of case study should be named an inductive case study, since a number of assumptions are made based upon the researcher's opinion, but there is not always a theoretical backing for these opinions.

The third type of case study, as examined by Baxter and Jack (2008:546), is an intrinsic case study. This case study type aims to better understand a single case. Baxter and Jack (2008:546) continue to explicitly state that the goal of this study type is not to form a generalised conclusion for similar cases, but only for the selected case. Levy (2008:4) concurs with these authors but names this type of case study a theory guided idiographic case study. According to Levy, this naming is chosen since it emphasises that the researcher's opinion is used to form the links, focusing only on the one selected case.

The fourth type of case study identified by Baxter and Jack (2008:546) is the instrumental case study. This method, as Baxter and Jack (2008:546) explain, aims to provide insight into an issue in real life by providing support. It helps to provide better insight into a problem and how the area can be improved by eliminating or reducing the effects of the problem. This last type is also named a plausibility probe (Levy, 2008:6). This type of study aims to develop a theory that can be effectively used within a real-life environment. This development, as Levy (2008:7) states, does not include implementation, but a test run (or pilot study) of the applicability can be done.

The different types of case studies explained above can be summarised under the viewpoint of two different scholars, namely Stake (1995) and Yin (2002). These scholars have different opinions of the definition of a case study, and how case study research should be approached and conducted. Stake (1995:2) defines a case study as an integrated system of parts working toward a purpose. Yin (2002:13) defines a case study as the understanding of the "how" and "what" of a phenomenon within a real-life context. Yin (2002:13-14) explains that a case study should consist of a meticulous, holistic examination of the selected case, whereas Stake (1995: 2-3) is of the opinion that a case study can function as a way to observe, interpret data and reflect on issues or actions identified within the case study. Yin (2002:19) is of the opinion that a case study should have a structured approach to analyse the study chosen and that the structure should not be altered. Stake (1995:16-17) has a more relaxed approach and states that, as the study continues, alterations can be made so that the optimal results can be gathered. Yin (2002:58) is of opinion that to be able to have a holistic view of the case, both qualitative and

quantitative data should be used to understand the case. To the contrary, Stake (1995:49) states that a case is examined by considering only qualitative data.

When taking the information of both Stake (1995) and Yin (2002) into consideration, the types of case studies can be summarised in the following way (Table 2-1).

Table 2-1: Types of case studies categorised

Yin's view	Stake's view
• Plausibility Probe	• Explanatory case • Exploratory case • Intrinsic case • Instrumental case

Source: Own compilation based on Stake (1995) and Yin (2002)

2.3.2   Implementation in this study

Within this research study, Stake's (1995) approach towards case studies will be followed, since the case study will only make use of qualitative data and the study will not have a holistic view but an interpretivist view towards the selected case.

The possible types of case studies that can therefore be considered are explanatory, exploratory, intrinsic and instrumental. When investigating the goal of each of these types of case studies, as determined above, it is clear that the instrumental case study type should be used within this study.

The instrumental case study, as discussed above, focuses on identifying a problem area and finding ways to improve the area to reduce the problem. The case that will be studied in this research document is the environment of the selected multinational company's budgetary system. The goal of the study is to develop an internal corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems. This will be done by firstly determining if there are any issues or problems within this area that can be addressed by using Industry 4.0 technologies. This study therefore concurs with the definition of an instrumental case study.

The data gathering method used in this case study was interviews, since this was one of the methods that Stake (1995:49) deems as appropriate. Stake (1995:50) remarks that when interviews are used as a data gathering technique, the researcher should have methods to gain robust sources of data that can give significant understanding to the investigated case. Stake (1995:50) continues by stating that the researcher should have a sceptical and culturally sensitive approach to the gathering of data. The analysing of the data is based upon the intuition and knowledge of the researcher and therefore suggests that the researcher performs a literature study to understand the research environment before conducting interviews (Stake, 1995:72).

2.4   Data gathering method: Interviews

Interviews are explained by Rabionet (2011:563) as a flexible and powerful method to gather qualitative data from different individuals. Whiting (2008) elaborates that interviews can be seen as the process of data collection where one person (interviewer) asks questions to another person (respondent) to establish an understanding of the topic at hand and gather the respondent's opinion about this subject. Rowley (2012:261) states that interviews focus on gathering facts, insights and opinions of a real-life event, process or environment. This data which was gathered then gives the interviewer insight that can be used within a study as qualitative data (Rowley, 2012:261-262).

An interview process can have varying structures giving rise to different types of interviews (Rowley, 2012:262). These types of interviews, according to Rabionet (2011:564), are structured, semi-structured and narrative or unstructured interviews.

The process of structured interviews has a high control environment, as Stuckey (2013:57) explains. This author continues to explain that this type of interview is known for a predetermined list of questions used in a specific order when conducting the interview. The reason for this is to be able to compare responses of different respondents more accurately (Stuckey, 2013:57). Whiting (2008) is of the opinion that structured interviews are more often used when large numbers of respondents are interviewed, which rather leads to the creation of a quantitative than qualitative dataset.

Semi-structured interviews, according to Rowley (2012:262), is the most common type of interview. The author elaborates that this method focuses on fewer initial questions but that additional questions can be added during the interview process if the need arises for more detailed information. Stuckey (2013:57) explains that the interviewer has to create and determine the

outline of the interview and that the respondent's answers will determine what questions are asked. Rabionet (2011:564) explains that the benefit of this method is that there is still some measure of control by the interviewer, but more data can be extracted since the questions can change based on the need of each interview conducted.

The process of unstructured or narrative interviews is started by the interviewer with a wide, open-ended question so that the story or narrative of the respondent can be heard (Stuckey, 2013:58). The rest of the interview is aimed at directing the respondent to share as much as possible information about the topic at hand. During this interview, the respondent is in control of the direction of the interview (Rowley, 2012:263).

Within this study, the type of interview conducted was semi-structured, since this would enable the interviewer to gather as much relevant information as possible without wasting time listening to a narration of the chosen process or limited by a predefined list of questions.

The semi-structured interviews will be conducted with at least six drilling site managers. The aim of these interviews is to identify the weaknesses and shortcomings of the current budgeting system. These interviews will be performed before the design of the budgeting artefact framework to be able to analyse what the improvements of this system should be. Since there are certain geographical constraints, as discussed previously, it is foreseen that these interviews will be done through an online platform. According to Vidal (2015: 177), questionnaires is a very effective way to gain information from a host of candidates. The author explains that, when designing a questionnaire, it is cardinal to keep in mind that the questions should vary between open-ended and closed-ended questions. However, as this is a qualitative study, the focus will be on open-ended questions.

2.4.1   Goal of semi-structured interviews

The first goal of the semi-structured interviews was to discover how the current budgeting process worked within the selected multinational company's environment. The interviews were used to understand how the employees that had to use and manage this budget were experiencing the current system. This information was required to determine whether the current budgeting system was appropriate.

The second goal of the interviews was to discover how user-friendly the current budgeting system was, and furthermore the needs employees had that the current system did not fulfil. The

responses were used to determine what improvements or changes should have been made to the budget system so that both the employees and the company could benefit more from this system.

The third goal of the interviews was to discover how the current budgets that were being used aided in real-time decision-making. This information was used to understand how the budget system could be improved to assist employees in making optimal decisions. By doing this, it would be possible to have a more effective internal governance system which could enhance visibility that would make it possible, as stated in Chapter 1 (section 1.6.3, page 13).

Lastly, the interviews aimed to discover how proficient and knowledgeable the employees were concerning Industry 4.0 technologies. This information was necessary to decide on the complexity level that the budgetary tool should be designed with.

2.4.2 Constraints of semi-structured interviews

Using interviews as a data source gave rise to a few constraints that could have affected the data. The first constraint was the validity of the comments made by the respondents, since people were giving their own opinion on each question and not necessarily the exact truth. The second constraint to the data was that the respondents might not have understood the question completely and could have responded incorrectly or inaccurately.

Some measures that were implemented in this study to reduce the effect of the above-mentioned constraints were the following: firstly, the data that was collected from respondents was matched against each other to determine where the data contradicted itself. This contradicting data was then excluded since this was due to the respondent not fully understanding the question but giving an answer that related to a different question. This data was then incorporated with the relevant question. Secondly, the interviews were conducted verbally so that each question could have been thoroughly explained. This measure reduced the risk of respondents misunderstanding certain questions.

2.4.3 Process to be followed with semi-structured interviews

The preparation for the interviews that were conducted was guided by a process to ensure that the data gathered from the respondents would be as accurate as possible. Whiting (2008)

explains that some key features should be considered when preparing to undertake interviews to gather data, especially the three aspects below:

- Firstly, it is important to know the purpose of the interviews, since this will determine how the rest of the process will be handled. Questions were therefore selected leading the respondents to provide information that would assist in addressing the research problem and which could provide the researcher with possibilities on how to address the research problem.
- Secondly, the interviewer should have clarification and adequate knowledge of the topic that is to be discussed. This was ensured by the researcher who had sufficient knowledge about the topic to know when data saturation was reached – a term used to indicate that enough data has been gathered so that a conclusion could be made.
- Thirdly, it is vital that the interviewer has knowledge of what information should be gathered by the interviews so that the correct questions could be asked. In this study, the interviewer made sure that the respondents felt comfortable and encouraged them to answer as truthfully as possible.

Linking interview questions with research questions

The questions posed to the respondents should be sufficient to supply the researcher with enough information so that the research question could be answered. Castillo-Montoya (2016:812) explains that it is of vital importance to link the research questions with the type of questions to be asked to the respondents so that the information gathered would correspond with the rest of the study. In qualitative research, the questions should be more open-ended, allowing the respondents to expand on their opinions and in turn supplying the researcher with a better background to the answers provided.

The first goal that the interviews should have reached was to be able to explain how the current budgeting process was working. This information was necessary so that the current process could be understood by the researcher. This goal was reached by questions 1 and 2 of Appendix A.

The second goal of the interviews was to understand the areas of weakness within the current system so that improvements could be made to the system. This information was collected by asking specific questions (questions 3 to 5 of Appendix A) aimed to discover if real-time data could be gathered from the current system. Lastly, question 6 of Appendix A was asked to gain any additional information about possible improvements to the current budgeting system.

The third goal of the interviews was to gain an understanding of what knowledge the employees had about Industry 4.0 technologies. This was done by firstly asking them an application question about Industry 4.0 technologies that could be used within their field of work – the budgeting system. This question is listed as question number 7 in Appendix A. Next, the respondents were asked to explain what they understood under the term Industry 4.0 technologies. This was done to establish what level of complexity could be used to develop the budgeting control framework.

The last goal of the interviews was to determine the view of the mine managers about budgeting and what precautions should be built into the budgeting tool to reduce risks of fraud and other possible methods of bypassing budgetary controls. This was done by asking an open-ended question about budgeting as the last question listed in Appendix A.

By following the above guidelines, the questions asked were able to give the researcher enough background so that an effective and suitable budget control framework could be designed.

Reaching data saturation

Etikan *et al.* (2016:3) state that the gathering of data is vital in research since this leads to a better understanding by the researcher of relevant theories. Saturation, which is explained by Etikan *et al.* (2016:4) as the point where a comprehensive understanding of the information is acquired, is therefore needed so that the research can be performed effectively.

Tongco (2007:147) avers that correct data and data saturation is established by collecting appropriate data. Sampling is a method used to collect appropriate data and is the process of selecting a portion of a specific population that would become the subject of the research (Etikan *et al.*, 2016:1). There are different methods of sampling that can be used, the two main types being convenience and purposive sampling (Etikan *et al.*, 2016:1). Convenience sampling is focused on interacting with respondents that meet certain criteria but that are also the most convenient to the researcher. By using this method, however, the researcher will only be able to make vague statements about the population as a whole, since only some elements of the population will be interacted with (Etikan *et al.*, 2016:1-2).

In contrast to the above, purposeful sampling is when a respondent is chosen as the subject of the research due to the information and knowledge that the respondent has (Tongco, 2007:147). Etikan *et al.* (2016:2) state that by choosing the respondents purposefully, data saturation can be gained easier since the responses will be more accurate and trustworthy. Tongco (2007:148) continues to explain that key informants should be identified and used as the subject of the

research by following an appropriate process. This process starts with firstly understanding the culture of the environment that will be used to choose the respondents. Secondly, criteria should be set to determine which individuals within a population can be chosen as possible respondents. Lastly, the respondents chosen should be able to participate in the study (Tongco, 2007:148).

Within this research study, purposive sampling will be used to gain data saturation. The environment that will be evaluated will be the selected multinational company's environment. Firstly, the culture of this environment will be understood by conducting background research on the company. Secondly, the criteria for respondents that can participate in this study will be that they should have sufficient knowledge of the company, and that they should actively be using the budgetary system to make decisions within the company. In accordance with these criteria, six managers were purposefully selected within the company. As these managers were not all located in South Africa, it was planned to perform the interviews digitally by using a programme such as Skype.

By following the above approach, data saturation was reached since a large number of high-ranking officers within the company were used as respondents.

Conducting the interviews

When conducting interviews, it is crucial that the interview process is handled in a way that would make it possible to extract as much information as possible from the respondents. Suitable preparation should be done before the interview commences (Rabionet, 2011:564; Rowley, 2012:265). This can be done by doing a pilot interview to test if the questions would deliver the correct results. Rabionet (2011:564) gives additional advice by stating that the direction of an interview is determined by how effective the greeting and introduction phase of the interview is handled. Rowley (2012:265) includes 'knowing when to ask which questions' and also 'knowing the desired data to be required' so that interviews can be guided towards questions that can provide it. This was achieved during the research by speaking in a way that was familiar to the respondent through explaining what the purpose of the interview was and by using the correct jargon to make the respondent more relaxed (Rowley, 2012:266). Rowley (2012:266) comments that it is the job of the interviewer to guide the interview by giving prompts and switching the direction of the conversation as necessary. The interviewer should try to extract as much information as possible from each question by asking follow-up open ended probing questions to make the respondent elaborate more on answers that were given (Rabionet, 2011:565).

This advice was incorporated and, as Whiting (2008) explained, the interviews flowed like a conversation that was comfortable for the respondents. The first step of the process was to build rapport, and during this phase the focus was on introduction and general conversing as well as explaining that the information shared would be handled confidentially. The second phase was to explore the knowledge that the respondent had by asking probing open-ended questions. Next, the interviewer co-operated with the respondent by engaging in the answers given and asking questions to extract more details about the answers that were given. Lastly, the interview was concluded by thanking the participant for his/her time and valuable information that was shared and requesting whether the respondent had any last comments.

2.5   Summary

The goal of this chapter was to address the first secondary objective of this study, which was to discover and give a detailed description of the method that was used to meet the objectives of this study. This was done by discussing the following key aspects of the methodology:

Firstly, the reason for the chosen research design, research approach and research method was explained so that the decisions regarding the rest of the study could be better understood.

The ADR method was then explained, and confirmation given that this study focused on the problem formulation process and ended with the concept design process as described in the various iterations.

Subsequently, the case study approach was investigated and explained. This was done by focusing on the different types of case studies and determining the appropriate case study approach of this study. The instrumental case study approach, based on Stake's (1995) viewpoint of case studies, was selected for this study. It was also clear that a literature study should be done before interviews are conducted to ensure that the researcher is able to effectively analyse the data gathered from the interview process.

Lastly, this chapter explained the empirical data collection technique of the study. Semi-structured interviews were conducted with six managers who engaged with the budgetary process on a regular basis. The saturation of data was gained by using purposive sampling to make sure that respondents who would be able to give the required information on the research question, would be interviewed. The interview process followed was also explained.

This chapter reached the goal of explaining the research method and how it was implemented in this study. It was then possible to follow the case study approach and interviews by using the guidelines given. By performing the interviews, data was gathered that aided in making decisions, firstly about the current limitations of the system and secondly about the requirements that the budget control framework should have. However, before a control framework could be designed, it was necessary to conduct a literature study to understand the benefits of different possible Industry 4.0 technologies. Chapter 3 will address this need.

CHAPTER 3

3 LITERATURE REVIEW OF BUDGETING AND INDUSTRY 4.0 TECHNOLOGIES

3.1 Introduction

The aim of this chapter is to identify and evaluate the different types of Industry 4.0 technologies and budgeting methods in the context of the budgeting process at the selected company. This has been addressed under the second secondary objective of this study, as stated in Chapter 1 (section 1.4.2, page 10).

This chapter can be divided into two distinctive sections. The first section (section 3.2) discusses and analyses budgeting systems that are currently being used within multinational companies. This information will be necessary so that the budgeting system of the company in question can be evaluated against these standards. This will determine how the current budgeting system should be adjusted so that an appropriate budgeting control framework can be implemented. This system will provide users with sufficient correctly calculated information.

The second section (section 3.3) will be presented in order for the reader to gain an understanding of the technologies that Industry 4.0 encompasses. This information was necessary to ensure that the researcher has the applicable knowledge to accurately participate in the process of deciding which technology should be used to develop the budgeting control framework. The information that was gathered from the literature study was used to eliminate technologies that were clearly not applicable to the case study.

Lastly, this chapter will include a conclusion of what has been discovered, and the possible options of Industry 4.0 technologies that could be used in this regard.

3.2 Budgeting in multinational companies

3.2.1 Introduction to budgeting

Optimising the budgeting process and developing a suitable framework require that some of the fundamental principles of budgeting have to be discussed. Firstly, this section will discuss why budgets are important and how they are used in multinational companies. The basic guidelines for effective budgeting will then be discussed. Lastly, a discussion around how budgeting can aid internal governance of an organisation by use of the stewardship theory will be presented.

3.2.2   Importance of budgeting

The corporate budgeting principle is primarily used to assist businesses in the planning of operations (Vaznoniene & Stonciuviene, 2012:157). Hansen and Van der Stede (2004:415-416) argue that budgeting is a substantial element of financial control that has to be used in all organisations and developed in such a way to add value to an organisation. Traditional budgeting, as reported by Bhimani *et al.* (2018: 307), focused primarily on implementing control over financial functions in certain and uncertain environments. Recent developments in budgeting, however, focus more on linking uncertainty with strategy.

Bhimani *et al.* (2018:308) explain that the key reasons for budgeting are based on operational planning and performance evaluation. These authors also suggest that budgets should be adopted so that management can learn from previous years and incorporate both mistakes and victories into the annual budgeting process. Vaznoniene and Stonciuviene (2012:157) elaborate that budgeting is also done to aid in:

- promoting harmonisation of different business units and activities;

- allocating resources to certain projects;

- delegating the correct staff to projects;

- motivating and evaluating staff, and

- having internal control over how the objectives of the organisation are being met.

This definition supports the statement made in Chapter 1 (section 1.1.1, page 2) that internal corporate governance, which is also known as internal auditing as stated by Chikwiri and De la Rossa (2015), should be a process that aids management in making decisions that could increase the performance of the company.

Therefore, by using new developments in the budgeting field as identified by Bhimani *et al.* (2018:308) and Vaznoniene and Stonciuviene (2012:158), an interactive budgeting system can be created to increase the internal corporate governance of a company. To be able to create a budgeting control framework that is interactive, the different types of budgeting developments have to be considered.

3.2.3   Stewardship and governance through budgeting

In Chapter 1 (section 1.1.1, page 2) it was established that, within this study, corporate governance is interpreted as a systemic provision of some measure of control over the actions of individuals within an organisation. It was also stated that stewardship can be seen as a method to implement autonomy within an organisation by giving away authority to lower ranked individuals and rewarding them for acting appropriately. Within this section it will be discussed how it will be possible to design a budgeting control framework that is able to incorporate these two themes of corporate governance and stewardship.

According to AlQadasi and Abidin (2018), good corporate governance requires mechanisms that are able to align the interests of different parties – so that goals can be achieved easier and more frequently – should be placed within the company. Subbotina (2014) argues that budgeting is a mechanism that can be used to increase corporate governance by highlighting that budgets are tools that are used to control certain outcomes so that the goals of the organisation can be met. Hansen and Van der Stede (2004:418) affirm this by stating that the goal of budgets is to increase operational performance, communication, strategy realisation and evaluation of the performance of individuals and projects or periods.

Stewardship theory, as Snippert *et al.* (2015:575) explain, is based on a relationship that is developed between the employer and the employee. Snippert *et al.* (2015:574) explain further that this relationship, which is based on trust and collective involvement, places importance on behaviour that leads to goal convergence. L'Huillier (2014:307) supports the above by stating that a trust culture is vital when a stewardship approach is being followed. Furthermore, for a stewardship approach to work optimally, the managers must delegate their authority to other employees.

Since such employees are motivated with rewards (monetary or non-monetary), there will most likely be a low risk to the company that the principal parties involved will not align with the vision of the organisation (Snippert *et al.*, 2015:575). By following this approach, both Snippert *et al.* (2015:575) and L'Huillier (2014:307) are convinced that the participants will develop autonomy and responsibility to achieve outcomes.

A warning is given by L'Huillier (2014:307) that, trying to control the principal parties might lead to loss of motivation, since they would not feel trusted. Instead the author points out that systems

should be in place that can assist the principal parties in reaching the targets that are expected from them.

Hansen and Van der Stede (2004:415-418) state that budgets are formidable systems that should be used in almost all organisations to aid in planning, control, strategy realisation and communication. It can thus be grasped that budgeting is a system that could aid principals in reaching their targets. Therefore, if a suitable budgeting method is developed, multinational companies should be able to empower employees to make decisions which can lead to the further development of these type of organisations, which are already the biggest suppliers of goods and services in the world.

3.2.4 Methods and guidelines for effective budgeting

As discussed in the previous section, it is necessary to understand how different budgeting techniques and developments (methods) can be used to construct a budgeting method that is interactive. A number of these methods will be discussed, followed by some guidelines that can assist in the development of a suitable budgeting framework. Thereafter, this chapter will discuss how these different methods and guidelines link to the main objective of the study by proposing a possible method that can be used to develop a budgeting framework.

Traditional budgeting

Goode and Malik (2011:208) explain that traditional budgeting is a fixed performance tracking system that is used by managers to control both costs and cash flows of a business. These systems are also used to evaluate performance after a project has been completed (Goode & Malik, 2011:208).

The main problem of this method is that it is difficult to adapt to the changing environment of companies when a fixed model is being used. Such a model demotivates employees, since the changes made during a project or year is not taken into account (Vaznoniene & Stonciuviene, 2012:159). This method is also very time-consuming during the creation process and consists of many non-value adding activities (Goode & Malik, 2011:209).

Activity-based budgeting

Vaznoniene and Stonciuviene (2012:159) are of the opinion that activity-based budgeting (ABB) should be used in operating and strategic budgeting since it supplies users with added

information. Bhimani *et al.* (2018:309) posit that ABB is able to establish relationships between management accounting principles and variables relating to the environment of the organisation. ABB estimates the resources required to produce the planned production volumes and helps an organisation to minimise its non-value adding activities. The budget, at the same time, caters for all the aspects required to stay within the designated guidelines for the specific project or timeline (Vaznoniene & Stonciuviene, 2012:159).

Goode and Malik (2011:209) highlight that a major benefit of this method of budgeting is that it supplies the management with a variance report that can assist in identifying problem areas. The shortcoming of this method is that it is not very flexible, which may lead to an inaccurate budget that does not support decision-making (Vaznoniene & Stonciuviene, 2012:159).

Zero-based budgeting

Zero-based budgeting (ZBB) is a measure that is used to force managers to provide reasons for each line that is added on the budget every year. Therefore the reference to the name, namely that each year or project is started from zero lines on the budget (Goode & Malik, 2011:212).The benefit of using this measure, as stated by Goode and Malik (2011:210), is that management can be certain that the budget is up to standard and does not include any dysfunctional figures.

Vaznoniene and Stonciuviene (2012:167) aver that this method can cost the organisation valuable time in having to recalculate and prove each amount that is listed on the budget. Goode and Malik (2011:209) agree by stating that this method, even though it is based on sound principles, leads to more dissatisfaction in management of organisations than the value that it could add.

Value-based budgeting

Hansen and Van der Stede (2004:419) argue that budgets can create more value when the budget is compiled based on a combination of the different reasons why the budget is needed. This method is known as value-based budgeting. This is confirmed by Bhimani *et al.* (2018:309) that posit that the emphasis of budgeting should be on the value that is being added to management decision-making. The benefit of using this budgeting method is that the value created must be greater than the cost allowed for the specific budget by ensuring that shareholder wealth is created and cash is retained (Goode & Malik, 2011:210).

The downside of this method of budgeting is that it is once again very time-consuming and can greatly limit the cash available for use if value is not immediately generated (Goode & Malik, 2011:212; Hansen & Van der Stede, 2004:419).

Rolling budgeting

Rolling budgeting (RB) is explained by Bhimani *et al.* (2018:310) as the forecast of key cost areas that have a probability to be expensed within a certain period. These key cost areas are therefore allocated a budget. A budgeting system is designed to continuously adjust as the key cost areas are expensed throughout the period. This ensures that the budget values and categories remain relevant. The RB is then incorporated within the traditional budget to periodically update the reported budget. In this way a forward-looking viewpoint is maintained by enabling an improved prediction of how key cost areas will influence the remaining budgeting values (Bhimani *et al.*, 2018:310).

Hansen and Van der Stede (2004:417) is of the opinion that, even though this method of budgeting has the ability to enhance the performance of budgeting for operational planning, it obstructs the evaluation of the performance and accuracy of the budget. The downside of this method is that, since the budget can be adjusted, there is little motivation to keep to the original budget. Different versions of the budget are then created which may lead to individuals having different versions of the truth (Hansen & Van der Stede, 2004:421).

Beyond budgeting

Beyond budgeting (BB) is a new philosophy of budgeting which recommends that the current budgeting process should be abandoned (Vaznoniene & Stonciuviene, 2012:158). According to Goode and Malik (2011:210), BB promotes flexibility, coordination and responsiveness within budgeting systems by focusing on both financial and non-financial measures rather than just on budgeting values.

This philosophy can be implemented by having a decentralised structure that empowers employees to make better decisions. Managers are rewarded for making appropriate decisions rather than constricting them to a set of values that may not be breached (Goode & Malik, 2011:210-211).

Vaznoniene and Stonciuviene (2012:158) explain that BB is aimed at increasing the value of the company by providing managers with the ability to act quicker to new information. This is done by

having action plans within the strategy that can be followed by managers without having a budgetary restraint.

Goode and Malik (2011:210) agree that this philosophy removes the restrictive nature of budgets so that vast benefits can be gained. These include: 1) empowering staff, 2) increasing flexibility, and 3) reduction in budgetary preparation time. These benefits can be gained as management will have more time to solve problems and add value to the organisation, since lower level staff is given authority to make decisions (Goode & Malik, 2011:211).

Figure 3-1 indicates the effects of having a BB approach to budgeting.

Figure 3-1: Effects of beyond budgeting approach
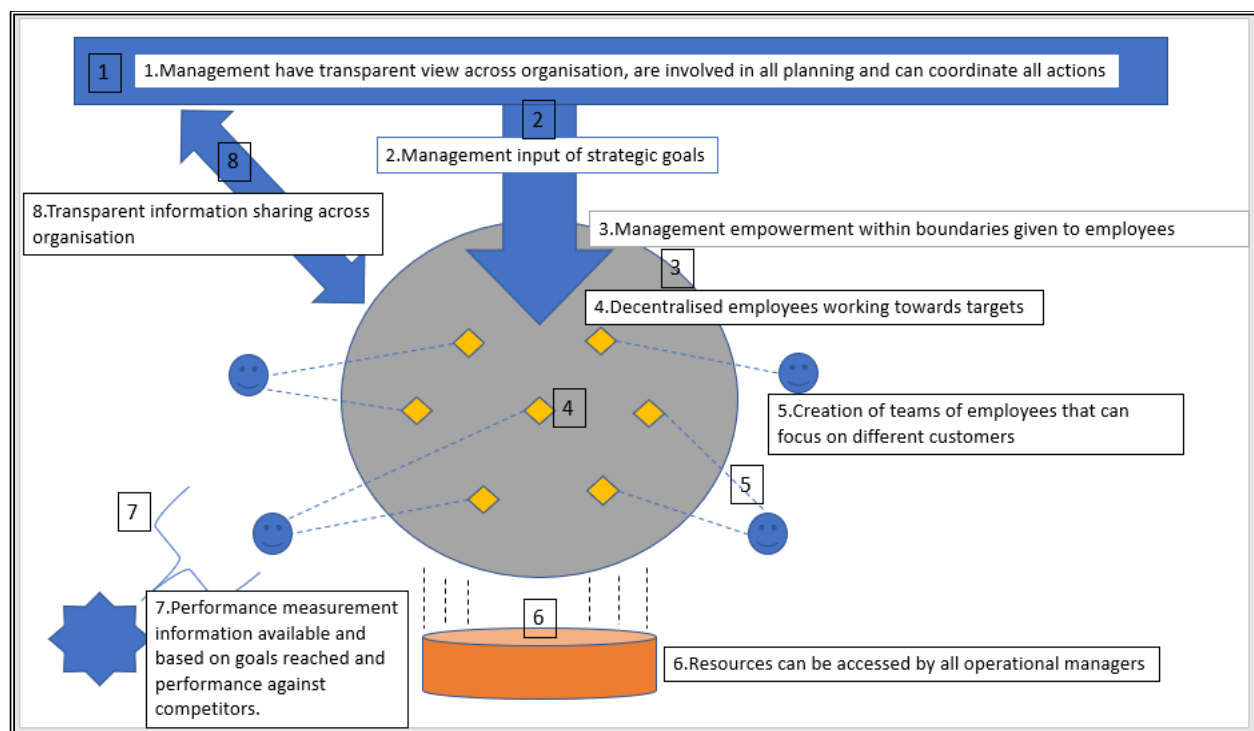
Source: Vazninuene and Sinciuzievne (2012:164)

Vaznoniene and Stonciuviene (2012:165) warn that this approach should not be followed carelessly. Management should have certainty that their organisation structure will be able to cope with this method since, as the above figure indicates, this philosophy requires a completely different way of approaching budgeting.

Table 3-1 provides a summary of the budgeting methods.

Guidelines for effective budgeting

Budgeting is a tool to enable financial management. It builds into the organisation by means of controlling activities of individuals (Subbotina, 2014). It is important that budgets are performed in the most effective way possible so that it can aid in the operational planning of an organisation (Vaznoniene & Stonciuviene, 2012:157). Subbotina (2014) provides some valuable insight into guidelines that should be followed when aiming to budget more effectively. These guidelines are listed below:

- Firstly, it is of vital importance that the employees understand the corporate strategy. This argument is supported by Hansen and Van der Stede (2004:416) who emphasise that budgets are failing due to not being connected with strategic planning.

- Secondly, there should be clear communication of how resources are being allocated to reach future goals. Bhimani *et al.* (2018:308) elaborate that organisations should prioritise coordinating resources within budgets so that optimal targets can be reached.

- Thirdly, there should be a method to compare actual results with the budgeted figures on a regular basis to evaluate the efficiency of the budget. Vaznoniene and Stonciuviene (2012:157) affirm this by stating that the success of a budget is evident when actual figures are compared to planned figures and divergences are determined.

- Lastly, the budgeting system should be developed in such a way as to promote innovation. Goode and Malik (2011:208) argue that unless business managers overcome restricting limits of certain budgeting systems, they will not be able to grow their organisation.

By adhering to a combination of these guidelines and an appropriate method of budgeting, it should be possible to create a budgeting control framework that can satisfy the objective of this study.

In the next section the different budgeting methods discussed will be evaluated to gain insight into the best possible method to be used to develop the budgeting framework that is able to meet the objectives of this study.

3.2.5   Selection of a possible appropriate method

In order to select the best possible budgeting method, it is firstly important to measure the benefits and drawbacks of each method discussed. Secondly, it should be established how each method links to the objective of the study and the guidelines mentioned above. Both of these factors will be addressed in Table 3-1 below.

Table 3-1: Benefits and drawbacks of budgeting methods

Name	Benefits	Downsides	Link to objectives and identified guidelines
Traditional Budgeting (TB)	• Possible to evaluate project or period • Encourages cost control	• Fixed schedule of costs • Time-consuming to generate	• Evaluation of budget performance
Activity based budgeting (ABB)	• More informative • Variance reports can be generated • Eliminates non-value adding activities • Possible to evaluate project or period	• Time-consuming to generate • Fixed schedule of costs	• Increased visibility • Evaluation of budget performance
Zero based budgeting (ZBB)	• Generates up to standard budget • Possible to evaluate project or period	• Highly time-consuming to generate • Fixed schedule of costs	• Increased visibility • Evaluation of budget performance
Value-based Budgeting (VBB)	• Ensures that shareholder wealth is being generated	• Unless value is added to the company, spending is prohibited.	• Evaluation of budget performance

	• Retains a cash balance • Possible to evaluate project or period	• Highly time-consuming to generate • Fixed schedule of costs	• Increased link to business strategy
Rolling Budgeting (RB)	• Flexible • Forward looking viewpoint is kept • Enhances operational decision-making	• Difficult to evaluate budget since continuously adjusted • Demotivates cost control	• Flexible budget • Forward looking • Increased link to business strategy • Promotes innovation • Improved resource allocation
Beyond budgeting (BB)	• Aims to increase company value • Flexible • Time saving • Possible to evaluate project or period	• Big change management • Not all companies are viable for this model	• Increased internal governance and stewardship • Increased visibility • Evaluation of budget performance • Promotes innovation • Improved resource allocation

Source: Own compilation

After reviewing the information stipulated in the table it can be gathered that, by using either RB or BB, the criteria of linking to the objectives of the study and the guidelines of effective budgeting will be met. Therefore these two methods will preliminary be chosen as the most suitable to develop the budgeting framework.

The next section will cover the various types of Industry 4.0 technologies.

3.3   Types of Industry 4.0 technologies

3.3.1   Introduction to Industry 4.0 technologies

To understand which Industry 4.0 technologies would be suitable to optimise the current budgeting system of the chosen company, two factors under each technology have to be considered. Firstly, the type of technology has to be explained. Secondly, the benefits and drawbacks of each type of Industry 4.0 technology should be discussed so that an informed decision could be made.

Vaidya *et al.* (2018) comment that Industry 4.0's effect on management is that they will be able to have real-time data at hand to make effective decisions, but the decision-making ability will still rely on the intuition of the manager. When taking this into consideration, the research on which method would be most applicable would be based on which method could aid management the most in making decisions.

The nine main types of Industry 4.0 technologies, as proposed by Vaidya *et al.* (2018), will be used to evaluate the various Industry 4.0 technologies.

3.3.2   Pillars of Industry 4.0 technologies

The nine main types of industry 4.0 technologies, as identified by Vaidya *et al.* (2018), are listed below:

1   Big data and data analysis

2   Autonomous robots

3   Simulation

4   System integration

5   The internet of things

6   Cyber physical systems

7   Cloud computing

8   Additive manufacturing, and

9   Augmented reality

Big data and data analysis

Grover *et al.* (2018) explain that big data is a term used to describe the immense quantity of communication or data that is generated when electronic devices communicate with each other. Vaidya *et al.* (2018) concur, but continue to explain that big data can be better understood when the different aspects of this phenomenon are analysed. These aspects are the high volume, velocity and variety of the data. Volume refers to the large supply of different data that is available. Velocity can be described as the high speed at which new data is accumulated. The data that is available consists of unique characteristics giving rise to a high variety of data that is available (Grover *et al.*, 2018; Vaidya *et al.*, 2018).

The main goal of big data is to provide people with enough data to make effective decisions and gain a competitive advantage in their respective fields (Grover *et al.,* 2018). Grover *et al.* (2018) report that, currently, companies are trying to focus on gathering as much as possible information to gain these benefits, but Griffiths and Ooi (2018) take a standpoint against this thought-pattern. Griffiths and Ooi (2018) are of the opinion that there is already too much data within companies and that the data in essence can provide no benefit to any company. Vaidya *et al.* (2018) support this argument and explain that the true value of big data is gained when the data is analysed.

Some of the benefits of effective analysis of big data for a company are the following (Grover *et al.*, 2018):

- it will have personalised guidance on how to make future decisions;
- it will be able to identify and analyse root causes or failures in real time;
- it will be able to better understand the needs of its customers;
- it will develop a method to highlight anomalies within current systems in the company; and
- it will be able to remove operational roadblocks by fine-tuning processes within a company.

The above benefits could be summarised as having a system that gathers data, displays what the current results are and then providing the company with information that aids in making decisions which can improve future results (Dalenogare *et al.,* 2018). These systems are known as data driven services (DDS) (Dalenogare *et al.,* 2018).

The biggest drawback of big data, as summarised by Grover *et al.* (2018), is translating the vast amount of data into meaningful information. The types of meaningful data that should be extracted – using the VRIO framework – consist of the following (Grover *et al.*, 2018):

- Valuable (V)
- Rare (R)
- Costly to imitate (I), and
- Organisationally embedded (O).

Grover *et al.* (2018) confirm with an empirical study that it is possible to gain data that is able to meet the above criteria. However, a significant problem is that not all the data that is available can be used (Raguseo, 2018). The biggest risk to big data is the privacy and security of the data. The owners of data are not always evident and if this issue is not resolved, proprietary information can possibly be distributed or used for decision-making without authorisation. Data that is not secured and guarded can easily be manipulated to give a false representation (Raguseo, 2018). Grover *et al.* (2018) support this in stating that some of the risks of big data are that neither the context nor the authors of the data are always clear. Another big risk, as emphasised by Grover *et al.* (2018) and Raguseo (2018), is that companies seldom have enough support to validate if their data extraction method is valid and working correctly.

Autonomous robots

Autonomous robots, as reported by Vaidya *et al.* (2018), refer to the innovation used where robots are constructed to perform certain mundane and repetitive tasks whilst being controlled by a management system that interacts with these robots. Wolff (2015) expands the above by stating that these robots are controlled by instructions encoded upon creation.

The benefits of these robots include a reduction in lost time due to people not being able to work non-stop, as well as a reduction in costs, since robots are cheaper to maintain than paying monthly salaries (Wolff, 2015). Vaidya *et al.* (2018) comment that additional benefits are that robots are able to work in places where humans cannot, combined with higher accuracy and without fatigue.

The downside of robots, however, is that large amounts of programming and knowledge is required to develop robots that operate seamlessly. Another downside is that robots are not able to make decisions based on intuition, but can only react on pre-programmed instructions and responses (Wolff, 2015).

Simulation

Simulation or Virtual Reality is an innovative technology that – as explained by Uriarte *et al.* (2018) – has the ability to create a virtual copy of real-life objects. Vaidya *et al.* (2018) elaborate that a virtual reality simulation can include data about people, machines and processes. Uriarte *et al.* (2018) comment that currently these simulations are used in the planning and evaluation phases of projects, especially in production, to identify possible bottlenecks or other issues within systems that limit the efficiency of these systems.

Vaidya *et al.* (2018) list, amongst others, the possible benefit of a virtual reality system as providing the users with a method to effectively analyse different versions of how a problem can be solved. According to Uriarte *et al.* (2018), another possible use of these systems is as an educational tool that provides training on how certain systems or machines works.

The biggest downside of virtual reality simulations is that it is expensive to develop. Another difficulty is that the model requires long development time of virtual reality simulations; this is due to the challenge to accumulate all the information needed to make a robust simulation (Uriarte *et al.,* 2018).

System integration

System integration is an Industry 4.0 technologies initiative where different systems are integrated to work together to achieve a goal (Vaidya *et al.*, 2018). This integration can be done on three different levels:

- The first level is horizontal integration between data of different departments within a company.
- The second type is vertical integration which happens within one department between data gathered form different processes.
- The third type of integration is end-to-end of a system life cycle – this means that the data of different phases within a certain system are integrated.

This integration or multiple alignment framework, as named by Wolff (2015), makes it possible for different data elements within a company to communicate so that delays due to human interaction and assembly of different data types can be eliminated. Uriarte *et al.* (2018) continue to explain that the goal of system integration is to align all the data within a company so that they can interact and create better holistic data packages.

The benefits of an integrated system, mentioned by Uriarte *et al.* (2018), is that the overall technology system of the company will become smoother, faster, more stable and more accurate. Wolff (2015) explains that by having this kind of system, a solution taking into account the impact on corporate departments can be developed, which is a big breakthrough in data that is used for decision-making.

The downside of these integrated systems, as Uriarte *et al.* (2018) explain, is that it will be difficult to introduce this system, since it can possibly take a large amount of adjustments to current technologies and accuracy across all systems in the company to make it possible for all the data systems to interact with each other. Uriarte *et al.* (2018) emphasise that a second risk which can have catastrophic effects is that an open communication channel is established between all data within the company which can give rise to data leaks.

The Internet of Things

The Internet of Things (IoT) is a worldwide network of uniform addressed objects that communicate via standard protocols (Vaidya *et al.*, 2018). Dalenogare *et al.* (2018) explain that the protocol that is used is the world wide web (www), since IoT comprises different stand-alone technological devices able to connect to the internet, making it possible for these devices to communicate without human interaction. According to Griffiths and Ooi (2018), it is expected that by 2030 almost 500 billion devices will be connected via the world wide web which will lead to the transformation of systems globally. Vaidya *et al.* (2018) explain that IoT is a combination of Internet of Service (iOS), Internet of Manufacturing Services (IoMs), Internet of People (IoP) and Integration of Information and Communication technology (IICT) which work together to deliver an optimal solution.

The benefits of IoT, as described by Dalenogare *et al.* (2018), include processing of data and execution of certain tasks instructed by a machine in real time. Therefore the normal flow of machine interacting with man, and man instructing the next machine, will be changed to two machines which directly interact with each other, leading to optimisation and reduced loss of time. This gives rise to an intelligent value chain where the system will be able to interact in a way that delivers optimal value (Vaidya *et al.*, 2018).

The downside of IoT is that it requires an extensive capital investment to enable all the devices within a certain process to be connected (Griffiths & Ooi, 2018). According to Dalenogare *et al.* (2018), an IoT system is only effective if a reliable network connection is available and if all

devices are connected. If this is not achieved, the process using IoT will not provide the benefits as described above.

Cyber physical systems

Cyber physical systems, as reported by Baheti and Gill (2011), are systems where technological systems and devices are used in combination with humans that, in turn, can lead to autonomy. Vaidya *et al.* (2018) explain that the strong connection and interaction between people, machines and services leads to a much higher quality output. Two of the characteristics that are achieved from implementing cyber physical systems are autonomy and decentralisation. Cyber physical systems are a product of the combination of other Industry 4.0 technologies – consisting of a combination of cloud computing and integration technologies (Baheti & Gill, 2011).

An additional aspect integrated into a cyber physical system is verification tools (Baheti & Gill, 2011). This is a system that takes into account the laws of certain practices, such as accounting or engineering, when performing certain tasks to ensure that the act aligns with the guidelines of these laws (Baheti & Gill, 2011).

The benefits of these systems are that a solution can be created that are robust and very accurate, since the system will include the testing of possible solutions and selecting the best method to perform a task (Vaidya *et al.*, 2018). By automating certain processes, it will be possible to save time and costs that were usually undergone to perform these processes (Vaidya *et al.,* 2018).

The downside of these systems, as reported by Baheti and Gill (2011), is that this can be a very complex system and would most likely require an expert to establish and maintain the system. The reason for this complexity is because different sectors have different rules and all of these have to be considered (Baheti & Gill, 2011).

Cloud Computing

Josep *et al.* (2010) explain that cloud computing is defined as the delivery of services over the internet – these services can include the access to certain software and hardware. Vaidya *et al.* (2018) elaborate that cloud computing is a technical backbone that gives access within milliseconds to certain personal or public data, systems and hardware saved on the cloud.

Cloud computing, as reported by Josep *et al.* (2010), enables a pay-as-you-use system where people and companies only pay for the data or systems that they actually use. This makes it

possible to save costs and to have access to certain technologies that a company might not be able to develop or maintain internally (Josep *et al.*, 2010). Dalenogare *et al.* (2018) mention that cloud computing aids in increasing the value perceived from customers due to the technology's range of benefits and the simplicity of the technology.

The downside of cloud computing, as Josep *et al.* (2010) inform, is that it requires a data connection to be accessed. The authors continue to explain that there is an increased risk of data security if the data is publicly available.

Additive manufacturing

Mahamood *et al.* (2014) explain that the original manufacturing process is developed in a subtractive way which leads to wastages in time and material because of the complexity of different processes that were needed to manufacture a product successfully. Niaki and Nonino (2017:1419) introduce a solution, named additive manufacturing, to this problem. According to these authors, this method uses one process that – with the aid of 3D modelling – makes a project layer upon layer leading to no wastage. The rapid, customisation possibilities and low cost of production makes this method a revolutionary breakthrough in manufacturing (Niaki & Nonino, 2017:1419).

Mahamood *et al.* (2014) highlight that additive manufacturing can be classified into the following groups:

- Laser additive manufacturing (LAM): LAM makes use of a high speed, high power laser beam that is used to shape materials as desired by melting and solidifying them again.
- Non-laser based additive manufacturing: During this process, a liquid form of the material is squirted into the desired shape and hardened before adding the next piece of the final product.

One of the advantages of this manufacturing technique is that the supply chain between the manufacturing and the end-user is shortened, which can be attributed to the radical reduction in distance – both time and physical (Niaki & Nonino, 2017:1426).

The drawback of this manufacturing process, as Niaki and Nonino (2017:1427) explain, is that the setup costs can be substantial. The lack of accuracy and preciseness of this manufacturing method is emphasised by Mahamood *et al.* (2014), who state that this may be the reason why this method is not yet used in mass production.

Augmented reality

Amin and Govilkar (2015:11) define augmented reality (AR) as the technology that generates a virtual image on top of a real image so that the user is able to interact in real time to the environment surrounding the user. A clear distinction between virtual reality or simulation and AR should be made. Virtual reality is when a person is placed into a new virtual reality and cannot interact with the real world around him. AR, on the other hand, merges a virtual reality and the real-life environment, making it possible to interact with both of these worlds (Amin & Govilkar, 2015:12).

Some key characteristics of AR, explained by Laurel (2016), are the following:

- The user immerses into a new environment and is able to look around in this environment to observe the full 360-degree setting (or the portion that is available).
- An allowance is made for depth perception and motion parallax which simulates the use of the eye that is able to move between images and calculate the distance from these images.
- The audio is matched with the head position of the user. Thus, if the user turns towards or away from certain sounds, it may become clearer or fade.
- The camera view is restricted to where the user is looking, thus the scene will not change automatically.
- The user is able to act within this virtual world and view the results of these actions. These actions can also influence the real world, such as flying a helicopter in Africa from a hanger in America (Vaidya *et al.*, 2018:237).

The major benefit of this technology, as Amin and Govilkar (2015:13) explain, is that it creates a method to cause effects in a real-life environment without physical interaction with this environment. A practical application hereof is in aiding deaf people to see sub-text in an AR environment when people are talking (Amin & Govilkar, 2015:14).

Some downsides of this technology are that there are still difficulties in reproducing exact environments and making the real-world react as needed (Laurel, 2016). Amin and Govilkar (2015:20-22) compare different types of AR technologies. The identified downsides are that these technologies are only compatible with certain devices and that licences and hardware, which may be expensive, are also required.

3.3.3 Evaluation of Industry 4.0 technologies

Müller *et al.* (2018) compiled a study to determine what the sustainable benefits of implementing Industry 4.0 technologies would be. The types of technologies referred to by them in this study are: connected manufacturing, or system integration, cyber physical systems, internet of things, cloud computing and big data analysis. These authors firstly determined that, by implementing these Industry 4.0 technologies, a higher flexible organisation will be created which is able to overcome global challenges. Secondly, they determined that these technologies used in conjunction with each other have the ability to increase social, economic and environmental sustainability (also known as the Triple Bottom Line concept).

Increased social sustainability will be due to people being connected and able to communicate and share data at all times. On the other hand, increased economical sustainability will be due to the overall lower operational costs after the initial costs of implementation have been made, as well as the drastic increase in sustainability and value creation. The environmental sustainability is increased due to better system integration and planning and can lead to lower energy consumption.

Based upon this study it can be seen that the benefits of Industry 4.0 technology are not only operational but also economic, social and environmental. The operational benefits will now be discussed in more detail.

The nine types of Industry 4.0 technologies, as reported by Vaidya *et al.* (2018) and discussed above, have different goals of optimisation and improvement in different fields. These different goals can be summarised (Table 3-2) into the following broad categories of benefits. The researcher divided these benefits into three categories of operational improvement, as uncovered in the literature study, namely production, communication and decision-making.

Table 3-2: Categories of benefits of industry 4.0 technologies

Improved production	Improved communication	Improved decision-making
• Autonomous robots • Cyber physical systems • Additive manufacturing • Augmented reality	• System Integration • Internet of things • Cyber physical systems • Cloud computing	• Big data and data analysis • Simulation • Cyber physical systems

Source: Own compilation

Table 3-1 illustrates the three major types of benefits that can be gained from using Industry 4.0 technologies. In this study, the key benefits appropriate for the development of a budgeting artefact is that it should enable the user to have data of available allowances (refer paragraph 1.1.3, page 6) as close as possible to real time.

When comparing this need to the summary of benefits illustrated in Table 3-2, the following can be concluded.

- Firstly, the budgeting control framework will not need improved production, since this artefact does not aim to produce any products. It is therefore clear that technologies that only benefit production will not be used in this study, thereby eliminating autonomous robots, additive manufacturing, and augmented reality technologies as possibilities.
- Secondly, the budgeting control framework will need to lead to improved communication to deliver the message of what the allowances are, thus the technologies of systems integration, IoT, cyber physical systems, and cloud computing are possibilities that can be used.
- Lastly, aiding in decision-making is one of the goals of the budgeting control framework and consequently these technologies of Big Data and data analysis, simulation, and cyber physical systems, can also be used to gain this benefit.

The next section will discuss the initial design specifications of the budgeting control framework.

3.4   Initial Design specifications of budgeting artefact framework

A framework, as defined by BusinessDictionary (2019), is an outline, skeleton or overview which supports an approach to an objective. The objective is the design of a budgeting artefact that uses Industry 4.0 technologies to simplify the user experience whilst increasing the benefit gained from

the budget process. In the previous sections of this chapter, the two main factors that influence this framework were theoretically discussed.

By taking into account the above information gathered from the literature study, a preliminary design for the budgeting control framework can be established. As discussed previously, this study will use the action design research model (refer Figure 1-2, page 12). This is therefore the first attempt, or iteration, that will be provided which will aid towards developing the most optimal framework.

The main outline will be presented in Figure 3-2 by intersecting the desired budget features (arrows on the left) and technological methods (arrows in the middle) to achieve the features identified earlier. A brief explanation to the selected technologies is then given (text boxes on the right).

Figure 3-2: First iteration of budgeting control framework

Flexible budgeting approach	System Integration	Big Data	A more flexible budget can be created by integrating systems to feed data and update available data
Continuous evaluation of performance	Data analysis	Simulation	Continuous evaluation can take place by analyzing data and simulating possible outcomes
Low time consuming	System integration	Cyber physical systems	Time used can be reduced by integrating systems and people to feed data
Visibility present and forward looking	Data analysis	Simulation	The strategy can be held as a focus point by integrating systems and people to feed data relating to the strategy
Single version of truth	Cloud computing	System integration	Automated data analysis and simulation can aid in higher visibility and forecasts
Link to strategy	System integration	Cyber physical systems	Spending can be reduced if data is analised more often and systems are integrated to link the spending and available budget amounts
Improved spending control	System integration	Data analysis	A single version of truth can be created by having a single online version of data by using cloud computing and system integration.

Source: Own compilation

3.5   Summary

The objective of this chapter was to gain insight into the two main aspects of this study – budgeting and Industry 4.0 technologies – in order that the second secondary objective of the study, as listed in Chapter 1 (section 1.4.2, page 10), can be met.

The concept of budgeting was discussed in depth. This was done by firstly considering the importance of budgeting. It was learnt that effective budgeting can aid a company in financial control, evaluation of projects or periods and communication of goals and strategies. Next, the chapter aimed to establish a link between stewardship, corporate governance and budgeting. This was done by realising that corporate governance and budgeting can be viewed as mechanisms

that can support in reaching the goals of the company. Stewardship furthermore requires a system to assist the principals in reaching their targets. Budgets, on the other hand, are systems used to help individuals or companies in reaching their goals.

The chapter continued with a discussion around the benefits and drawbacks of different budget approaches. The aim was to identify a specific method that can be used to achieve the objective of this study of designing a budgeting control framework. After these methods had been discussed, guidelines that will enhance the budgeting process even further were presented. Both beyond budgeting and the rolling budget philosophy were identified as provisional methods to be used to develop the budgeting control framework.

The next section investigated the various Industry 4.0 technologies. The nine pillars of Industry 4.0 technologies, as reported by Vaidya *et al.* (2018), were utilised. Focus was placed on: 1) what these technologies are; 2) how they can lead to improvement and optimisation of different processes or areas, and 3) what their drawbacks are. An evaluation of the various Industry 4.0 technologies was conducted by applying each technology's relevance to the case study by referring to its benefits. The main benefits that Industry 4.0 technologies could bring were identified as production, communication and decision-making. The possible technologies that could be used in the development of this budgeting control framework were identified as system integration, internet of things, cyber physical systems, cloud computing, big data analysis and simulation.

The chapter concluded with a first iteration of the budgeting control framework. This was done by defining the key areas – based on literature – which should be included in the framework so that the objective of this study could be met.

The next chapter will provide the results from the interviews conducted to enable the refinement of the budgeting control framework in order to meet the needs of the selected multinational company.

CHAPTER 4

4   FEEDBACK ON EMPIRICAL STUDY

4.1   Introduction

The aim of this chapter is to address the third secondary objective, as set in Chapter 1 (paragraph 1.4.2, page 10), namely to determine the requirements for an effective budgeting control framework. This framework should improve the visibility and impose a higher level of control over the use of a budgeting system.

The chapter will commence with feedback on how the interview process was approached. This will include feedback on: 1) difficulties and successes gained during the process; 2) how the respondents interacted within the interviews, and 3) a short summary of the profile of the respondents. Next, a summary of the data gathered from the respondents will be provided by identifying the themes and outliers within the qualitative data. Lastly, the analysed data will be used to adjust the specifications for the budgeting artefact.

4.2   Feedback on interview process

4.2.1   Interview process

The interviews were conducted over a timespan of two months. The reason for this lengthy timespan was that few of the respondents were located at the same geographical location and most of them had different traveling schedules. The respondents were, however, willing to conduct the interviews and they understood the interview process. All of the respondents gave valuable feedback on most of the questions asked, except for one (this will be discussed in detail later in this chapter). In some instances, the respondents extensively elaborated in response to one question and while doing this, answered some of the other questions as well. The interviewer had to intervene in certain instances to clarify what the respondent was trying to say, since company "slang" was used that may not be understandable to external parties.

In general, the interviews were considered as successful since it was possible to gain valuable insights into the current budgeting system and to identify the main difficulties thereof.

4.2.2 Difficulties and successes of the process

During the interview process there was a few unexpected events that had both positive and negative influences on the gathered data.

The positive influences included that the respondents were much more open to answer and share from their personal experiences with the budgeting system than was expected. The respondents were also willing to make time to attend the interviews held at the head office, making it possible to conduct all the interviews face to face instead of using a Skype call as originally anticipated. The key benefit of this is that it was much easier to interact with the respondents and in turn gather more data. A second success was that all of the respondents identified similar areas for improvement and similar difficulties with the current process. The respondents were thus in agreement.

The negative aspects included that the respondents did not have sufficient knowledge of Industry 4.0 technologies, making it difficult to discuss the different types of technologies that can be used. This was the one question that the respondents were not able to answer successfully. This led thereto that the respondents' insight into which technology would be most efficient, could not be established.

4.2.3 Portfolio of the respondents

In Chapter 2 (paragraph 2.4.1, page 26) it was discussed that purposeful sampling should be used to select respondents, since this would enable data saturation to be reached. It was therefore decided that six manager-level employees would be interviewed. However, during the interview process, it was possible to increase this number to seven managers. These managers were selected from different areas of the business so that a more holistic view of the business' perception on the budgeting system could be gained. Another benefit of having managers from different areas of the business is that it was possible to gain more insight into the deficiencies of the current system. It was also possible to better understand the benchmark for an improved budgeting system required by the management team.

Table 4-1 indicates the designations of the respondents within the multinational company chosen to participate in this study.

Table 4-1: Designations of respondents

Designation	Responsibilities
Financial Manager South Africa	Responsible for all financial decisions made regarding South African mines, including budgeting and maintaining of the ERP system.
Financial Manager – Africa	Responsible for all financial decisions made regarding the African continent (excluding South Africa) mines, including budgeting and maintaining of the ERP system.
Chief Operations Manager – Africa	Responsible for the management of all operational decisions made regarding the Africa continent (including South Africa) mines, including tracking the performance of a project and making decisions to help improve the project performance.
Operations Manager – South Africa	Responsible for the management of all operational decisions made regarding South African mines, including tracking the performance of a project and making decisions to help improve the project performance.
Contract Manager – South Africa	Responsible for managing a specific set of mines in South Africa. These responsibilities include making sure that the budget of the project regarding time and costs is followed, as well as making sure that the actual drilling process is running smoothly.

Source: Own compilation

The ratio in which these different designations were included in this study can be seen in Figure 4-1 below.

Figure 4-1: Ratio of representatives
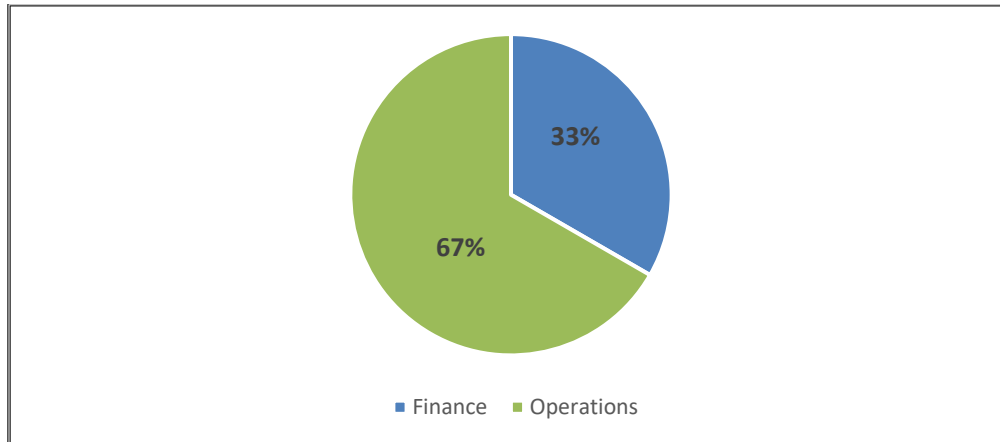
Source: Own compilation

Figure 4-1 above indicates that a larger number of operational staff members than finance staff members were interviewed.

The objective of this study was to develop an internal corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems. The first reason for the higher representation of operational staff is that visibility and enforcement correlate with the actual operations of the selected company. Even though the budgeting process is seen as a finance function, financial staff is responsible for the creation of budgets that are used by operational staff. The operational staff therefore has more interaction with the budgeting system, and the feedback gathered from them will be more beneficial.

The second reason for the lower representation of financial managers is due to the structure of the company. Within the selected company there is an average ratio (as calculated by the management of the company) of 12 mining sites per financial manager. By considering this statistic, it becomes clear why that there are fewer financial managers that could have been interviewed – leading to the ratio indicated above.

4.3 Results of qualitative data gathered from interviews

4.3.1 Introduction to data analysis

The aim of this section is to successfully analyse the data gathered from the respondents so that a suitable budgeting control framework can be proposed. The most appropriate data analysis approach should therefore be identified. According to Rowley (2012:268), the analysis of data can be a daunting process and should be approached in an orderly manner. According to Tongco (2007:148), the level of analysis required is based on the technique that the researcher used to identify the various respondents. Tongco (2007:148) continues to explain that, when purposeful sampling was used to identify respondents, the amount of analyses required will decrease since the respondents are more likely to supply accurate information.

Purposeful sampling was used in this study and in agreement with what Tongco (2007) argues, it is evident that the gathered data is largely similar and therefore a less strenuous analysis was required. The first level of analysis that was implemented, as suggested by Rowley (2012:268), was to determine the main themes of responses towards each question.

According to Stuckey (2013:58), interviews should be used in a qualitative study to firstly underline the research that was already conducted on the subject, and secondly to rationalise how the conclusions drawn from the study had been determined. Therefore, the interview data will be linked to the literature study – conducted in Chapter 3 – to determine how the responses to each question support or contradict the literature.

The next section will present the responses to the interview questions.

4.3.2 Responses to interview questions

Within this section the data gathered from the interviews will be analysed per question posed. The responses to each question will firstly be discussed, followed by identification of the main themes. Furthermore, the identified themes will be linked back to the relevant literature, where possible. Lastly, comments will be provided on how the information gathered from a question will affect the proposed design, as stipulated in Chapter 3 (section 3.4, page 52), of the budgeting framework.

Question 1: What is the current process that is to be followed to get a budget for your project?

The goal of this question (refer section 2.4.1, page 24) was to determine how the current budgeting system is used to create a budget for each of the company's projects. This is important since the method of budgeting used by the company must be known in order that appropriate optimisation can be done.

All of the respondents indicated that the current method of budgeting used within the company is a traditional budgeting system. The budget comprises fixed amounts that are not adjusted throughout the budgeting period. Furthermore, it was revealed that the budget is created by dividing the total amounts by the length of the project. Respondent 2 reported that the budget is based on historical spending trends for all projects, since the tender information is not always available to create a budget. Respondent 3 confirmed that the budget is calculated by performing manual calculations based on the tender information received. This respondent also stated that the more complex the tender is, the less accurate the budget becomes. Lastly, all of the respondents agreed that the budget creation process is time-consuming and manually intensive.

From the responses it is evident that the general trend is that there is not a uniform way in which the budgets are being created. Personal judgement plays a major role in how the amounts budgeted for are determined. A high level of manual intervention is furthermore required in the budgeting process to generate an usable budget.

It was therefore determined that there is not a standardised process to create a suitable budget. In Chapter 1 (section 1.1.1, page 2) it was stated by Maria (2018:74) that power within a company can be greatly misused and therefore a need arises for appropriate and acceptable governance that provides assurance to all stakeholders within multinational companies. The response gained from question one highlights the importance of governance – in this case – over budget creation, since different creation methods will create an area where possible misstatement can take place. Additionally, in Chapter 3 (section 3.2.4, page 36), the traditional budgeting system was criticised for being time-consuming and not flexible. This is similar to the feedback received to question one.

Question 2: What is the current process that is to be followed when an expense must be made?

The goal of this question (section 2.4.1, page 26) was similar to that of question 1, namely of trying to understand the current budgeting process. However, this question focused more on discovering how expenses against the budget are allocated and approved.

From all the participants' responses, it became clear that there are clear approval levels based on budget expenditure limits when an expense is captured on the ERP system. The approval process is relatively easy for expenses within budget, but becomes tedious for amounts exceeding the budget. Only a few managers are required for approval within budgeted limits, while the number of managers increases depending on the size of the expense. The level of seniority then rises and can even be escalated to requiring CFO approval. Most of the respondents commented that it is difficult to know what the budgeted amounts for each expense category are, namely the various key budgeted cost areas. Since the drilling process is similar for each project, the expense categories are similar. However, budgeted amounts for expense categories are mostly calculated manually by relying on past experience and personal judgement. The challenge arises when the actual expense exceeds the forecast budget. It is the practice of the mine managers to bypass or adjust the budget in these cases so that the expense can be documented in the ERP system.

Respondent 2 explained that this process usually happens when unforeseen expenses occur due to breakdowns or emergency items that are required to keep the machines running. The problem is that these expenses have to be approved to ensure the project continues without incurring delays and penalties which may lead to greater financial losses.

Some of the respondents pointed out that they have difficulty in tracking the actual expenses that have been allocated to each category against the allowed amounts for each category. As Respondent 3 explained, the actual expenses have to be tracked to ensure that the aggregate budget can be monitored to determine if the project will still make the same profits. Currently, as explained by this respondent, he is only able to view the total amount spent at the end of the month which makes it difficult to track the project's performance in real time.

Some major trends visible from this question are: 1) manual intervention is once again an issue, indicating that this is an overall problem that has to be addressed, and 2) there is limited visibility

of the budgeted amounts since most analysis is only performed after the expenses have been incurred instead of before they are expensed.

The objective of this study was to use Industry 4.0 technologies to improve the budgeting system. Industry 4.0 technologies, as indicated in section 1.1.3 (page 4) (Dalenogare *et al.*, 2018:384), enable companies to have improved and more flexible business processes. This is to optimise strategic and operational decision-making which will lead to a data-driven culture within the company. It is clear that these technologies will be able to assist in reducing the high amount of manual intervention that is currently needed. Furthermore, as was discussed in Chapter 3 (section 3.2.4, page 36), it is possible to have a budgeting system such as a rolling budget that is flexible and which can be adjusted as unplanned expenses are incurred.

Question 3: How do you know what are your current allowances for each expense category today?

The goal of this question (section 2.4.1, page 26) was to discover if real-time data of allowance could be gathered from the current system.

All the respondents concurred that real-time data is not visible and have to be calculated manually. Respondent 2 explained how he uses an extensive calculation process – which is time-consuming – to obtain a figure that is still not 100% accurate. Some of the respondents also commented that in some cases they have to rely on an estimate based on their prior knowledge and experience. Respondent 1 mentioned that it would be valuable if the system was able to measure the project costs to date at various stages of the project.

The theme of manual intervention continued in this question and a second theme of different versions of the same figures appeared. It was learnt that staff are using different methods to calculate the same budgets, which lead to an inconsistent result. A theme of inaccurate budgeting was also visible since it was mentioned that the respondents were unsure whether the budget they created was accurate.

Question 3 highlighted the importance of a single version of the truth. In Chapter 1 (section 1.1.2, page 4) it was argued that stewardship theory proposes the enforcement of corporate governance within a company. As reported by L'Huillier (2014:315-316), the actions of different agents should be directed towards one goal – or one version of the truth – so that the strategic goals of the company can be better achieved. The responses on question 3 supports this by highlighting that

goal congruence becomes problematic when all parties do not work with the same version of the truth.

A link between corporate governance, stewardship and budgeting was made in Chapter 3 (section 3.2.3, page 35). It was concluded that effective budgets are invaluable in aiding in planning, control, strategy realisation and communication (Hansen & Van der Stede, 2004:415-418). It is crucial to have one consistent budget representing accurate figures, rather than various versions. This will enable optimal decision-making by management.

Question 4: How do you know what is your progress of the project against the projected timeline?

The goal of this question (section 2.4.1, page 26) was to discover to what extent the current system is supplying the users with visibility of the budget.

All the respondents once again agreed that they have to perform a manual calculation to determine a rough estimate of a project's progress. Respondents 2 and 4 elaborated that the manual process also only enables them to have a backward-looking view on the expenses that were incurred. It was also discovered that there is limited control over the work done by people on site who are supposed to keep track of the progress on a predefined sheet.

The reoccurring theme of manual intervention was evident. Furthermore, the issue of limited visibility was raised once again. A new theme of lack of control over behaviour of employees were identified. It can be seen that managers do not have sufficient control over local employees who work on site to enforce certain behaviour and disciplines.

The question informed the researcher that the company's budgeting system currently only has the ability to analyse expenses and progress of the project in a backward manner. Chikwiri and De la Rossa (2015) report, as mentioned in Chapter 1 (section 1.2, page 7), that the true value of an internal audit function can be achieved when this function can shift to a forward-looking approach by implementing systems that can eliminate possible risks. This statement is verified by the information gathered from question 4. The managers expressed a need for forward-looking information so that issues can be identified sooner, and avoided. In Chapter 3 (section 3.2.4, page 36) it was learnt that by implementing a rolling budget philosophy, a forward-looking approach can be established (Bhimani *et al.*, 2018:310).

Question 5: How you know what is the total amount of allowances that you have left for your project?

The goal of this question (section 2.4.1, page 26) was to discover to what extent the current system is supplying the users with visibility of the remaining budget amounts.

Most of the participants responded that without performing a manual calculation, it is not possible to know the remaining budget amount. Respondent 3 stated that even though he is able to perform a calculation that can give him the remaining amount, the value will relate to the previous month and has no significance to make future decisions.

The main theme identified in this question is that the visibility of the budget is limited, as it is static and not easily adjustable as changes to the project is made. Another theme that can be identified is that data is only received after the actual events had happened. It is therefore not meaningful to make future decisions on the delayed data.

Bhimani *et al.* (2018:308) explain, as mentioned in Chapter 3 (section 3.2.2, page 34), that budgeting should aid in operational planning and performance evaluation. From the responses, it was evident that a lack of efficient budgeting leads to a lack in performance evaluation and operational planning. Therefore it can be assumed that by improving the budgeting process to become more efficient, evaluation and planning will improve.

Question 6: Please explain how you would like the current process to be improved.

The goal of this question (section 2.4.1, page 26) was to determine what improvements or changes should have been made to the budget system so that both the employees and the company could benefit from its use.

The respondents mainly focused their improvement ideas on obtaining more visibility and reducing the amount of manual input that is required to create and track a budget for a certain project. Respondent 5 mentioned that the budget should indicate early warnings when the total actual expenditure is likely to exceed the total budget based on the current up-to-date spending trend. Respondent 6 argued that it would be a considerable gain if the spending pattern of a specific item such as accommodation could be tracked individually.

The theme of reducing manual input through automation of certain procedures was identified. This automation is viewed from two different perspectives. Firstly, that automatic warnings should

be given if overspending is due to happen, and secondly, that the manual labour in creating a budget should be replaced with automation. The second identified theme relates to visibility. The participants highlighted the need for spending visibility on an item level and not only on a monthly lump sum as is currently available.

In Chapter 3 (section 3.3.3, page 51) it was preliminary determined from literature that by using Industry 4.0 technologies such as system integration and cloud computing, increased communication with system users would be possible. The same need for improvements to the budgeting system was identified by the respondents. Furthermore, it was stated in Chapter 1 (section 1.2, page 7) that an efficient internal audit function will aid in improved performance and increased visibility (Sabar *et al.*, 2018:1093). Additionally, in Chapter 3 (section 3.3.2, page 43) it was discovered that a budgeting system can act as an internal control. It can therefore be assumed that by improving the visibility of the budgeting system, it will be possible to improve the performance of the company.

Question 7: How are you able to make data driven decisions to enable you to manage your project optimally?

The goal of this question (section 2.4.1, page 26) was to establish the knowledge the employees had about Industry 4.0 technologies and using data to make decisions.

Most of the respondents answered that they are not always sure if the data that they have is 100% accurate, since different versions of a set of data sometimes exist. Some of the respondents mentioned that they do use the data to make decisions. However, such a decision is usually only made towards how a next project can be performed differently instead of changing the course of the current project. The reason for this, as Respondent 6 explained, is that the data is only available after the events had taken place.

The themes that can be identified within this question is once again visibility and a single version of the truth. The information received from the respondents indicate that the data within the company is of some value, but that there is an opportunity for more value to be gained from this data if there is only one version of the truth and a higher level of visibility.

In Chapter 3 (section 3.3.2, page 43), it was explained (Grover *et al.*, 2018) that data driven decision-making can theoretically aid in:

- guidance on how to make future decisions;

- better understanding the needs of their customers;

- identifying and analysing root causes or failures in real time;

- highlighting anomalies within current systems in the company, and

- removing operational roadblocks by fine-tuning processes within a company.

From the responses gathered it is evident that the respondents are of the opinion that if data can be received or accessed earlier, and if it is accurate, some of the benefits described above will be gained.

Question 8: What do you understand under the term Industry 4.0 technologies?

The goal of this question (section 2.4.1, page 26) was to determine the knowledge the employees had about Industry 4.0 technologies.

All of the respondents answered that the term was unfamiliar to them and that they did not have any idea how these technologies could aid in the development of a more efficient budgeting system.

The one consistent theme was that all of the respondents were unfamiliar with these technologies. This shows that there is room for improvement and that the users of the new system will most likely require training.

In Chapter 1 (section 1.1.3, page 6) it was determined that a new industrial revolution is already occurring. The fact that this is a relatively new concept, was supported by the fact that the respondents were unaware of this revolution.

Question 9: Please elaborate on some difficulties that you have because of the current system.

The goal of this question (section 2.4.1, page 26) was to determine the experience of employees using and managing the current budgeting system.

Some of the major difficulties that were identified by most of the respondents have been highlighted before and include: 1) not having the desired visibility about the budget and expenses to make effective decisions; 2) not able to track costs per item effectively; 3) not receiving the data before decisions have to be made, and 4) that the creation of a budget is time-consuming.

Some specific issues were also raised by the following respondents. Respondent 7 argued that the tendered, budgeted and actual costs are not visible and is not comparable. This limits the ability to make improvements to the project to achieve a higher gross profit. Respondent 1 highlighted that there is a lack of visibility of allowances for time-based and production-based costs. Lastly Respondent 5 stated that he is unable to view the progress in the spending of each expense to enable better planning; for example overspending in one month while still under-spent for the complete project.

Themes identified from this question are: 1) weak visibility that specifically makes it difficult to track the spending of each category; 2) optimal decision-making being hindered by data that is not received timely, and 3) the time consumed by creation of the current budgeting process.

Vaznoniene and Stonciuviene (2012:159) found that it is difficult to adapt to the changing environment of companies when a budgeting model is fixed. The participants concurred by highlighting how difficult it is to track actual performance against the current budget method which is based on fixed amounts. Goode and Malik (2011:209) added and confirmed the argument of the respondents that the creation process of a fixed budget is very time-consuming – as mentioned in Chapter 3 (section 3.2.4, page 36).

Question 10: Would you prefer being told how much to spend in each category per month or having the freedom to spend as you want for each category but having a total budget that may not be overrun? Please explain your answer.

The goal of this question (section 2.4.1, page 26) was to determine the view of the mine managers about budgeting, as well as their requirements in terms of precautions that should be incorporated into the budgeting tool to reduce risks of fraud and other possible methods of bypassing budget controls.

All of the respondents stated that both of these sets of information, the monthly and total budget, would be required so that the optimal level of decisions could be made. This indicates that they are acting in the best interest of the company since it will be impossible to commit fraud or benefit personally. The project data cannot be manipulated to reflect better in one month, or over the period, since both periods will be visible.

The theme that once again emerged was the requirement of visibility of the total project spending. As discussed by some of the respondents, they require this data to enable better decision-making that will increase the performance of their projects.

In Chapter 3 (section 3.2.4, page 36), it was argued that organisations that coordinate their resources optimally will be most likely to reach their strategic goals (Bhimani *et al.*, 2018:308). It was evident from the responses that the participants require as much as possible information so that they can allocate their resources effectively and make better decisions.

The responses to questions 1 to 10, described above, provided vital information that greatly assisted in the process to refine the original draft design, based upon the literature study, for the budgeting framework.

These changes will be made based upon the identified themes and comments made by the respondents.

4.3.3   Themes identified from interviews

A few themes were identified during the semi-structured interviews as areas of concern for the participants. These areas became the focus of design, since it should be improved by using Industry 4.0 technologies. Within this section, each of these new themes will be discussed to determine if it should be considered in the creation of a control framework for a budgeting system. The selected themes will then be investigated to determine how Industry 4.0 technologies can aid in addressing the issue identified. A final control framework that is expected to improve the budgeting process of the selected multinational company will be presented.

Single method of creating budgets

From the literary study (Chapter 3, section 35, page 35) it was determined that the benefit of using a single method of budgeting is that it can aid in promoting the co-ordination of both people and procedures with a more clear project goal. This will aid in better visibility of actual performance against a budget. The empirical study confirmed that the respondents have a desire for a single method of budget creation to ensure that the data can be compared in a meaningful way. During the first iteration of the proposed framework, the aspect of a single method to create a budget was not addressed. However, based on the gathered information, it became clear that this aspect should be added as a requirement of the framework.

The previous iteration did however identify that a single version of a budget must be upheld. It can be assumed that, if there is a single version of the truth, a single version of budget creation should automatically happen.

Single version of the truth

A single version of the truth is a key aspect of a budgeting control framework which was already discussed in Chapter 1 (section 1.3, page 9). The case study company did identify this as a need. During the literature study in Chapter 3 (section 3.2.4, page 36), it was discovered that budgeting systems such as the traditional system discourage people to keep to the budget, since the figures displayed are not always the correct version of the truth. The participants, however, highlighted that since the current budget follows a fixed, or traditional, budget method, it has to be adjusted as changes occur. Yet, these changes are rarely made in such a way that all employees still have the same version of the truth.

Fortunately, this aspect of the budgeting process has already been addressed in the first iteration of the development of the budgeting control framework. The results gathered from the empirical study once again highlight how important this issue is.

High level of manual intervention

As highlighted in the literature review in Chapter 3 (section 3.2.4, page 36), manual intervention is time-consuming. The success of new developments such as beyond budgeting and rolling budgets can partially be related to less manual intervention required. This leads to employees having more time for value adding activities such as analysing the budgets.

The interviews highlighted that, currently, a high level of manual intervention is required to ensure that the budgeting process works efficiently. This was a major frustration for the respondents, since this is a time-consuming exercise without ensuring an accurate project budget.

From the above, the importance of including this aspect into the budgeting control framework is evident. This theme was addressed to some extent in the first iteration. The main method of reducing the time taken was by reducing the level of manual intervention. These two themes – manual intervention and accuracy – will therefore be combined in the budgeting control framework.

High level of time consumption

The creation of a budget should not be too time-consuming – this was identified in Chapter 3 (section 3.2.4, page 36). Budget creation should rather consist of value adding activities which are less time-consuming. Some new developments in budgeting have tried to bridge this gap by assigning greater responsibility to individual employees. The aim is to ease the load of budget creation and using techniques such as beyond budgeting to minimise budgeting creation. This was discussed in Chapter 3 (section 3.2.4, page 36).

The empirical study indicated that time consumption is a major problem since respondents want to be able to have more time to analyse budgets to improve the performance of projects.

Time consumption was included in the original iteration and is a crucial aspect to consider when creating a budgeting framework. As was discussed above, this aspect will be combined with the high level of manual intervention aspect in the final budgeting framework.

Limited visibility of budgeted values

The visibility issue is a problem that has led to major difficulties in more than one multinational company, as discussed in Chapter 1 (section 1.2, page 7). Furthermore, internal governance is a function that aids in the performance of a company through creating the ability to view spending and other aspects of a project or time-period (section 1.2, page 7). To do this, a high level of visibility is required.

During interviews conducted with users from the operational and finance activities, and senior and junior position-respondents, a strong need for more visibility was expressed. This visibility is explained as an ability to view the total monthly budgeted allowance, as well as the year to date allowable expenses. The latter refers to all actual expenses up to and including the current date.

This ability of the budget artefact was identified in the first iteration, only presenting the current and forward-looking budget information. The possibility of the data of a single budget in different formats, as described above, was not considered and this was therefore added to the framework.

Data that is not completely correct

In Chapter 3 (section 3.2.4, page 36) it was discussed that an effective budget should clearly describe how resources are allocated to different sections of a project or a time-period. It was also mentioned that budgets should be compared to actual results so that a greater benefit can

be gained. Comparing of budget figures can only be done if the data is accurate, since the benefit will be lost in comparing data that is wrong.

In the empirical study it was discovered that incorrect data is mostly generated due to the fact that there is a high level of manual input and that different versions of the truth exist. Therefore it can be assumed that, by addressing these aspects, it would be possible to drastically reduce the possibility of incorrect data.

It is clear that this aspect of the budget will be addressed through other abilities that will be included in the framework. This aspect will therefore not be considered in creating a budgeting control framework.

Difficulty to enforce employee behaviour

The difficulty of managing employee behaviour in a multinational company is regarded as a serious problem at present. This was identified in Chapter 1 (section 1.1.1, page 2) as one of the major reasons why multinational companies fail. It was also learnt (section 1.2, page 7) that enforcing behaviour in a multinational company with different cultures and values is impossible if a command- or agency-theory approach is followed. It was proposed in Chapter 1 (section 1.1.2, page 4) and section 3.2.3 (page 35) that a stewardship approach should be followed to better address this problem.

The interviewed managers highlighted that they have little control over employees on site to act in a way that supports the strategic goals and mission of a project and the company.

This aspect was not directly addressed in the first iteration, since the focus was only on spending control and not on adjusting the behaviour of employees. It was, however, included in the updated framework.

Static budgeting system

A budgeting system's purpose, as was discovered in Chapter 3 (section 3.2.1, page 30), is to assist organisations in operational planning. The business environment of the selected multinational company is highly volatile and constantly changes, as confirmed by the respondents. A static budgeting system will therefore not address the need to make adjustments based on changing circumstances.

Some of the respondents commented that they are unable to keep up with the required adjustments to budgets due to operational incidents.

The concern around static budgeting was addressed in the first iteration by the need for a flexible budgeting process. This was included in the final budgeting control framework, since it is of vital importance.

Delay time in receiving data

In Chapter 3 (section 3.2.2, page 34) it was pointed out that a budget must add value to the organisation. If outdated data is used, the value created by the budget will be drastically reduced. Therefore this is a consideration that has to be taken into account when creating the budgeting control framework.

During the empirical study the respondents commented that having information that is outdated, leads to inaccurate decision-making and resource allocation.

This concern regarding up to date information in budgeting was not identified in the first iteration. It will be addressed under the aspect of visibility, since the visibility of actual spending against the budget is required to be as close as possible to real-time values.

No warning system for overspending of budgets

Another goal of a budgeting system, as indicated in Chapter 3 (section 3.2.2, page 34), was that budgets should aid in planning and harmonisation of business units. By continually overspending on a certain budget, planning and harmonisation of business units will not be achieved. It is also argued that management should learn from previous project losses and successes. To be able to optimally utilise the budgeting system, management should have swift access to a project's actual performance against budget. A warning system is therefore important to be considered in the design of the new budgeting system.

The empirical study highlighted that, with the current system, a project's performance against budget is only possible by conducting calculations and assumptions. This is a time-consuming exercise. This concern was addressed in the first iteration as having the ability of improved spending control and the continuous evaluation of the budget. This aspect will be included in the final iteration of the framework.

4.4 Summary

The goal of this chapter was to aid in addressing the third secondary objective of this study, which was to determine the requirements needed to create an effective budgeting system. This was done by conducting semi-structured interviews.

The chapter started by discussing the process that was followed when conducting the interviews. This section highlights that the respondents were able to understand the process of the interviews and gave valuable feedback on most of the questions. It was also determined in this section that it was required from the interviewer to intervene in some cases to ensure that the questions were understood clearly.

The second section of the chapter elaborated on some of the difficulties and successes which were experienced during the interview process. The main positive aspect was that the respondents were much more open to share information than what was expected. The main negative aspect was that the respondents did not have enough knowledge regarding Industry 4.0 technologies, which limited their inputs into which technologies should be used to design the most suitable budgeting framework.

The third section gave feedback on the portfolio of respondents that were interviewed. Here it was indicated that managers from operational and financial positions were interviewed, which lead to gathering a greater spectrum of information. Furthermore, it was explained that the main reason why a higher number of operational staff was interviewed, was because they are interacting on a more regular basis with the budgeting system.

Subsequently, the section started to analyse the data gathered from the respondents. In this section it was discovered that a less strenuous process could be followed due to the fact that purposeful sampling was used when picking the respondents. The process that was followed was to link the data received to the literature study to determine if it contradicts or supports the available literature. After this, themes were identified. A comment was classified as a theme when it was addressed by more than one respondent in the same question.

The last section of this chapter discussed each theme identified to determine if it should be included in the final iteration of the budgeting control framework or not.

The next chapter will investigate how the final secondary objective of this study can be achieved, which is to design a budgeting framework artefact that uses Industry 4.0 technologies.

CHAPTER 5

5 DESIGN OF BUDGETING ARTEFACT FRAMEWORK

5.1 Introduction

The aim of this chapter is to address the fourth secondary objective of designing a final budgeting control framework based on information gathered. This will lead to meeting the main objective of developing an internal corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems

The final budget iteration will first be discussed. This iteration was done based on the initial design from the literature study and adjustments made based on the information gathered during the empirical study. Secondly, the different aspects of the final budget framework iteration will be linked to a suitable Industry 4.0 technology that will assist in the requirements highlighted through the specific identified themes.

The last step will be to determine whether these links to Industry 4.0 technology are viable, based on costs and changes that have to be made to accommodate these requirements.

5.2 Final budget control framework iteration

The following list indicates the final themes that have been identified, using both the literature and empirical study. These themes were included in the final budgeting control framework after careful consideration. All of these items support an environment in which a multinational company can entrust employees with more responsibility (stewardship), whilst also having increased control and visibility over the spending on each budget (acting as an internal audit function). These considerations are the following:

- A flexible budgeting system.

- A minimal time-consuming budgeting system that requires limited manual intervention.

- Visibility of the budget from different viewpoints. These viewpoints should include past events, as close as possible to real-time events, ways to predict future events as well as monthly and year to date viewpoints.

- Limiting overspending on budgets and giving prompt warnings when overspending is likely to occur.

- Having a single method of budget creation and a single version of the truth.

- Encouraging employees to interact with the budgeting system and use the budget to reach the goals of the company.

5.3 Linking themes of budget control framework to Industry 4.0 technologies

These various considerations, as determined above, are required to design a budgeting process. The aim of the budgeting control framework is to aid in the control and performance of a multinational company through the support of Industry 4.0 technologies. In this section, each theme of the final budget control framework will be linked to an appropriate Industry 4.0 technology. The technologies that were chosen were based on: 1) the requirement that most employees are unfamiliar with these technologies and therefore it should not be complex, and 2) the probability that they can address the concerns identified in the current budgeting framework.

To link these different themes to Industry 4.0 technologies, the themes have to be divided based on the benefits of aiding in decision-making and communication – as illustrated in Chapter 3 (section 3.3.3, page 51).

Table 5-1: Linking themes to benefits of Industry 4.0 technologies

Improved production	Improved communication	Improved decision-making
N/A	Visibility of the budget from different viewpoints (theme 1)	Having a flexible budgeting system (theme 1)
	Limiting overspending on budgets and giving prompt warnings (theme 2)	Low time-consuming system requiring minimal manual intervention (theme 2)
	Encouraging employees to interact with the budgeting system (theme 3)	Single method of budgeting creation and having a single version of the truth (theme 3)

Source: Own compilation

Since it is now evident that each theme of the budgeting control framework fits into the possible benefits that Industry 4.0 technologies have, an appropriate theme must be chosen from the list of each category, as determined in Chapter 3 (section 3.4, page 52). These chosen methods should also not be difficult to implement or should not lead to high capital expenditure, since this will not contribute in the budgeting process.

Table 5-2 illustrates how each theme of the framework can be supported by a specific Industry 4.0 technology, as well as the reason thereof.

Table 5-2: Final iteration of budgeting framework

	Chosen Industry 4.0 technology	**Reason for chosen technology**
Improved Communication		
Theme 1	System integration	By integrating the ERP system with the budgeting control framework, it is possible to see the budget on different viewpoints and time periods.
Theme 2	Cyber physical systems	By creating a budgeting control framework that takes input from the user and based upon the input, determines if the budget is overspent or not.
Theme 3	Cloud Computing	Employees will be able to access the budget from anywhere and gain notifications if actions are required. This will make it more likely that they would interact with the budgeting system.
Improved decision-making		
Theme 1	Big data and data analysis	By designing the budgeting control framework in such a way that it is able to change as the estimated time and resource allocations change, based upon previous data and data patterns, it is possible to create a flexible budgeting system.
Theme 2	System integration	By integrating the tender and budgeting systems, a budget template can be automatically generated from the tender values

		which will drastically reduce the time taken to create a budget.
Theme 3	System integration	By integrating the tender and budgeting system, a single version of the truth can be created since the values are not calculated manually. By integrating the ERP system with the budgeting system, the actual values can be shown without any calculations – which will then show a single version of the truth.

Source: Own compilation

5.4 Viability of links made

Each of the links that were made in the previous section should be investigated to determine if it is viable – based on cost, time to implement and user-friendliness of the technology. The different identified technologies will now be discussed:

System integration

The integration of systems has no additional costs, unless the systems are not able to communicate with each other as highlighted in Chapter 3 (section 3.3.2, page 43). These additional costs will mostly be a once-off initial cost. In Chapter 3 (section 3.3.2, page 43) it was established that the value created over the long-term will be greater than these costs.

System integration will initially take some time to ensure that the systems are set up correctly. Thereafter, the time taken will reduce since the systems will then automatically communicate with each other (section 3.3.2, page 43). Since these systems communicate automatically, the difficulty of this technology is relatively low. The only difficulty will be in the setup of the systems.

Cyber physical systems

The setup costs of cyber physical systems can be high if the system is very complex (refer Chapter 3, section 3.3.2, page 43). In the case of the budgeting system, the cyber physical system will not be that complex based on the following reasons:

- The budgeting system will have a single framework that is always used (since a single method of budget creation will be followed) and the budgeting system will always receive the input in the same way (always from the tender).

- System integration and cloud computing technologies will also be implemented and will drastically reduce the cost of the cyber physical system since, as discovered in Chapter 3 (section 3.3.2, page 43), these are the main technologies needed to create such a system.

With regard to the time consumed by implementing this system, it will once again only require time during the setup phase. After the setup has been completed, time will drastically be saved due to the system only needing input from the user.

This technology will not be difficult to use since, once it has been set up, the user will only be required to enter data when prompted.

Cloud Computing

Cloud computing functions on a pay-as-you-use principle (refer Chapter 3, section 3.3.2, page 43). Costs will therefore be lower than buying a new system or data warehouse to perform the desired tasks.

Cloud computing takes no time to set up, since the data will be automatically shared to all staff members who have access (refer Chapter 3, section 3.3.2, page 43). Cloud computing has the ability to increase social sustainability by ensuring that all people who have access can communicate with one another.

The concept of cloud computing is relatively easy to understand, since the goal of this technology is to connect people and the technology itself – as described in Chapter 3 (section 3.3.2, page 43).

Big data and data analysis

Big data relating to the organisation is freely available within such an organisation and therefore there will be no costs in obtaining this data. The only costs that will be incurred will be the cost of data security programmes to protect the data against cyber-attacks.

Big data may take some time to analyse since there is such a vast amount of data (refer Chapter 3, section 3.3.2, page 43). To reduce time consumption, the data has to be analysed

compartmentally. This will be done by analysing only the data for a specific budget or tender, which drastically reduces the amount of data and the time needed to perform the analysis.

Big data is not a difficult technology to understand and the only difficulty is in creating links between the data that is gathered (refer Chapter 3, section 3.3.2, page 43). This problem can, however, be addressed by creating a tool that extracts only the required data.

From the above it can be seen that even though there may be some financial expenditure and initial time consumption, these themes will have a cost and time benefit and therefore the technologies would be viable.

5.5   Summary

The aim of this chapter was to address the fourth secondary objective, as set in Chapter 1 (section 1.4.2, page 10), of determining how a multinational Industry 4.0 budgeting control framework should look like. This was done by firstly discussing the different themes that have to be considered. These themes were linked to Industry 4.0 technologies that can aid in addressing these considerations. Lastly, these technologies were then scrutinised to determine if they would be viable in terms of cost, time and the difficulty of the technologies.

In this chapter it was learnt that it is possible to formulate a budgeting control framework for a multinational company using Industry 4.0 technologies. It was also established that this framework is feasible, since the design and implementation of such a framework will not be too expensive or will not require a high amount of time or knowledge regarding these technologies. This is possible due to the fact that the technologies that were chosen, complement one another and that each of these technologies are not extremely complicated.

The final chapter will discuss the conclusions and recommendations of the study, based on all the information that was gathered.

CHAPTER 6

6   CONCLUSION AND RECOMMENDATIONS

6.1   Introduction

The goal of this chapter, as determined in Chapter 1 (section 1.4.2, page 10), is to fulfil the final secondary objective of this study which is to make practical recommendations, identify limits of the study as well as areas for future research.

This chapter will start with a presentation of each secondary objective of the study so that a clearer understanding can be displayed of how each objective has been addressed. Secondly, this chapter will provide recommendations that can be implemented based on the results obtained. Thirdly, the chapter will discuss the limitations of the study. Possible contributions made to the literature that is relevant to this study will follow. The chapter will conclude with areas of possible further research that have been identified.

6.2   Feedback on secondary objectives of the study

6.2.1   Secondary objective 1

To present the appropriate research design and methodology followed in this study to answer the set research objective

In Chapter 2 (section 2.1, page 16) it was determined that – to be able to choose an appropriate research methodology – three aspects had to be considered. These three aspects were the: 1) research approach, 2) research design, and 3) research method.

The appropriate research approach identified was a qualitative approach. The reasons for this decision were:

- the type of data required to adhere to the main objective of this study would be the opinions of people – classified by Creswell (2014:31) as qualitative data, and

- to gain comprehension in an exploratory study, a qualitative approach should be followed, as per Babbie and Mouton (2008). The objective was to explore the use of Industry 4.0 technologies to assist in designing a budgeting framework.

The research design refers to the nature of society accepted for the study, as Holden and Lynch (2004:3) explained in Chapter 2 (section 2.1, page 16). This study was nested in interpretivism. This design was chosen as the study relies on both the insight and interpretation of the researcher and the opinions and perceptions of people. These are subjective and are required to design a budgeting framework that will meet the requirements of this study.

The chosen method of research was a case study. This method provided sufficient information for the researcher to design an insightful budgeting framework. In Chapter 2 (section 2.1, page 16) it was highlighted that Robert Stake's viewpoint of case studies was followed. It was furthermore mentioned that the data collection technique utilised was semi-structured interviews.

To ensure that enough information was gathered to create an optimal budgeting control framework, an action design research (ADR) process was followed in this study. It was determined in Chapter 2 (section 2.2.2, page 20) that this process enables the user to determine the success of a study. This chapter continued to explain that it is possible to perform an additional iteration to discover more about the topic and to ensure that the best solution possible is being suggested.

Within this study two iterations were performed to ensure that all aspects have been considered to design a suitable budgeting control framework. The first iteration was to conduct a literature study regarding budgeting and Industry 4.0 technologies so that a better understanding of these topics from literature could be gained. The second iteration was completed after an empirical study where managers within a multinational company were interviewed to determine their specific needs and expectations of a budgeting system.

The first secondary objective of this study has therefore been met, since the chosen methodology is deemed appropriate.

6.2.2   Secondary objective 2

To identify and evaluate the different types of Industry 4.0 technologies and budgeting systems in the context of the budgeting process at the chosen multinational company

In Chapter 3 (section 3.1, page 33) the approach to meeting this secondary objective was explained. It was stated that budgeting will firstly be discussed to determine which budgeting method would be the most appropriate and to discover the acceptable budgeting guidelines. The

second step was to conduct a literature study around different Industry 4.0 technologies so that a better understanding of their benefits and drawbacks could be gained.

When the importance of the budgeting principle was investigated in Chapter 3 (section 3.2.2, page 34), it was learnt that budgeting can aid in internal corporate governance and increased operational performance and planning. Furthermore, it was found that effective budgeting can assist in the harmonisation of different business units and effective decision-making by management.

Upon further investigation, it was documented in Chapter 3 (section 3.2.3, page 35) that it is possible to link budgeting back to the chosen theory of this study – stewardship theory. This is possible since Hansen and Van der Stede (2004:415-418) explained that an effective budgeting system is able to help employees within a company to work towards the same goal as the management of the company. This is achieved when a budget is able to increase control, strategy realisation and communication.

The different methods of budgeting were subsequently discussed in Chapter 3 (section 3.2.4, page 36). In this chapter, it was discovered that most budgeting systems are not able to achieve the three aspects listed in the previous paragraph, due to being inflexible, time-consuming, or comprising of non-value adding activities. The concept of rolling budgeting and beyond budgeting revealed that it is possible to achieve these three aspects when a different approach to budgeting is followed. This approach is to ensure that guidelines, such as firstly having a method to update the budget, are followed so that the most relevant figures are used. The approach should also empower staff members in such a way that they would be able to operate as decentralised units with healthy boundaries (the budgeting system), working towards the same strategic goals as the management team.

Some further effective guidelines for budgeting were then provided in Chapter 3 (section 3.2.4, page 36). It was learnt that there should be a clear link between the budget and the strategy of the company, which should be communicated to the users of the budget. It was also reported that the budget should clearly communicate how resources should be used to reach the goals of the company. The actual and budgeted values should also be compared on a regular basis to ensure that the budget is efficient. Lastly, the budget must lead to the promotion of innovation by giving employees more responsibility.

In the next section of Chapter 3, different Industry 4.0 technologies were discussed to understand what the different technologies are, as well as their respective benefits and drawbacks (Chapter 3, section 3.3, page 43).

The nine types of Industry 4.0 technologies – as determined by Vaidya *et al.* (2018) – were investigated. It was determined that the benefits of these nine technologies can be categorised into three different sections. These sections are: 1) improved production, 2) improved communication, and 3) improved decision-making. The relevance of these benefits was discussed in relation to this study in Chapter 3 (section 3.3.3, page 51). It was determined that the increased production branch of benefits will not be suitable technologies for this study, since the main areas of the budgeting system that require improvement is the communication of values and better decision-making. The main types of technologies that were firstly appropriate to reach the main goal of this study, and based upon literature, were: 1) big data, 2) simulation, and 3) cyber physical systems.

To fulfil this secondary objective, an initial iteration of the budgeting control framework was developed in Chapter 3 (section 3.4, page 52). This iteration considered the various aspects of budgeting and Industry 4.0 technologies found in the literature review. An illustration (Figure 3-2, page 54) showing the intersection between the desired budgeting features and possible Industry 4.0 technologies were designed.

It is therefore evident that the second secondary objective has been achieved, since the different budgeting methods and Industry 4.0 technologies were investigated to enable the researcher to compile an initial budgeting framework.

6.2.3 Secondary objective 3

Gathering qualitative data to determine the current status and future requirements for the budgeting system by conducting semi-structured interviews

Data was collected by performing semi-structured interviews within the selected multinational company. The respondents were chosen by using purposeful sampling, as discussed in Chapter 4 (section 4.3.1, page 60). The respondents that were selected was a compilation of financial and operational managers, since both groups are interacting with the budgeting process.

These respondents were able to give the researcher a clearer understanding of the requirements, difficulties and expectations of the employees of this multinational company regarding a budgeting

system. This understanding was gained by examining the responses of all the interviewees to each question and by identifying themes that more than one of the respondents had mentioned. These themes were then examined in more detail in order to determine if they were viable aspects that should be included in the framework of the budgeting system. This examination was conducted by discussing the comments made by the respondents, how these comments link to the relevant literature and whether this theme has been identified previously.

The third secondary objective of this study has therefore been reached, since it was possible to gain a clear understanding of the selected multinational company's environment.

6.2.4 Secondary objective 4

To design a final budgeting framework based upon gathered qualitative data

The final budgeting framework was discussed in Chapter 5 (section 5.2, page 75) and the main themes to be included in a budgeting framework were identified. These themes were determined by considering the information gathered in the literature study and the data collected during the empirical study.

The next step was to link each of these themes of the budgeting framework to an appropriate Industry 4.0 technology. This was performed in Chapter 5 (section 5.3, page 76). After these links had been made, the viability of the technologies were discussed and it was determined that the cost, time and difficulty of these technologies were viable in relation to the benefit that could be gained from using it.

The fourth secondary objective has therefore been reached, since it was possible to design a budgeting framework that uses Industry 4.0 technologies.

6.3 Limitations of the study

The following limitations of this study can be highlighted:

- The sample size of this study is small in relation to the high number of managers of multinational companies that exist in the world. For purposes of this study it was, however, sufficient, especially as the focus of the study was a single company and the responses given by the interviewees were similar – indicating that their concerns around the budgeting system were alike.

- The results of the study are specifically aimed at a specific multinational company, and the results of this study might therefore not be applicable to all multinational companies.

- The framework was designed based on the qualitative data gathered. The results unfortunately do not include the performance of the system once it has been implemented.

6.4 Future research

The areas for future research that can be conducted on this topic attempt to address the limitations of this study by expanding on the designed framework. These areas include the following:

- Extending the research approach to other multinational companies that struggle with internal governance in budgeting.

- Designing the budgeting control framework and moving into the second phase of ADR.

- Implementing the designed framework in the multinational company and moving into the last phase of ADR.

- Investigating the possible change management that should be considered when implementing such a system.

6.5 Summary

The main objective of this study was to develop an internal corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems. In Chapter 1 (section 1.4, page 10) it was highlighted that, when each of the secondary objectives (discussed above) have been reached, the main objective of this study would have been achieved.

In addition to developing a budgeting control framework, a stewardship relationship between the management of an organisation and the employees of the organisation was also established. This makes it possible for management and employees to work towards the same strategic goals. This can be achieved by implementing a framework that focuses on reducing the time spent on creating budgets, increasing visibility of budgets, encouraging employees to interact with the budgeting system and having a warning system for overspending. These themes of the control framework have been made possible by using Industry 4.0 technologies and, by using these technologies,

the dilemma of internal governance in a multinational company can be addressed to some extent. The links established between the recommendations, findings and objectives can be seen by referring to Appendix B.

The use of information gathered from literature and an empirical study gave the researcher a good understanding of the multinational budgeting environment which enabled the development of a budgeting control framework.

APPENDICES

Appendix A: Interview questions

The following is a list of questions that were discussed with the mine managers to discover the current setup of budgeting controls within the selected multinational company:

1. What is the current process that is to be followed to get a budget for your project?
2. What is the current process that is to be followed when an expense must be made?
3. How do you know what are your current allowances for each expense category today?
4. How do you know what is your progress of the project against the projected timeline?
5. How do you know what is the total amount of allowances that you have left for your project?
6. Please explain how you would like the current process to be improved.
7. How are you able to make data-driven decisions to enable you to manage your project optimally?
8. What do you understand under the term Industry 4.0 technologies?
9. Please elaborate on some difficulties that you have because of the current system.
10. Would you prefer being told how much to spend in each category per month, or having the freedom to spend as you want for each category, but having a total budget that may not be overrun? Please explain your answer.

Appendix B: Diagram of link between objectives, findings and recommendations

Main objective of the study

To develop a corporate governance control framework for a multinational company using Industry 4.0 technologies that can aid in visibility and enforcing of budgeting systems.

The main objective was broken down into four secondary objectives

Objectives of study

To present the appropriate research design and methodology followed in this study to answer the set research objective

To evaluate Industry 4.0 technologies and budgeting systems in the context of the budgeting process at the chosen multinational company

Gathering qualitative data through semi structured interviews to determine the requirements for the budgeting control framework

To design a final budgeting framework based upon gathered qualitative data

The secondary objectives was discussed in chapters 2-5

Findings in the study

Chapter 2 explained how the methodology would be followed

Chapter 4 established how empirical data can be used to gain understanding of budgets and industry 4.0 technologies' ability to assist in budgeting

Chapter 3 discussed both budgets and industry 4.0 technologies and designed an initial control framework Refer Fig 3.2

Chapter 5 discussed how information gathered in chapter 4 & 5 was used to develop the control framework Refer Table 5.2

Each chapter aided in gaining information to develop the final budget control framework

Recommendations made in conclusion

The control framework should be able to reduce time spent on creation, increases visibility ,encourage employees to interact and warn on overruns

Industry 4.0 technologies can aid in developing a budgeting control framework

Industry 4.0 technologies can to some extent aid in internal governance of multinational companies

A stewardship approach can be used to better manage budgeting in multinational companies

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TO WHOM IT MAY CONCERN

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For

A VAN WYK : Student number: 25896318

I, Magda Burger, ID number 521006 0038 080, hereby declare that I have linguistically revised the mini-dissertation *Developing a budgetary control framework for a multinational company using Industry 4.0 technologies* for student A van Wyk.

Yours sincerely

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