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ENVIRONMENT

POSTGRADUATE SCHOOL OF ENGINEERING MANAGEMENT

**The importance of post-mortems in construction projects**

by

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For a minor dissertation in partial fulfillment for the degree

Magister Philosophiae

in

Engineering Management

At

THE UNIVERSITY OF JOHANNESBURG

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## DECLARATION

I Gavin Motswadi hereby declare that the minor dissertation submitted for the Engineering Management Masters' degree to the University of Johannesburg, apart from the help recognized, is my own work and has not previously been submitted to another university or institution of higher education for a degree.

Signed \_\_\_\_\_ Date \_\_\_\_\_

## STATEMENT 1

This dissertation is being submitted in partial fulfilment of the requirements for the degree of Masters in Engineering Management at the University of Johannesburg.

Signed \_\_\_\_\_ Date \_\_\_\_\_

## STATEMENT 2

The findings on this dissertation are the result of my own independent work and investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references.

Signed \_\_\_\_\_ Date \_\_\_\_\_

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## ABBREVIATIONS:

BIM	:	Building Information Modelling
IT	:	Information Technology
OL	:	Organisational Learning
SACPCMP	:	South African Council for the Project and Construction Management Professions
UK	:	United Kingdom



## **ABSTRACT**

Organisations in the construction industry are frequently faced with the challenges of not achieving the set targets with reference to late project completions, exceeding the budget and undesirable quality of work due to poor workmanship. By including post-mortems as best practice, organizations are likely to mature as they can make considered decisions and further enhance the management of future projects.

The purpose of this research is to identify the key factors of effective and successful project post mortems that organisations in the construction industry can implement in management of future projects. The research further aims to identify the benefits these organisations can gain from the project post-mortems. The research scope is limited to organisations executing construction projects in Gauteng, South Africa.

This research adopted a quantitative research approach using a structured close-ended questionnaire as a data source. The target population of the research was 150 consisting of various stakeholders with experience in the construction projects such as project managers, construction managers, project engineers, construction supervisors. The 93 research sample participants for the questionnaire were randomly selected through the South African Council for the Project and Construction Management Professions (SACPCMP) database. The research quantitative data was collected and analysed using an online Google Form survey tool. Cronbach's coefficient was used to measure the internal consistency of the research questionnaire.

Chapter 4 discussed the analysis of the information obtained from the research questionnaire which included identification of the key factors and benefits of successful and effective project post mortems. The key factors were broken down into two categories, People aspects and Systems aspects. The research results suggest that though project mortem is a beneficial tool for organisations to review their projects, there is challenge with the clear procedures on how to conduct project review meetings or workshops and a lack of drive or instruments to employ lessons learned from past experiences.

# CHAPTER 1 : INTRODUCTION

## 1.1 Introduction

This research investigates the importance of conducting project post mortems, with the specific focus in construction industry in Gauteng Province, South Africa. The research objective is to identify the key factors of a successful and effective project post mortems for organisations in the construction industry. Further, the research aims at identifying the benefits organisations can gain from successful project post mortems. The results obtained could then be used by organisations in effecting successful project post mortems.

Chapter 1 introduces the research topic. Previous and recent literature on similar research will be assessed and investigated. It presents the background to the research, research problem, research questions, objectives, the significance and scope of the research.

## 1.2 Background to the Research

Project management is an important and advanced practice pursued by organisations in managing projects within the construction industry (Sanjuan and Froese, 2013). Many organisations perceive project management as a vital tool which has an effect on the organisation's performance, profitability and competitiveness (Maluleke and Marnewick, 2012). Literature by Chron er and Backlund (2015) emphasise the importance of learning in project-based organisations as a way an organisation sustains and enhances its ability to compete successfully with other organisations.

Jugdev (2012) noted that projects consist of different, interrelated activities including the challenges of performance, contractual matters and staff turnover among others. Project-based construction organisations are dependent on the high-level of skill or knowledge of their engineers and their capacity to adapt to high-levels of complicated matters in a project (Fuller, Dainty, Thorpe and Torpy, 2009; Takhravanchi and Pathirage, 2015). There is a need for skilled workforce in the construction industry, particularly advancing countries, to drive and manage the project to ensure successful completion thereof (Callistus and Clinton, 2016).

According to Demirkesen and Ozorhon (2017) construction project performance is dependent on several aspects of project management. Integration management is one of the crucial aspects as successful project management practices begin with merging humans and a series of actions to be taken to achieve the required results. Therefore, efficient handling of lessons learned is important in a construction industry. For the reasons that obtaining, distributing and using information in a construction is important, effective handling of such information is regarded as critical components that assist organisations in achieving positive results (Ozorhon, Karatas and Demirkesen, 2014). Organizations use most known methods like post-mortems, post-project reviews, project debriefings and lessons learned discussions for reviewing and analysing the project performance (Chirumalla, 2016).

By including post-mortems as the best practice, organizations mature as they are able to make considered decisions and enhance the arrangement or overseeing of future projects (Maluleke and Marnewick, 2012). Post-mortems involve sharing of information on some of the areas in a project that were successfully completed according to plan, areas of improvement and methods of addressing the challenges identified before embarking on next project (Jugdev, 2012).

Maluleke and Marnewick (2012) emphasise that post-mortems in projects are an important process by which organisations learn new things and capture the findings from that specific project. Findings by Vergopia (2008) suggest that organisation often neglect post-mortem analysis after project completion for different reasons, justified as not having sufficient time for post-mortems and a lack of support from top management. Stenholm, Landahl and Bergsjö (2014) share the same view as Vergopia (2008) and further highlighted the challenges of organisations not making time for post-mortems sessions due to work overload as one of the contributory factors.

Studies by several scholars highlight the importance of handling information and resources efficiently within an organization and noted difference between tacit and explicit knowledge (Williams, 2008; Fuller, 2011; Wibowo and Waluyo, 2015; Takhravanchi, 2017). Tacit knowledge noted as an individual's knowledge based on their expertise, insight, experience and ability to make valuable opinions or good decisions. This type of knowledge is difficult to be expressed in a concise manner and

transfer from one person to another person by means of writing it down or verbalising it. Explicit knowledge, being the opposite, is defined as knowledge that can be conveyed in words, symbols and numbers and can be easily transmitted to others.

With reference to the above-mentioned two types of knowledge, it becomes difficult for organisations to capture some of the lessons learned in a project if they are solely dependent on the expertise of some of the team members based on the lessons they learnt over the years on previous projects (Terzieva, 2016). Ozorhon, Karatas and Demirkesen (2014) further noted that for the fact that every construction project has its own distinctive features, there is a lack of cohesion with regards to the flow of resources such as the workforce, material and data, making it a challenge to follow a specific model for increasing the flow of information in a project and recording of valuable lessons learned.

### **1.3 Overview of Construction Projects**

Construction projects are often faced with the challenges of organisations not achieving the set targets with reference to late project completions, exceeding the budget and undesirable quality of work due to poor workmanship (Rui, Ismail and Hussaini, 2015). The global financial challenges have encouraged numerous organizations to investigate the possibilities of improving the delivery of their products and services. This pattern has become visible in the construction industry with the clients requiring efficient management of projects and service provided, in order to meet the set project objectives (Irani and Kamal, 2014).

According to Horta and Camanho (2014) the construction industry has over the past few years had a significant impact in the economic growth for both developing and developed countries. Motlhatlhedhi and Nel (2019) highlight that the construction industry is one of the sectors that has a significant contribution towards the economic growth of many countries across the world, including South Africa. The construction industry has experienced considerable changes due to globalization, innovative advancement and expanded regulation which promoted competition among various organizations within the construction environment.

Wibowo and Waluyo (2015) emphasise that organisations must be able to expand and compete against other construction organisations, form new business avenues and

improve its ways of conducting business. Past research concentrated on the lesson learned based on project management framework, with less research been done defined to construction organizations (Carrillo, Ruiker and Fuller, 2013). The construction industry is a learning-based industry where most of the organisational's learnings are created in projects (Ferrada, Núñez, Neyem and Serpell, 2016), hence, the effective handling of information in projects is equally important for organizations conducting projects in a construction environment (Eken, Bilgin, Dikmen and Bigonul, 2015).

Leal, Cunha and Couto (2017) suggest that construction projects are generally treated as special projects and lasts for only a limited duration, implying that the construction team members in various disciplines are only required for that limited duration. The authors further highlight out the importance of gathering data about the projects' events, results and the measures put in place including their effectiveness. The gathered data is then to be used as the available lesson learned for future projects.

Several scholars examined the challenges associated with effective handling of information in a construction project context and these include the absence of senior management support, the nature of limited duration allocated for the projects and project team members (Kameraho, 2015). A disconnection of flow of knowledge between team members, failure to retain the lesson learned, the absence of standard procedures between the distinctive organisations in a project as well as the challenge of team members being hesitant to share the lessons learned due to defensive behaviours, are some of the contributory factors (Carrillo *et al.*, 2013).

Chronéer and Backlund (2015) similarly agreed that even though scholars have throughout the years drawn special attention to the significance of managing and supporting the processes of acquiring knowledge through experience in project-based environment, it still remains a challenge.

#### **1.4 Post-Mortem in Context**

Project management in construction projects includes organised and un-organised processes and practices through which the project team members acquire knowledge or skills on and from the project (Jugdev, 2012). According to Wei and Miraglia (2017) information or skills acquired through experience is a critical asset for an organisation. The manner in which the information or skills are disseminated and used, supports the

ability of an organization to continuously be more successful than its competitors (Oyemomi, Liu, Neaga, Chen and Nakpodia, 2018).

For organisations in the construction environment to improve in future projects, it is important to conduct post-mortems from the old projects with the main purpose of analysing if the organisations met its goals (McAvoy, 2006; Khuzaimah and Hassan, 2012). Equivalent and familiar terms used for post-mortems are known as project reviews, lessons learned, project completion audits, project assessments, appraisals, project debriefings and post-implementation assessments (Taniguchi and Onosato, 2018).

Research conducted by Maluleke and Marnewick (2012) suggests post-mortem is an important instrument used by organisations in Information Technology (IT) industries to obtain knowledge from previous projects and perform better in future projects. A post-mortem in a project is a process conducted once the project is concluded with the aim of identifying and assessing all aspects of the projects that went according to plan as well as aspects that did not as planned.

According to Welding (2013) assessment of a project generally uncovers shortcomings in the accompanying three areas: poor task definition, inadequate project support or disorganized project management. The author further emphasises that when running project assessment, it is imperative to set up a common understanding from all members that post-mortem process is a participative problem-solving process. A standard procedure to be followed throughout the process is set-up upfront where the emphasis is on issues and not individuals, censoring is possibly welcome only if an alternative or effective solution is presented.

The Project Management Institute (2013:5) refers to the post-mortem process as lessons learned whereby the information obtained during the construction project can assist organisations to perform better in forth-coming projects by drawing lessons from how activities were handled and resolved, or how the activities should be resolved.

Figure 1 illustrates that a formal assessment of the project is conducted in each phase of the project, from phase 1 (Initiation), phase 2 (Planning), phase 3 (Implementation) through until phase 4 (Close-out). Thereafter, post-mortem review is conducted for the overall project (Taniguchi and Onosato, 2018). This process is usually led by independent authorities external to the organisation.

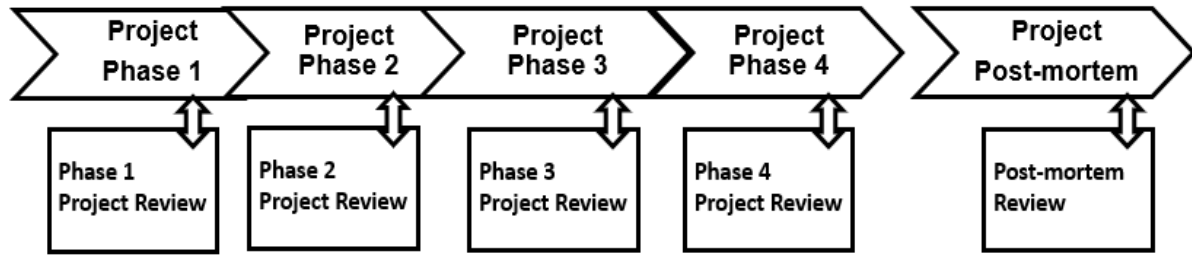


Figure 1: Project Review-phases and Post-mortem (Taniguchi and Onosato,2018: 4)

A typical method of recognising improvements in construction projects is through an exercise of lessons learned (Carrillo *et al.*, 2013). Welding (2013) suggests that sharing of information from previous projects to current and future projects are perceived as having a positive impact with broad information for improving how activities are executed in a project.

According to Love, Teo, Davidson Cumming and Morrison (2016) lessons learned add significant contribution to the organisation when they are considered integral part of the organisation's continuous learning process. The lessons learned ought to be recorded, shared and archived throughout the project from the inception phase to the close-out phase as this can empower an organisation to increase its ability to recognise the value of new information, assimilating and applying the knowledge.

Lessons learned process changes perceptions to lessons recognized and lastly to lessons learned and implemented (Andersson, Dennis; Eriksson, 2015). As illustrated in Figure 2, the process involves the gathering of information, investigation, and execution of operational experiences whereby the need for experiences is defined in the planning/direction phase and a decision is taken concerning the prioritisation of collection resources.



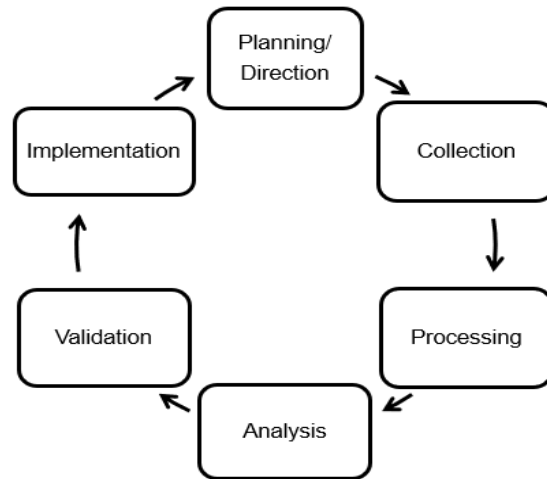


Figure 2: The Lessons Learned Process (Andersson, 2015:4)

Distinctive techniques are used to compile the lessons learned in the collection phase, then processed, analysed and validated. Finally, the lessons ought to be implemented and implementation constantly followed up (Andersson, Dennis; Eriksson, 2015). Irrespective of the lessons learned processes being prominent, it has been unsuccessful in conveying the expected results due to the fact that as the lessons are noted, they are generally not being followed throughout the entire organisation (Duffield and Whitty, 2015).

Carrillo *et al.*, (2008) conducted research on the application of post-mortem analysis in the United Kingdom (UK) construction industry and emphasised that post-mortems can yield the desirable and undesirable outcome, however, either one of them should influence the organisation's learning. Construction industry usually experiences challenges with sharing of information and learning within projects as well as from project to project. Post-mortems are seldom carried out and when carried out is normally time of pointing fingers (Hackett, 2017).

Elkaffas and Wagih (2013) emphasise that few organisations do not capture the lesson learned from completed projects mainly due to the fact that employees are not willing to attach their names and signatures on the documents, particularly in cases where it is noted that the lessons learned are from activities that were executed incorrectly or there were deviations; as well as from an unsuccessful project. Although several employees acquire knowledge and skills from the mistakes they have committed

previously, the same mistakes are implemented by other fellow employees due to the fact that they are not recorded and shared with other fellow employees.

Taniguchi and Onosato (2018) noted that though organisations achieve to record the lessons learned from projects, the challenge still remains with the process of transferring and distributing the information within an organisation. The arrangement, planning and development of infrastructure construction usually include complicated and several distinct activities that require inputs relating to specialised and non-specialised type work, which can be difficult to manage at times requiring a lot of time and effort (Babalola, Ibem and Ezema, 2019).

Literature review by Stenholm, Landahl and Bergsjö (2014) indicate that scholars recommend that project post mortems be conducted at the end of the construction project to enable the transfer of the lesson learned into the organisation. The authors further note the following challenges that contributes to ineffectiveness of post-mortem process:

- Only conducting post-mortems at completion of construction project when most of the information or lessons learned were not recorded and irretrievable.
- Only the project leader recorded the lessons learned.
- No valuable information was provided.
- Records of results cannot be reached.

The manner in which organisations conduct their daily business presents a threat to sharing of lessons learned within the organisation as it has the ability to affect the project team's choices if they need to exchange or transfer the lessons learned in a project (Wei and Miraglia, 2017). However, Rahman, Endut, Faisal and Soleyman (2014) highlighted the importance of information sharing and improved communication among project team members as some of the crucial factors that require continuous evaluation for construction projects to be successful.

Takhtravanchi (2017) emphasises the main challenge of project post mortem as the process not providing ways of capturing information as the project progresses. In addition, the process does not explain how the generated and captured information should be shared and utilised in new projects. Considering that the users of the captured and generated new knowledge will be in future projects and not current

project, they are often hesitant to participate in activities that lead to the analysis and judgment processes.

### **1.5 Problem Statement**

Over the past years, construction projects' sequence of events has turned out to be more complicated, constantly changing and having an effect on other events. Project managers are continually expected to make quick decisions within a short space of time. Lessons learned, are therefore, identified as a significant factor contributing to leadership and improving the competitive advantage of organisations undertaking projects (Kanapeckiene, Kaklauskas, Zavaddskas and Seniut, 2010).

The construction industry plays an important role in the economic growth of a large number of organisations and the projects carried out have a significant environmental and social effect (Opoku and Fortune, 2011). The authors further highlight the need for sustainable change in the construction industry and the capability of construction organisations to adapt to such changes as part of the process whereby organisations acquire knowledge from previous projects.

Previous research has indicated that at least 85% of project team members working on a project accumulate new information and skills through experience, emphasising the importance of organisational learning and acquiring new knowledge as the success of projects is assessed based on performance and project learning (Lj, Petrovi, Mihi and Bushuyev, 2015). It is therefore critical for organisations running projects in the construction industry to adopt an effective lesson learned processes from which it can learn and improve in future projects. Well established and financially stable organisations ought to gain from past choices to implement lessons learned in their decision-making process for other projects to be executed at a later stage (Vignos, 2014).

### **1.6 Research Questions**

The research aims at addressing the following questions:

- What are the key factors of an effective and successful project post mortem process for organisations in the construction industry?
- What are the benefits of a successful project post mortem?

## **1.7 Research Objectives**

The objectives of this research are as follows:

- To identify the key factors of an effective and successful project post mortem for organisations in construction environment.
- To identify the benefits of a successful project post-mortem.

## **1.8 Significance of Research**

Literature from previous research provides important learnings that can be used by engineering organizations to improve in future construction projects. The Project Management Institute (PMI) (Baxter, Hastings, Law and Glass, 2008; Taniguchi and Onosato, 2018) emphasises the significance of gathering and recording the project post-mortem learnings, to enable the organisation to improve in future projects.

This research will assist in identifying the key factors of an effective and successful project post mortem that organisations in the construction environment can use in their construction projects as well as the benefits these organisations can gain from the post-mortems. Thus ultimately, improving in future projects by implementing the knowledge acquired from the lessons learned.

## **1.9 Scope and Content of the Research**

The outline of this study is structured as follows:

### **Chapter 1: Introduction**

Chapter 1 is an introductory chapter covering the research background and problem statement. The objectives of the study are discussed in this chapter.

### **Chapter 2: Literature Review**

A thorough assessment of previous and recent literature relevant to this research topic is carried out.

### **Chapter 3: Research Methodology**

In this chapter, an assessment of different research methodologies, approaches and the application thereof, will be conducted. This will assist with the selection of the correct research design suitable for this research topic.

### **Chapter 4: Data Collection and Analysis**

This chapter entails the collection of data, analyzing and evaluation of the collected data as well as the findings of the research to reach a conclusion.

### **Chapter 5: Conclusions and Recommendations**

Chapter 5 will present conclusion from the research as well as suggestions for future studies.

#### **1.10 Summary**

This chapter introduced the research topic and highlighted the research background, research problem, research aim and objectives. The chapter further provided an overview of the scope of this research and outlined the structure of the report. It was noted that the construction industry is a learning-based industry where most of the organisational learnings are created in projects, thus requiring organisations to find areas where they need to improve as part of its learning process before embarking on other projects.

In line with the objectives of this research, the next chapter presents a comprehensive literature review on project post-mortems in a construction industry including the characteristics, challenges and benefits associated with the post mortems processes to understand the effects thereof with regards to developing organisational learning.

## **CHAPTER 2 : LITERATURE REVIEW**

### **2.1 Introduction**

This chapter provides an overview of the literature for this research that includes the general phases of project post-mortems, particularly within the construction industry. The typical features and analysis of post-mortems will be presented. Previous and recent literature related to the purpose of project post-mortems in a construction industry will be examined with the intension of obtaining background and understanding the effect of lesson learned in projects with regards to organisational learning.

The chapter will further discuss the process followed for conducting project post-mortems. The challenges with post-mortems in construction projects will also be discussed.

### **2.2 Post Mortems and Organisational Learning**

Previous research has been conducted relating to the same subject with an effort to understand the phenomenon of project post-mortem in the construction industry. Taniguchi and Onosato (2018), highlight familiar terms used for project post-mortems known as project reviews, lessons learned, project completion audits, project assessments, project appraisals, project de-briefings and post-implementation assessments.

Research by Chirumalla (2016) defines project post mortem as knowledge obtained from the experience in a project. Experience can provide either desirable or unpleasant results. Irrespective of whether the results are desirable or unpleasant, Grover and Froese (2016) indicate that knowledge is a crucial resource for an organisation and it is therefore critical that an organisation endeavours to record and reuse the knowledge obtained for continuous improvement of its processes. The authors further highlight the low levels of efficiency challenges faced by the construction industry relating to a lack of knowledge management and having the same mistakes being repeated in projects.

Duffield and Whitty (2015) emphasise that in most cases projects undertaken by organisations are unsuccessful because of the absence of lessons learned among the

people who are part of the project and due to no exchange of information happening. The authors further note that knowledge management instruments and strategies can be utilised to convey possible risks among individuals of a project team. Thus, it is crucial for an organisation to be in control of its risk management process which requires recognition, dissemination and utilisation of lessons learnt associated with the potential project risks to assist with the forecasting and management of risks.

The construction industry is a learning-based industry where the majority of the organisational learnings are created in projects (Ferrada *et al.*, 2016), which makes effective handling of knowledge obtained in projects an important aspect for organisations in a construction environment. The authors indicated the following as the main drivers that prompted organisations to conduct project post-mortems:

- To acquire knowledge and skills from completed and past projects with the aim of not implementing the same mistakes in future.
- To ensure that the positive results achieved in current projects are implemented and repeated in future projects.
- To stay ahead of its competitors.
- To avoid the loss of key skills and professionals.
- To encourage creativity.

Several scholars agree that project post mortem is an important aspect for organisational learning throughout all phases in project management and noted various challenges that organisations are faced with concerning the implementation or application of post-mortem in its projects (Duffield and Whitty, 2015; McClory, Read and Labib, 2017) . Research conducted by Eken *et al.* (2015) suggests that projects are complex due to the fact they are formed by people with different skill set, different school of thought, substantial dependence on past experiences, special tasks, less time to complete and constrained spending plans, and making the handling of information a challenging task to deal with. However, controlling and capturing of knowledge are crucial for organisations as the project success is dependent on the organisation's ability to excel and acquire knowledge from the completed project (Todorovic, Petrovic, Mihić, Obradović and Bushuyev, 2015).

Research by McClory, Read and Labib (2017) indicate that the post-mortem process is meant to accurately record project performance, project achievements, under-performances and integrate them as part of learnings to be used by an organisation for upcoming projects. The authors further note that even though the lessons learned are often recognized, accurate recording and classification of those lessons learned become a challenge due to unavailable time and procedures, while their application on upcoming projects seems to be restricted.

### **2.3 Challenges with Post Mortem Process**

Duffield (2017) notes that although organisations are following the post-mortem process, the challenge is to obtain support and participation from the workforce to re-use the information gained from the post-mortem sessions. Various studies highlight the challenges with regards to the processes followed by organisations for capturing of information to promote learning and exchange of information to other future projects and within the organisation as a whole (Todorovic *et al.*, 2015; Pettiway and Lyytinen, 2017; Taniguchi and Onosato, 2018). The studies indicate the following as the challenges encountered for controlling and handling of information in a project:

- Lack of procedures that can be followed regularly and other forms of promoting learning, including the absence of lessons learned and records from passed completed projects;
- Records of how the project performed relative to the organisation's procedures as organisations struggle to reflect on the course of strategies and activities, making the practice and implementation of such procedures questionable;
- The absence of productive and constructive estimates, insufficient correspondence and transfer of information, lack of using the lesson learned from past experiences.
- Due to the uniqueness of projects and their long-life cycle, hence, the challenges with the recovery of lessons learned after a long time, whereas projects require new project team gatherings for each project.
- Although people become progressively capable and experienced, there is frequently no instrument or drive for that learning to be shared inside the organisation.



- In-consistency between short-term objectives and long-term objectives of organisational learning, where the control of information relies upon the level of the organisation's project maturity.

Despite the challenges, knowledge management should be a key part of an organisation's strategic objectives. Work by Chirumalla (2016) note that the manner in which the organisation is structured and conducting its daily business activities are key elements to gathering and spreading lessons learned within or across the entire organisation. The organisation's procedures require built-in feedback loops to evaluate how they perform and to make sure that lessons learned are promptly attainable by its employees as and when required.

It can also be noted from literature that effective handling of knowledge management can lead to improved organisational performance and organisation having the leverage of competing successfully with its competitors. Research by Jin-Feng, Ming-Yan, Li-Jie and Jun-Ju (2017) emphasise that securing, exchanging, sharing and managing knowledge has become one of the crucial elements in today's business ventures to acknowledge innovation and compete successfully.

#### **2.4 Types of Knowledge**

Literature review indicate two types of knowledge, namely explicit knowledge and tacit knowledge respectively. Explicit knowledge is defined as knowledge that is arranged and stored in a logical order that people can follow in the form of data, figures, specifications and manuals. It can be effectively exchanged among people at all levels in an organisation. Tacit knowledge is on the other hand, not easy to arrange in a logical manner and challenging to pass on from one person to the other. Tacit knowledge is profoundly established in people's actions, mentalities, principles, qualities and emotions (Zhang and Chen, 2016). The authors further note that it is important that there is a connection between tacit and explicit knowledge as it enhances the creation of knowledge which could benefit an organisation.

Ganiyu, Egbu and Cidik (2018) note that the conversion of tacit knowledge to explicit knowledge can be accomplished through the four processes, namely Socialisation, Externalisation, Combination and Internalisation as depicted in Figure 3.

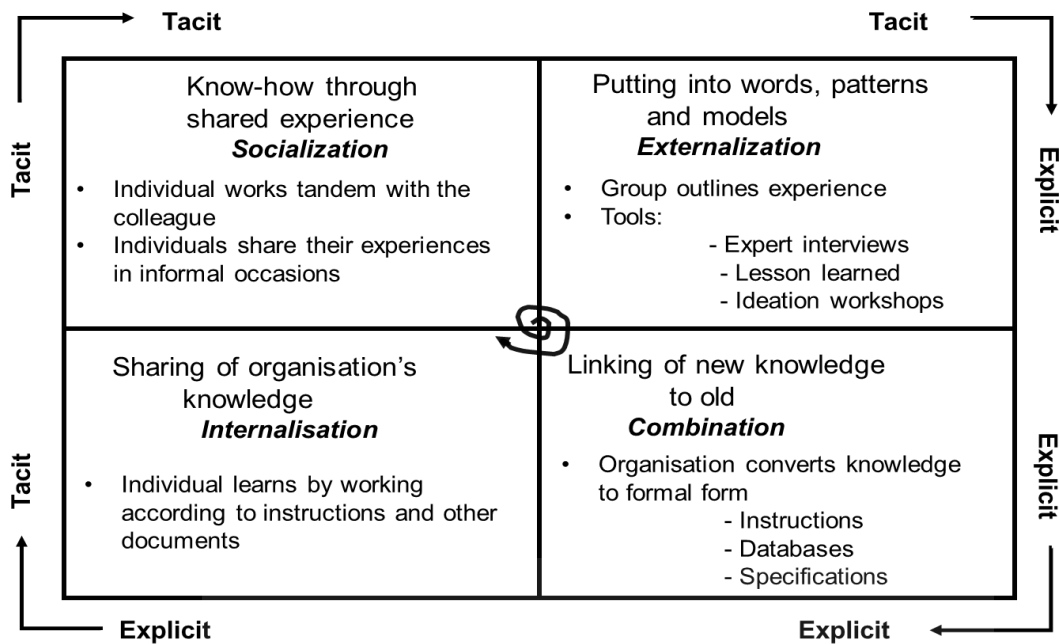


Figure 3: Organisational Knowledge Conversion Cycle (Ganiyu, Egbu and Cidik, 2018: 6; Khuzaimah and Hassan, 2012: 345)

The fundamental purpose of the organisational knowledge conversion cycle is to show the differences between tacit knowledge (personal) and explicit knowledge. Socialisation is defined as a process whereby individuals share tacit knowledge amongst themselves from their experiences, Externalisation noted as a process of converting tacit knowledge into explicit via lessons learned, interviews and ideation workshops. Combination is a process of converting explicit knowledge into formal formats such as instructions, databases, specifications, while internalisation process is used to build tacit knowledge from explicit knowledge when individual in an organisation acquire knowledge by working according to the developed procedures (Ganiyu *et al.*, 2018; Córdova and Gutiérrez, 2018).

Grover and Froese (2016) agree that the standard practice in construction projects is to record the lessons learned through project post-mortems at the end of the project. However, project post-mortems are held very late after the project is completed and at that time majority of the project team members have left and moved on to other projects. Hence insufficient time is committed to the post mortem reviews and consequently this process becomes just a formality where tacit knowledge is not recorded from the individuals who left at the end of the project.

Mtsweni and Maveterra (2018) established various facts that have an effect on implementation of tacit knowledge within the software development projects in Republic of South Africa; presented in Figure 4:

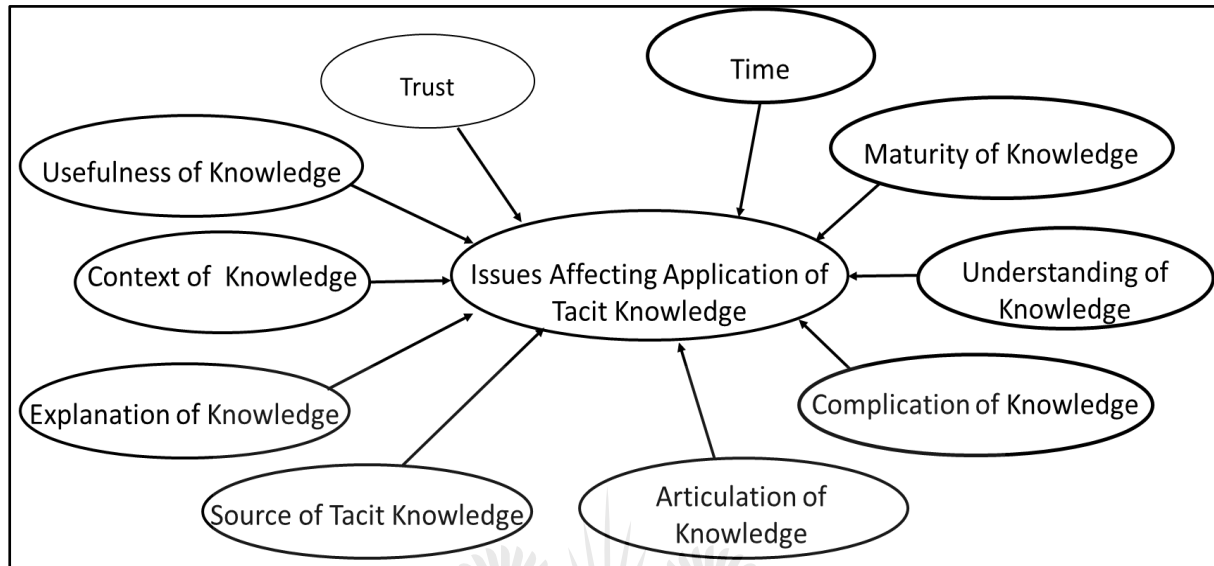


Figure 4: Issues Affecting Application of Tacit Knowledge Sharing (Mtsweni and Maveterra, 2018: 847)

The authors explain the impact of each factor on the application of tacit knowledge based on a series of questionnaires/interviews conducted as follows:

**a. Lack of trust**

The people who partook in the questionnaires/interviews highlighted that they could not utilise the knowledge shared with them due to the lack of trust from the person who shared the information with them. Secondly, it is important for individuals to be have trust in their individual tacit knowledge before sharing it with others. Trust makes a connection among the project team members in an organisation for tacit knowledge to be shared; however, in many organisations trust is broken where some of individuals assume credit without recognizing the source of the information (Mohajan, 2017).

Project teams require more trust in light of their mutual reliant tasks and since the reliance of project teams on one another is high for performing their tasks, it makes trust important (Buvik and Tvedt, 2017). According to Nesheim and Hunskaar (2015) when the relationships between the project team members

has a high level of trust, more individuals are prepared to give, listen to and take great interest in another individual's knowledge in contrast to the relationships with a low degree of trust. Kameraho (2015) emphasises the importance of partnerships in a project environment which promotes collective learning and information sharing during the project execution phase by improving cultural values and beliefs that support trust, permitting discretion and experimentation, and causing an environment in which individuals feel comfortable working together and sharing knowledge with all the stakeholders.

**b. Lack of time**

Research by Bellini (2016) suggests that time constraint in projects is one of the contributory factors to the transfer and application of knowledge, whereby, the project team members do not have time during the execution of the project and at the end of the project to capture, store and transfer knowledge. In addition, project team members do not have time to avail knowledge, to impart it to other people, to educate and guide others, or to utilise their knowledge information and introduce new ideas (Mohajan, 2017).

**c. Maturity of tacit knowledge**

According to Wibowo and Waluyo (2015) the maturity of knowledge management identifies the quality and adequacy of knowledge management processes in an organisation. The knowledge available should exist for long periods of time and utilised to have an effect on the maturity of tacit knowledge. The quality and maturity of tacit knowledge will lead to increased confidence that the knowledge will bring positive outcomes thus resulting in better application of tacit knowledge (Mtsweni and Maveterra, 2018).

**d. Understanding tacit knowledge**

Understanding tacit knowledge was noted as having an effect on the application of tacit knowledge for the reasons that individuals could not apply specific knowledge as they did not good understanding of how it should be used. A need for demonstration how the information should be applied was found to be critical. Khuzaimah and Hassan (2012) are of the view that since tacit knowledge is not easy to be shared with others through the proper processes

of learning and techniques connected with explicit knowledge, tacit knowledge can be uncovered through social interaction between team members. The only question that remains is to find the right strategy or technique to use to uncover tacit knowledge and simultaneously encourage the process of information sharing.

**e. Complication of tacit knowledge**

Complication of tacit knowledge refers to the project team members not being able to utilise tacit knowledge and regarded as complicated since it is not officially documented and belonged to someone else. Jin-feng, Ming-yan, Li-jie and Jun-ju (2017) note that tacit knowledge owned by individuals is part of their self-esteem and personality which can help these individuals to have a competitive advantage, widespread respect and admiration felt for them in the organisation. However, the authors emphasise that through a positive incentive system, an environment where individuals are willing to share their information with others can be promoted.

**f. Articulation of tacit knowledge**

Articulation of tacit knowledge refers to the sharing and conversation of individual knowledge and skill during project meetings or information sharing/feedback meetings by which the individuals in an organisation can accomplish an improved level of understanding the processes mediating between the activities required to execute a specific task and the delivered results (Ekrot, Kock and Georg, 2016). In many cases the team members could not utilise tacit knowledge due to the fact that they could not understand where it from. Knowing where and how the knowledge was formed could assist in checking its accuracy and assessing it.

#### **g. Source of tacit knowledge**

Jin-Feng *et al.*, (2017) emphasise that members and the individuals in an organisation are the bearers and conveyors of knowledge. Furthermore, they serve as a stream of information for change and management in an organisation.

It can be noted that the source of tacit knowledge is similar to the articulation of tacit knowledge as knowledge could only be used once the originator of the knowledge confirms that the information is useful. In some cases, tacit knowledge could not be utilised by senior team members as it was coming from a junior team member who was unable to confirm that the knowledge is worth using due to lack of confidence (Mtsweni and Maveterra, 2018).

#### **h. Explanation of tacit knowledge**

According to Schindler (2015) professional experience and a high level of knowledge are considered to depend on tacit knowledge whereby the individual experts can naturally conduct some activities but are incapable of articulating the information utilised in such activities. In some cases, it was noted individuals could not use the knowledge obtained from others due to lack of explanation and understanding of the knowledge.

#### **i. Context of tacit knowledge**

Context of tacit knowledge refers to the correct use of knowledge applicable to a specific environment. Team members could not apply any knowledge obtained from other previous projects as it was regarded as unsuitable for the specific project and would not bring any positive outcomes. It is important for team members to have the ability to differentiate between various environments and apply the relevant knowledge suitable for that environment. Basten and Haamann (2018) emphasise the importance of having cross-functional teams that can be utilised for transferring any learning or knowledge when compared to having a single functional unit. Cross-functional teams make it possible for organisations to have a pool of diverse expertise from different units to achieve difficult interconnected activities as a team.

## **j. Usefulness of tacit knowledge**

Tacit knowledge is a critical source of an organisation's ability to maintain its competitive advantage over a period of time due to the fact it is challenging for its competitors to copy it (Cha, Kim, Park and Lee, 2015).

Studies by McClory, Read and Labib (2017) suggest that both organisational learning and knowledge management should form part of the main elements considered by organisations in their project process from initiation to close-out. The two elements are noted as the elements that can assist an organisation in bettering its performance and achievements in terms of managing projects. The purpose of organisational learning is to improve the processes of how an organisation operates and has decision making processes through efficient ways of obtaining relevant knowledge and application thereof (AlMaian and Qammaz, 2019). The authors emphasise that organisations that aim to have effective plans of organisational learning ought to create a culture of management beliefs, attitude and commitment to promote progressive learning and development of new knowledge.

Figure 5 illustrates the Organisational Knowledge Loop where organisational knowledge is maintained as artefacts. Artefacts consist of formal procedures, regulations, that provide information on how new knowledge should be retained for future use (McClory, Read and Labib, 2017). Organisational learning is stored within the knowledge base and for it to be clearly understandable it must be supported by individual learning through doing things differently. Learning is obtained and shown from the output in form of revised or improved procedures and methods through testing and creation of new knowledge.

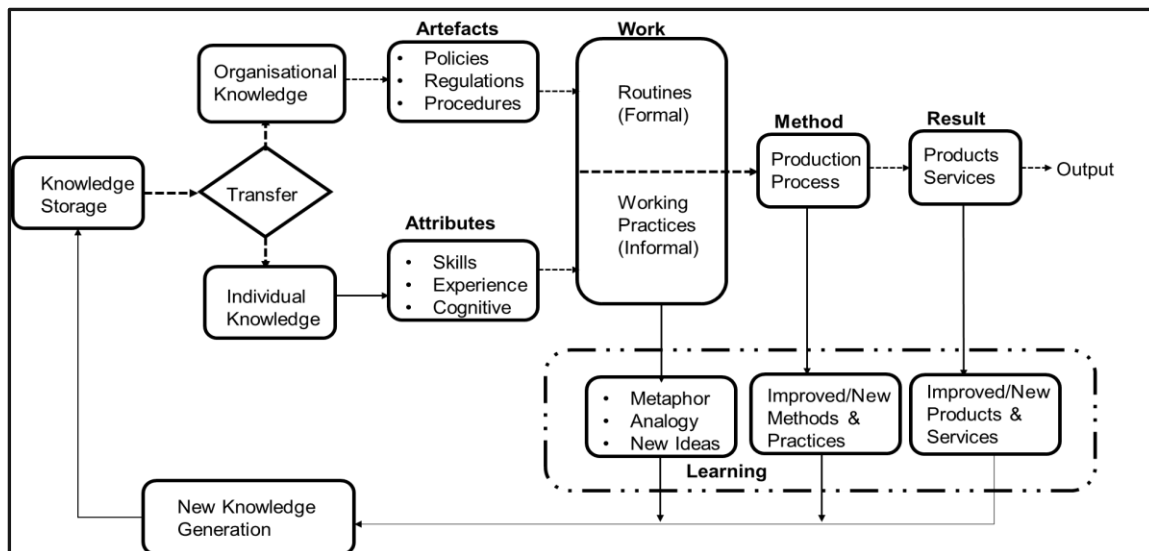


Figure 5: The Organisational Knowledge Loop (McClory, Read and Labib, 2017)

## 2.5 Knowledge Management in the Construction Industry

Several scholars have conducted research and recognized the significance of knowledge management particularly in the construction industry (Wibowo and Waluyo, 2015; Tauriainen, Marttinen, Dave and Koskela, 2016; Aerts, Doms and Haezendonck, 2017). Knowledge plays an important role in the success of organisations, which involves multi-discipline stakeholders (Enshassi, Falouji, Alkilani and Sundermeieri, 2016). Knowledge considers the integration of individuals, procedures and innovation to generate values from the organisation's resources (Saqib, Din and Baluch, 2017). In addition, knowledge management enables the sharing of information within various stakeholders which can fundamentally improve existing relationships or create new ones.

Ahmady, Nikooravesh and Mehrpour (2016) highlight that in today's world, knowledge has been the primary key of competition between several organisations. New organisations have been developed and founded on knowledge which implied that organisations had to be arranged in such a manner that they could identify and know their organisational knowledge, by storing and utilising it when the need arises.

A study by Ganiyu *et al.*, (2018, p.8) emphasises the importance of sharing the knowledge developed through experience in construction projects for better decisions-making based on progressive learning. The author further highlights the Building Information Modelling (BIM) as a possible answer that could assist with the efforts of



recording and sharing of information through the process of encouraging teamwork and continuous learning. However, it can be noted from the study that though BIM is being progressively used in the construction industry as a possible answer to the challenges experienced, the way BIM methods are implemented provides little deliberation on recording of knowledge and taking advantage of the experienced-based knowledge produced in BIM-enhanced projects.

Belay, Torp and Thodesen (2016) mention a few concepts of improving knowledge management methods such as agile project management planning, set-based thinking, iteration management, learning and sharing, as well as building a system integration framework. These concepts were linked to the practical example of constructing a Norwegian E39 ferry-free coastal highway. System thinking and integration are noted as the important factors that can assist in improving knowledge management in typical construction projects. However, the responsibility always remains with the project managers on how they implement system integration in the project to ensure that all the concerned parties acquire reliable and effective knowledge relating to the project.

Knowledge management ought to be viewed as an explicit and methodical process of learning critical issues with regards to creating, capturing, organising, recovering, sharing, exchanging and assessing the body of knowledge and the collective knowledge of individuals by affirming the correctness of information based on information technology and exchange of information so as to expand proficiency, productivity and accomplishing organisational goals (Takhtravanchi, 2017).

Zouari and Dakhli (2018) define knowledge management as a purposeful and deliberate methodology that enables organisations to promote the formation, sharing, application of information, feeding of useful lessons learned and best practices into the organisation stimulating organisational learning. The purpose of knowledge management is to record and disseminate the learning within projects and an organisation before it is lost, for continuous improvement in all project activities. Even though organisations significantly benefit by saving money and time from previous experience through the knowledge management process, the authors highlight the challenges relating to undocumented information which can result in the same organisation losing important knowledge due to the movement of its employees

between projects. Thus, the need arises for organisations to take the responsibility of controlling its knowledge management processes through collection, storing and ensuring the information is available and can be reached by all its employees as and when required.

A further important aspect noted by the authors is that knowledge management is crucial for the organisation's ability to fulfil its objectives and its continued existence in the persistent evolving financial, technological, political and social environment. The authors note the following important four facets for knowledge management: (p.651)

- a. Technological facet;
- b. Human resource facet;
- c. Process facet and;
- d. Context facet.

Knowledge management requires organisations to expand effort on modelling and managing its capabilities as well as the things they are dependent on (Thannhuber, Bruntsch and Tseng, 2017). Knowledge management comprises of different processes known as creating, securing, capturing, co-ordinating, combining, retrieving and distributing of knowledge (Abubakar, Elrehail, Alatailat and Elçi, 2017; Takhravanchi, 2017) . Table 1 shows the characteristics of the four facets for knowledge management systems.

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Table 1: Characteristics of the knowledge management systems four facets (Chouikha Zouari and Dhaou Dakhli, 2018: 651)

Process Facet		People Facet	Context Facet	System/Technology Facet
Task	Process			
Combination	Knowledge Creation	Management involvement, communication, knowledge boundaries management, trust	Collective decision-making problem solving, collaborative documentation, organisational structure, organisational culture	Database and data repositories, tools to build boundary objects, access to information via internet, intranet, knowledge extraction systems.
Socialization	Knowledge Creation	Trust, communication, incentives, knowledge boundaries management, national culture, management involvement	Brainstorming sessions, conferences, face to face meetings, communities of practice, cooperative projects across multiple organizational units, initiation process initiation of new organizational actors, experts, catalogues, storytelling, norms, standards,	Web 2.0 technology (wikis, discussion forums, blogs, virtual chat rooms ...), IT support of communities of practice, videoconferencing tools, tools to build boundary objects, software artefacts, wireless technologies.
Externalization	Knowledge Collection	Trust, communication, training, management involvement, national culture, incentives	Short lists of knowledge items needed to start a project, projects assessment reports, projects systematic documentation, organizational culture, organizational structure	Expert systems, databases, repositories, intranets. Tools
Internalization	Knowledge Collection	Management involvement, communication, incentives, knowledge boundaries management, trust	Face to face meeting, communities of practice, learning by doing or by observing, training, expert catalogues, storytelling, norms, standards, and practices, organizational culture, organizational structure	Tools supporting e-learning, messaging tools, IT support of communities of practice, tools to build boundary objects
Transfer	Knowledge Sharing	Management involvement, communication, incentives, knowledge boundaries management, trust, national culture	Progress reports, notes, presentations, organizational culture, organizational structure, expert catalogues	Groupware, intranets, repositories, databases, access to information via the internet, tools to build boundary objects.
Guidance	Knowledge Application	Trust, communication, incentives.	Hierarchical relationships, organisational structure, support centres, experts, catalogues, assistance service (Help desks)	Decision-making systems, expert systems.
Routine Execution	Knowledge Application	Trust, training	Organisational rules and procedures, heuristics, norms and standards	Management Information Systems, expert systems, Integrated software packages.

The following processes were discussed in detail:

### **a. Knowledge Creation and Capturing Process**

The knowledge management cycle begins with the knowledge creation where people create new ways to improve the proficiency and adequacy of the business process within the organisation itself (Saqib, Din and Baluch, 2017). It is a process whereby knowledge is obtained outside the organisation, then the information is developed and constructed inside the organisation to increase the value of the past knowledge obtained (Kurniawati, Samadhi and Wiratmadja, 2016; Donate and Sánchez de Pablo, 2015). Anagnostakis *et al.* (2016) define knowledge capturing as a method of drawing out knowledge and special skills from highly knowledgeable people.

### **b. Knowledge Sharing**

Adequate synchronisation and integration of collective efforts of individuals in an organisation and sharing of knowledge between themselves are the two critical and mutually related capabilities that enable organisations to improve its competitiveness (Wen and Qiang, 2016; Oyemomi *et al.*, 2018). The authors further emphasise that sharing knowledge is a key organisational capability.

Knowledge sharing encourages consistent improvements in how well the organisation performs its projects; and it is crucial vehicle for development of new ideas. Sharing of knowledge from one project to the other has advantages in minimising loss of time or effort in creating something that already exists (Ekambaram, Sørensen, Bull-Berg and Olsson, 2018).

### **c. Knowledge Storage and Retrieval Process**

Knowledge storage and retrieval are processes of arranging, structuring, grouping, storing, tracking, locating and recovering knowledge that has been obtained or made in a manner that makes it more formalized and reachable with the intention of improving the efficiency and successful utilisation of the organisation's knowledge (Kurniawati, Samadhi and Wiratmadja, 2016).

According to Abubakar *et al.* (2017) the creation of new knowledge is inadequate when there is no system in place to enable the storage and retrieving of

information as and when required. The storage process leads to the development of organisational memory resulting in the existence of information in different formations such as electronic databases, written documents, explicit and tacit knowledge.

#### **d. Knowledge Transfer/Dissemination**

The knowledge dissemination or transfer process is defined as a process whereby information or knowledge is transferred between individuals and groups of people in an organisation through the use of different communication media (Abubakar *et al.*, 2017). Knowledge is transferred and shared to a group of individuals and is accessible by anyone requiring it. Knowledge sharing is essentially a process intended to acquire experience and understanding from other individuals (Razak, Pangil, Zin, Yunus and Asnawi, 2016). The authors further emphasise that it is imperative that knowledge sharing be practised as part of an organisation's planning or strategy implemented to enhance its competitive advantage, improve its efficiency and create human capital with the generation of new ideas and creativity. It is important to share the information with others if there has to be continuous learning in an organisation.

#### **e. Knowledge Application Process**

The knowledge application process is also referred to as the knowledge utilisation or implementation process. The newly created knowledge is introduced, integrated into the organisations processes to resolve day-to-day business matters through understanding of the information available (Shujahat, Sousa, Hussain, Nawaz, Wang and Umer, 2019). Knowledge application incorporates implementing knowledge action, critical thinking and for decision making purposes which can eventually lead to the development of new knowledge creation. The created knowledge is then captured, shared and implemented and it becomes a continuous process (Abubakar *et al.*, 2017).

Decrease in expenses and increase in efficiency are noted as one of the results from effective implementation of knowledge application process. It is important to take advantage of the existing project knowledge available in the construction industry, particularly the tacit knowledge that is within the human minds as it

makes up a significant proportion of the know-how much required towards the accomplishment of improved project execution and an organisation been able to maintain a competitive advantage (Khuzaimah and Hassan, 2012)

## **2.6 Benefits of Conducting an Effective Project Post Mortem**

In spite of lessons learned being critical in ensuring that previous mistakes are not repeated, preventing occurrences of loss of information and gaining knowledge, research does not suggest a reasonable and co-ordinated model to assist project leaders with a plan of action (Darfeuille, 2017). However, beside the challenges of knowledge management in construction projects with regards to capturing, sharing and transferring of information within an organisation, research by Carrillo *et al.* (2010) indicate that post mortem processes have the following benefits:

- Encourage collaborative learning amongst individuals.
- Provide re-use of internal information/knowledge and reduction of errors.
- Provide an advantage to an organisation's customers in different ways.
- Cultivate the improved process of controlling and organising the different phases of a project.
- Provide intervention processes that prevents the occurrence of loss of information and increased process transparency.
- Encourage better communication across departments and with customers, increased quality of products and services.
- Improve teamwork, increased productivity and time-savings in routine work.
- Increase motivation and employee involvement.

The author further emphasises that, despite the undertaking that post-mortems are seen as an extra constraint and that organisations do not have the resources to scrutinise the information or reports, there is no clear reason on why organisations are not exploiting the advantages of project post-mortems.

Progressive and instant knowledge work can possibly support and assist organisations to benefit from all positive viewpoints that related to reusing knowledge. Progressive and instant knowledge work is a mental attitude, a product and a systematic approach that provide support to organisations to manage with the main challenges encountered from working with project post-mortems (Stenholm, Landahl and Bergsjö, 2014).

Bellini, Aarseth and Hosseini (2016) highlight the importance of co-operation between individuals, transparent or open communication and trust as components that facilitate effective knowledge transfer and subsequently lead to organisations achieving success.

Table 2 and 3 illustrates a summary of people and systems related key factors and benefits of successful post-mortem process from the literature review:

Table 2: Summary of key factors and benefits of successful project post-mortems–  
People Aspect

#	Key Factors	Benefits	Authors
1	Common understanding- understanding the importance of sharing information amongst team members and customers	Sharing of specialist expertise. Reduced time to re-act. Cross-collaboration and increased customer relations.	(Vignos, 2014; Banihashemi <i>et al.</i> , 2017 ; Mohajan, 2017)
2	Commitment/willingness to share - knowledge transfer/ Accessibility to Knowledge	Active participation by team members. Teaching other team members who did not participate.	(Bellini, 2016; Enshassi <i>et al.</i> , 2016; Saqib, Din and Baluch, 2017)
3	Co-operation- Learning/Experienced individuals	Quality of work improved and reduction of errors and costs. Collaboration and exchange of ideas – innovation.	(Jugdev, 2012; Chronéer and Backlund, 2015; (Kameraho, 2015; Terzieva, 2016; Takhravanchi, 2017)
4	Trust building between team members	Enhancing organisational efficiency, improved teamwork.	(Enshassi <i>et al.</i> , 2016; Banihashemi <i>et al.</i> , 2017; Buvik and Tvedt, 2017; Saqib, Din and Baluch, 2017)
5	Incentives and rewards	Optimise project team member's efficiency and productivity. Increased morale.	(Bellini, 2016; Pettway and Lyytinen, 2017; Sanz <i>et al.</i> , 2019)
6	Common goals - clearly defined goals and objectives	Shared objectives – settling disagreements	(Alias <i>et al.</i> , 2014; Bellini, Aarseth and Hosseini, 2016)

Table 3: Summary of key factors and benefits of successful project post-mortems – System Aspects

#	Key Factors	Benefits	Authors
1	Knowledge management policies, strategies and tools, best practices for project post-mortems (such as E-learning, online forums/learning management systems)	Continuous learning and improved organisational capability. Improved organisational processes. Reduction of loss of knowledge. Re-use of knowledge.	(Vergopia, 2008; Vignos, 2014; Todorovic <i>et al.</i> , 2015; Córdova and Gutiérrez, 2018; Ganiyu, Egbu and Cidik, 2018)
2	Workshops and meetings- circulation of lessons learnt through workshops, meetings and trainings; learning from mistakes.	Continuous improvement – consolidate what has been learned and it provide time for reflection. Provide closure on the projects.	(Eken <i>et al.</i> , 2015; Taniguchi and Onosato, 2018; Hughes, Rana and Dwivedi, 2019)
3	Procedures and Standards	Implementation of effective information sharing. Integration and best practice formalised in internal policy document.	(Andersson, 2015; Turkulainen <i>et al.</i> , 2015; Bellini, 2016)
4	Knowledge management database	Promotes organisational learning and sharing of information	(Cha, Kim, Park and Lee, 2015; Eken, Bilgin, Dikmen and Birgonul, 2015; Cha <i>et al.</i> , 2015)
5	Lessons Learned	Knowledge retained, transfer of knowledge amongst all stakeholders, re-injection of lessons learned into the existing processes.	(Elkaffas and Wagih, 2013; Love <i>et al.</i> , 2016; McClory, Read and Labib, 2017; Taniguchi and Onosato, 2018)

## 2.7 Summary

An overview of the literature was presented that discusses the value of post mortems, organisational learning and knowledge management with specific focus on the construction industry. The different types of knowledge were presented and the critical activities of knowledge management such as knowledge creation and capturing, knowledge sharing, knowledge storage and retrieval, knowledge transfer/dissemination and knowledge application were discussed. The advantages and disadvantages of project post mortem process were reviewed. The following chapter focuses on the research methodology.



## CHAPTER 3 : RESEARCH METHODOLOGY

### 3.1 Introduction

Chapter 3 provides an overview of the research methodology and design approach considered for the current research. The research methodology is a process that is followed as a guideline throughout the research. According to Takhtravanchi (2017) a research methodology is a procedure considered by the researcher for organising and conducting the research in a logical manner to acquire the most relevant outcomes so as to accomplish the aim of the research.

The chapter further highlights the research design, philosophy, approach, strategies and proposed data analysis that were utilised to accomplish the objective of the study.

### 3.2 Research Questions

The following research questions were developed by the researcher with the aim of addressing the research objectives:

- To identify the key factors of an effective and successful project post mortem for organisations in construction environment.
- To identify the benefits of a successful project post-mortems.

### 3.3 Research Concept

Zefeiti and Mohamad (2015) highlight research design as a crucial link between the hypotheses and arguments that inform the research and experimental information collected. The authors further emphasise that the research design gives guidance for gathering and examining information in a specific study.

This study adopted the “Research Onion” model developed by Saunders, Lewis and Thornhill (2012). The distinctive characteristics to note of this model are its structure that empowers the authors to choose appropriate strategies and approaches through its various layers (Zefeiti and Mohamad, 2015; Takhtravanchi, 2017). Figure 6 presents the research onion model whereby the accompanying six layers – **philosophies,**

**approach to theory development, methodological choice, strategies, time horizons and techniques and procedures** clarify the details of the model.

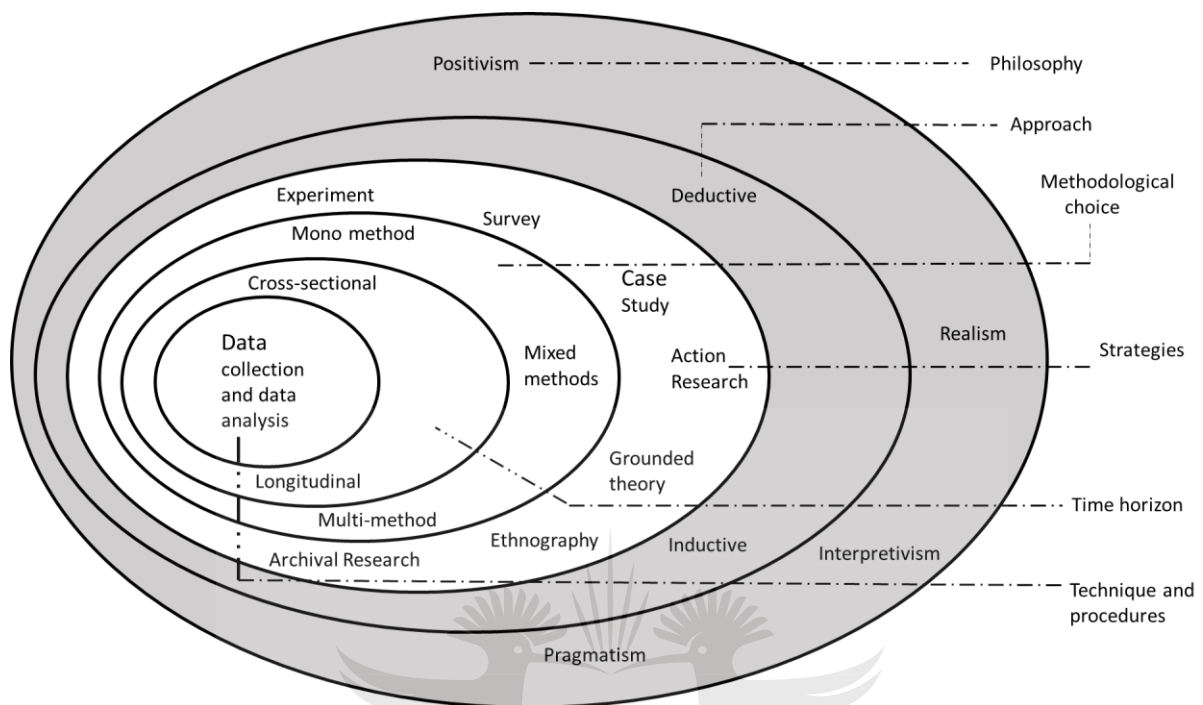


Figure 6: The “Research Onion” Model (Saunders et al., 2012: p.128)

As illustrated in the research onion model, the research process begins from the first/outer layer (**philosophy**) which recognises the philosophy to be chosen and followed for the research (Takhtravanchi, 2017). The process then continues with pulling away various layers of the onion until it arrives at the centre of the onion, which is the sixth layer (**data collection and data analysis**). At this layer, the strategies that should be utilised to collect data are identified respond to the research questions. In this layer, the researcher makes a decision on the content and details of the research questionnaire as well as the sample groups Saunders et al. (2012).

The second layer is the **Approach** which takes into account the research approach to align with the chosen research philosophy (Du Plessis and Pretorius, 2019). **Research Strategy** is the third layer which considers the research procedure most relevant to the study (Rahi, 2017). The research strategy offers different styles of research to gather and analyse data; however, every research style has its benefits and

limitations. **Methodological choice** is the fourth layer in which diverse methodological choices for research are considered of which according to Antwi and Kasim (2015) various methodological choices are impacted by the research philosophy and research approach. Layer five of the research onion (**time horizon**) consists of two-time horizon methods which are cross-sectional and longitudinal (Takhtravanchi, 2017). Cross-sectional method, can be used to conduct a short-time study in which either qualitative and quantitative research can be employed. Longitudinal method can be applied for conducting a long-term study and allows the researcher to use both qualitative and quantitative research methods. However, this method is used to study the behaviour and events with focused samples over a longer time period.

### **3.4 Research Philosophy**

As illustrated in the research onion model, the research process begins from the first/outer layer (**philosophy**) which recognises the philosophy to be chosen and followed for the research. Research philosophy is more about the source, nature and progression of new information as it assists in deciding on the suitable strategy by which a research can be managed (Bilau, Witt and Lill, 2018).

Zefeiti and Mohamad (2015) emphasise that the researcher adopts research philosophy in a particular study to reflect significant assumptions about his/her thoughts and ideas and the way wherein he/she perceives the world. This, in turn, influences the author's strategy with regard to research plan or strategy the author chooses to follow for his/her study.

From literature review, Ontology, Epistemology and Axiology are the three assumptions connected to the research philosophies.

#### **a. Ontology Philosophy**

Ontology philosophy represents the nature of reality and existence. It is regarded as the beginning for most formal discussions on a specific subject between the philosophers and it prompts researchers to enquire about the commitment to certain perspectives and the manner in which the world works (Snyder, 2019).

According to Saunders, Lewis and Thornhill (2012) ontology philosophy consists of two aspects namely Objectivism and Subjectivism. Objectivism aspect has the view that social realities are made through the beliefs and resulting actions of the concerned social actors whereas Subjectivism has the view that social phenomena are made from the observations and responses of social actors such as individuals or interested parties.

In line with the aim of this research with an effort to understand the key factors of an effective and successful project post mortem process for organisations in the construction industry, the input and the views from the stakeholders such as project engineers, project managers and project team members, on the concerned subject is crucial. Thus, the study will rely more on the Subjectivism aspect.

#### **b. Epistemology Philosophy**

Epistemology philosophy is the manner in which learning ought to be gained and responds to the questions: “how we know it” and “what is viewed as satisfactory information”. It is regarded as a way to deal with what information is acceptable with regards to its accuracy, technique and elective methods for accomplishing and imparting the information (Saunders *et. al.*, 2012). The researcher further expresses the view that each philosophy or way of thinking is appropriate for accomplishing diverse research objectives in respect to the research questions, which could seldom be addressed distinctly within one philosophical space.

According to Kankam (2019) positivism can be characterised as self-administering, free and objective presence of truth since it is a research worldview that is established on the ontological guideline and belief that the facts and truth are free and independent of the viewer and observer. Whereas, interpretivism is characterised by the view that there is neither a generally accepted truth nor worldview. Interpretivism researchers further grasp, translate and comprehend from their own orientation reference and perceptions since they hold the view that uncertain and unconcerned impartiality is

impossible. Furthermore, interpretivism asserts that reality is influenced by different factors related to culture, sexual orientation and social values.

There are different ideas or conflicts of these philosophies from different scholars. With regards to the epistemology philosophy, this research will rely more on the Interpretivism philosophy mainly for the reason that the participation and the role of the stakeholders such as construction personnel, project engineers and project managers, is crucial in light of the fact that their experiences, observations and understanding in the construction industry are the main sources of information.

### **c. Axiology Philosophy**

Bilau *et al.* (2018) state that axiology philosophy recognises the researcher's standard of behaviour and justification. The researcher's principles, views and experiences can be communicated through research. Likewise, the researcher can also be better placed in a space where he/she is able to judge the idea of the research fairly – Value Free (Positivism). The researcher's view can also be influenced by the way he/she perceives the world, individual experiences and upbringing – Value Laden (Interpretivism). The axiology philosophy for this study will be more towards the Value Laden-interpretivism.

## **3.5 Research Approach**

According to Naaranoja, Kähkönen and Keinänen (2014) when the researcher is aware of the research model to be utilised and the research questions have been initiated, a research approach can then be selected. The research approach is a crucial part of research as it enables the researcher to meet the specified research objectives.

Generally, many researchers find it useful to differentiate between quantitative or qualitative research approach when coming to the selection of research method (Bell, Bryman and Harley, 2019:35). However, it can be noted that literature classifies three categories of research methods into quantitative, qualitative and mixed-methods (Zefeiti and Mohamad, 2015). Naaranoja *et al.* (2014) emphasise that the quantitative approach make use of measuring data or developing surveys of a sample and

analysing the gathered data by utilising statistical techniques. This approach further involves a deductive approach to the relationship between theory and research whereby special attention is paid to demonstrating that the hypotheses are valid or not.

In contrast, the qualitative research approach is concerned with making practical and reasonable importance of the information gathered and analysed from a given phenomenon through the recognition of words and images used instead of measurements in the formulation of a hypothesis (Bilau, Witt and Lill, 2018). According to Takhravanchi (2017) qualitative research entails an inductive approach in which the theory is created based on the investigation of gathered information. The outstanding feature of this approach is that it is specifically concerned with the phenomenon in which such events occur and under scrutiny to provide better understanding of that phenomenon.

A mixed-method research approach utilises both quantitative and qualitative methods in a specific research topic to collect and analyse information (Zefeiti and Mohamad, 2015). This method is described as a combination of purposeful and probability sampling, open-ended and close-ended data collection strategy. The rationale behind this method is to obtain an increasingly thorough comprehension of a studied model and supplement the shortcoming of the quantitative approach.

This research will adopt a quantitative research method based on the research questions and objective of this study.

### **3.6 Research Strategy**

Research strategy is the third layer of the research onion while time horizon is the fifth layer (Zefeiti and Mohamad, 2015). According to Amaratunga, Haigh and Ingirige (2015) research strategy outlines the manner by which the research is conducted. The research strategy selected and used should not contradict the research questions and should be led by the research aim, objectives and the philosophical approach on which the research is based (Abutabenjeh and Jaradat, 2018; Bilau *et al*, 2018).

Amaratunga *et al.*, (2015) highlight that the decision on the research strategy is directed by the degree of existing information, the amount of time and other resources available. Distinct research strategies can be used to conduct research and this incorporates experiment, case study and surveys amongst others (Bilau *et al.*, 2018).

#### **a. Experiment**

Experimental survey strategies are progressively used in the social sciences to investigate, individual or certain group of individuals' opinions and feelings, standards and fairness judgements (Liebe *et al.*, 2017). According to Tanner (2017) experimental research is attempted when a researcher desires to discover through investigation the cause-and-effect connection between described or characterised factors. The author emphasises that most research experiments involve a number of tests and it is crucial to ensure reliability in management of the experiment.

#### **b. Case study**

Case study is a research method often used in a qualitative research and it assists in an investigation of a situation observed to exist or happen within a specific context through different sources of information (Rashid *et al.*, 2019). According to Dasgupta (2015) in a case study method, a decision must be made between a single and a multiple case design, whereby, a single case study is a suitable design when it speaks to an extremely important case in testing a well-defined hypothesis, or a special case. Multiple case studies provide a more grounded base for theory-building.

#### **c. Survey**

Survey researchers have a few options of survey methods that can be considered for their study such as postal, individual interviews-based, via telephone, online and mixed method and it further investigates the researcher's organisation issues (Tanner, 2017). The author notes that surveys accumulate information that depict and clarify population or sample features, practices, attitudes or thoughts and may be used to indicate in advance the future trends.

According to Nardi (2018) the quantitative method commonly include composing questions for surveys and in-depth interviews, learning to evaluate responses and

factually investigating recorded, historical or researcher's very own information, with the self-managed questionnaire being a typical form of survey used. The author further highlight that questionnaires are especially appropriate for respondent who can read, for estimating individual's attitude and views, for getting a countless number of respondents that is not easy to deal with and taking a lot time to observe with qualitative methods. A survey may merge one or more validated components with any number of particular new questions that provide more important data to the researcher (Shankar *et al.*, 2018).

Moy and Murphy (2016) emphasise that survey researchers who depend on closed-ended questions makes use ratings scales such Likert-type scales, semantic differential things or feeling thermometers, in many instances. Rating scales are specifically useful as they can make the process for requesting information from the research participants much easier and decrease the overall time of the survey.

This research will utilise the survey strategy in the form of a questionnaire since it is generally associated with the deductive approach. However, each research strategy has its advantages and disadvantages, thus it is important for the researcher to be aware of the advantages and disadvantages of the survey research (Nardi, 2018). Table 3 illustrates the advantages and disadvantages of surveys:

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Table 4: Advantages and Disadvantages of Quantitative Survey Research (Nardi, 2018, 16)

Method	Advantages	Dis-advantages
Quantitative Survey	Less costly to reach larger samples	Self-report require reading ability in the language (age, eyesight, limitations, education)
	Standardise questions	Possible gap between what people report they do and what they actually do
	Ideal for asking about opinions and attitudes	Return rate can be low for mailed and computer-based surveys, thus limiting generalizability
	Less labour intensive to collect data or train researcher	Close-ended questions can be restrictive and culturally sensitive or dependent
	Can guarantee anonymity	Difficult to explain meaning of items and probe answers
	Suitable for probability sampling and more accurate generalizability	Depend on asking about re-collected behaviour
	Easier to code close-ended items	More difficult to code open-ended responses
	Respondents can answer at own pace	Can't guarantee respondent answering it was the person intended to answer it
	Better for sensitive and personal topics	Require skill in questionnaire design
	Easier to replicate a study	Long and complicated survey can be tiring to complete and lead to errors
	Can address multiple topics in one survey	Easy to overlook, skip around and misunderstand questions
	Ideal of computer-based and online surveys	More difficult to generate reliability and validity for one-time-use questionnaires
	Easier to compare with other studies using similar questions	

### 3.7 Research Protocol Design

The process to be followed for this research will be as illustrated in Figure 8. The first step of the process is defining of the research objectives, followed by reviewing of literature related to the selected topic. The third step is where the research methodology is determined. A quantitative research method has been adopted and is based on the questions and objectives of this research. Once the research method is determined, the research questionnaire is developed for data collection.

The questionnaire developed considers the selected target population. The data collected from the selected population is then analysed. The last step looks at reporting and concluding on the findings.

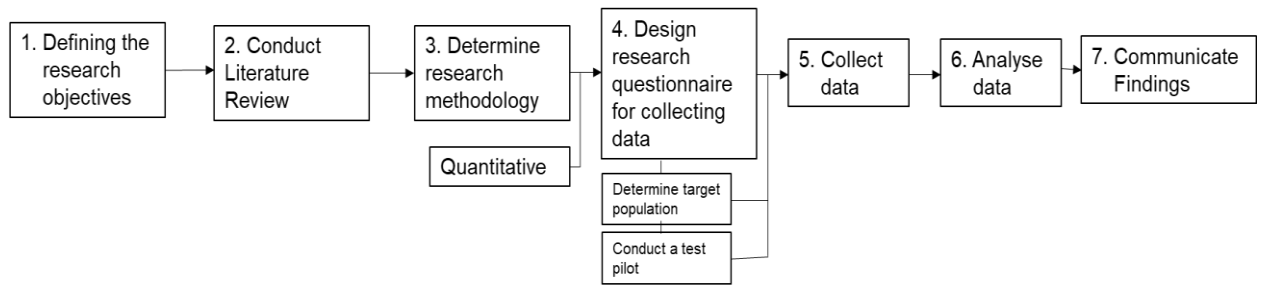


Figure 7: The process of quantitative research followed

The research process noted in Figure 7 is adopted from the quantitative research process by Bryman (2012) as illustrated Figure 8 below. According to Choy (2014) quantitative researchers normally start with a general subject of study or issue of individual interest, thereafter, reduce it or focus on a particular research question that can be addressed in the research. This requires a cautious review of the research literatures and creating hypothesis that originate from the social theory.



Figure 8: The process of quantitative research adopted from Bryman (2012)

New information is collected in agreement to the research problem from the large population and analysis of the information but in the process disregarding individual's feelings and emotions or environmental context (Rahi, 2017). The author further emphasise that quantitative process focuses on objective and measure it through the activities and opinions which encourages the researcher to portray the data rather than to interpret the data.

### 3.8 Questionnaire Design

In this research an online questionnaire was developed and distributed to research participants. The online questionnaire was split into three sections, A, B and C, whereby section A consisted of three questions relating to the demographic information of the participants. Section B consisted of questions developed to identify the key factors contributing to effective and successful project post mortems in a construction industry and Section C were questions to identify the benefits of successful project post mortems. Subsequently, the results obtained were analysed and presented in the form of tables with additional explanations.

#### 3.8.1 Section A: Demographic Information

In this section, the questionnaire consisted of three questions (question 1 to 3) as follows:

- a. **Question 1:** *The educational background of the participant*
- b. **Question 2:** *The number of years of experience the participant has in construction projects.*
- c. **Question 3:** *The role of the participant in construction project.*

Each of the three questions was accompanied by a drop box containing the answers from which the participants were requested to respond by selecting the answers are applicable to them.

#### 3.8.2 Section B: Key factors and benefits of an effective and successful post-mortem for construction projects.

Subsequent to a comprehensive literature review, 24 questions were formulated in Section B to reveal the key factors for an effective and successful project post mortems. It was noted from literature review that the key factors resonate around two aspects, namely People and Systems. The People aspect include factors such as organisational learning/sharing of knowledge amongst the team members, culture of the organisation, trust between the team members people, management support and commitment, the culture of incentivising and rewarding people.

The Systems aspect looks at processes, technology and infrastructure as critical tools for effective project post mortems.

In this section, the participants were required to rate each question on a 5-point Likert scale that required a ranking ranging from 1 to 5, where 1 represented Strongly Disagree, 2 – Disagree, 3 – Neither Agree or Disagree, 4 – Agree and 5 – Strongly Agree. The intent was to identify the participant's level of understanding of the identified key factors and benefits of effective project post mortems for organisations in the construction industry.

The questions developed were closed-ended with the aim of simplifying completion and intensifying the response rate.

**Questions 4 to 13 falls under the category of People aspects and consisted of the following questions:**

a. **Question 4:** *The research participants requested to indicate if they work in project in the construction industry.*

b. **Question 5:** *The research participants were requested to indicate if they think it is important to conduct post mortems in construction projects.*

c. **Question 6:** *The internal project team worked effectively together?*

This question was formulated in relation the key factor 1: Team Work.

d. **Question 7:** *The project team worked effectively with the client and/or other stakeholders?*

Question 7 is also related to key factor Team Work and Collaboration with the project owners and other relevant stakeholders.

e. **Question 8:** *There was a high degree of trust within the team and the team openly shared knowledge amongst themselves.*

This question is related to the level of trust between the team members in sharing and transferring knowledge.

f. **Question 9:** *Were the goals of the project clear to you? (Clear requirements, planning, common goals).*

Question 9 was based on communication factor and dissemination of information of information between all stakeholders.

g. **Question 10:** *Were you satisfied with the level of technical support in the project?*

h. **Question 11:** *Were you satisfied with the level of management support?*

Questions 10 and 11 relate to the leadership support/ top management support to the project team in terms of resolving issues that require management involvement as well as provision of technical support as and when required.

- i. **Question 12:** *Was the project communication handled efficiently and effectively in disseminating information at all levels decision-making within the team?*

Question 12 covers the sharing of information, the level of participation and involvement of team members in the project.

- j. **Question 13:** *Did you feel appreciated, recognised and rewarded for your efforts?*

Question 13 is associated with the incentive and reward system to promote participation of the team members in post mortems.

**Questions 14 to 24 falls under the category of Systems which includes technology, processes and infrastructure:**

- k. **Question 14:** *Do you think the organisation has knowledge management strategies and tools in place for knowledge capturing? (Including tools enabling retrieval of information, lessons and logs from past projects).*

- l. **Question 15:** *Was the process for reporting challenges/problems clear, easy to follow and efficient?*

- m. **Question 16:** *Were the issues dealt with and resolved in a timely and satisfactory manner?*

- n. **Question 17:** *The project issues and decisions taken were well documented.*

- o. **Question 18:** *Was the information easily accessible?*

- p. **Question 19:** *There was use of lessons learnt from previous projects by the team.*

- q. **Question 20:** *The project team held post-mortems during the project to discuss the successes and failures of a project.*

- r. **Question 21:** *The project team held post-mortems to discuss the successes and failures of a project at the end of the project.*

- s. **Question 22:** *The project sub-teams conducted their own post mortems.*

- t. **Question 23:** *All project sub-teams took part in larger post-mortem sessions involving all teams.*

- u. **Questions 24:** *The project team followed through on the recommendations of post mortems.*
- v. **Questions 25:** *It is better and effective for individual/smaller teams to conduct their own post mortems.*
- w. **Question 26:** *It is better and effective to conduct project post mortems as a larger team representing all disciplines.*
- x. **Question 27:** *Project post-mortems are a beneficial tool in construction projects.*

### **3.8.3 Section C: The benefits of project post-mortems.**

**Questions 28 to 35 falls under the Section C which highlights the benefits of project post mortems.**

- y. **Question 28:** *Do you think that sharing of information can influence the level of participation of other project team members and better communication with customers?*
- z. **Question 29:** *Re-use of internal available knowledge obtained from project post mortems reduces the repetition of errors and result in time-saving/costs.*
- aa. **Question 30:** *Do you think the involvement and support of top management for project post mortem processes has an impact on organisational performance?*
- bb. **Question 31:** *Discussion about the project challenges and celebrating the achievements brings the project team closer together?*
- cc. **Question 32:** *Project post-mortems makes the project team members feel more engaged and allows the organisation to capitalise on the lessons learnt.*
- dd. **Question 33:** *Performing a post-mortem brings clarity and improvement opportunities on its processes after a project is closed?*
- ee. **Question 34:** *Collective improvement and individual contributions through project post mortems receives appropriate recognition in projects?*
- ff. **Question 35:** *Active participation of senior management and the project team in the review and collaboration process promotes continuous improvement in the organisational learning process.*

**Note: Refer to Appendix A for the complete questionnaire.**

### **3.9 Target Population**

Population is described as the total number of components, associations, people or things that are selected to be measured as the sample of the research (Zefeiti and Mohamad, 2015). The authors highlight an important point that regardless of the kind of research strategy followed (qualitative or quantitative) for collection of information and analysis, the researchers will definitely encounter challenges in trying to study everyone, in all locations and doing all things. Therefore, researchers are persuaded to consider selecting a specific sample to concentrate on for their research, then generalise the study outcome to the entire population (Dragusha, 2016; Shankar *et al.*, 2018).

To achieve the objectives and answer the research questions for this study, the target population was 140 which consisted of various stakeholders with experience in the construction project (i.e. Project Managers, Construction Managers, Project Engineers) with the focus in Gauteng Province, South Africa.

### **3.10 Unit of Analysis**

According to Khan (2014) unit of analysis is the most crucial section of any research as the whole research depends on it and the establishment of unit of analysis during the early stage of research is essential as the research ideas, information gathering strategies and sample size all relies on the unit of analysis. The units of analysis could be people, groups or organisations.

In this research, the unit of analysis is the individuals with more than 2 years of experience in construction projects (Project Engineers, Construction Managers, Project Managers, Construction and Supervisors). The unit of analysis is chosen to gain an understanding the key factors of an effective and successful project post mortems in a construction industry. An online questionnaire was distributed to the participants to obtain feedback about the key factors and benefits of post mortems in construction projects.

### **3.11 Time Horizon**

According to Saunders et al. (2012) cross-sectional and longitudinal are two forms of time horizon considered in research. Cross-sectional time horizon takes a preview of a solitary moment in time with an effort of trying to understand and establish factors for a specific observable circumstance. It is further noted that this type of time horizon does not give a firm and conclusive information in the manner in which circumstances develop over time and how something is done during the time of the research. As such, it does not, take into account the circumstance before and after the preview.

On the other hand, longitudinal time horizon is normally used for studies that require quite a while to give valuable information and results. Longitudinal methodology requires a long time to check the progress regularly and notice how the circumstance advance after some time.

The current study is for academic purposes and is related to understanding the key and effective factors of a successful post mortem in construction project. Taking this into account, the time horizon adopted for this research is cross-sectional.

### **3.12 Data Collection Method and Analysis**

According to Zefeiti and Mohamad (2015) data collection is a way of gathering data from different sources in order to respond to the research questions. Primary and secondary data are generally two types of data used for research. Primary data is classified as the direct data gathered from a specific target population chosen to be used for the first time as a sample for the objectives of the study, whereas, secondary data such as written materials, journals, books, conference papers and public records, is the information readily available. However, the primary usage of secondary data is to triangulate the findings dependent on other information gathered through other data collection instruments such as interviews or questionnaires (Takhtravanchi, 2017).

There are numerous methods of gathering research data like post, telephone, interview, internet-based study, e-mail and by hand delivery (Zefeiti and Mohamad, 2015). The questionnaire on Google Form is a data collection method used in this research. A questionnaire is an instrument frequently utilized in the study and consists of written or verbal questions constructed in a logical order (Shankar, Davenport,



Woolen, Carlos and Maturen, 2018). Schieg (2007) argues that although all the research participant receives the same questions given in a structured order and are open-ended questions appropriate for a post-mortem analysis, the evaluation of open-ended questions is a very long exercise since the appropriate responses must be grouped and merged with comparable answer models.

On the other hand, Vergopia (2008) is of the view that since a written questionnaire provides the same set of questions, it presents fewer possibilities for interviewer/interviewee prejudice, instead of direct contact or telephonic interviews, while it makes the process of analysing the information gathered much simpler to conduct. Questionnaires are developed following a process of conducting a survey-based research study as depicted in Figure 7, with the aim of addressing the research questions. The questionnaire will include the 5-point Likert scale items and close-ended questions.

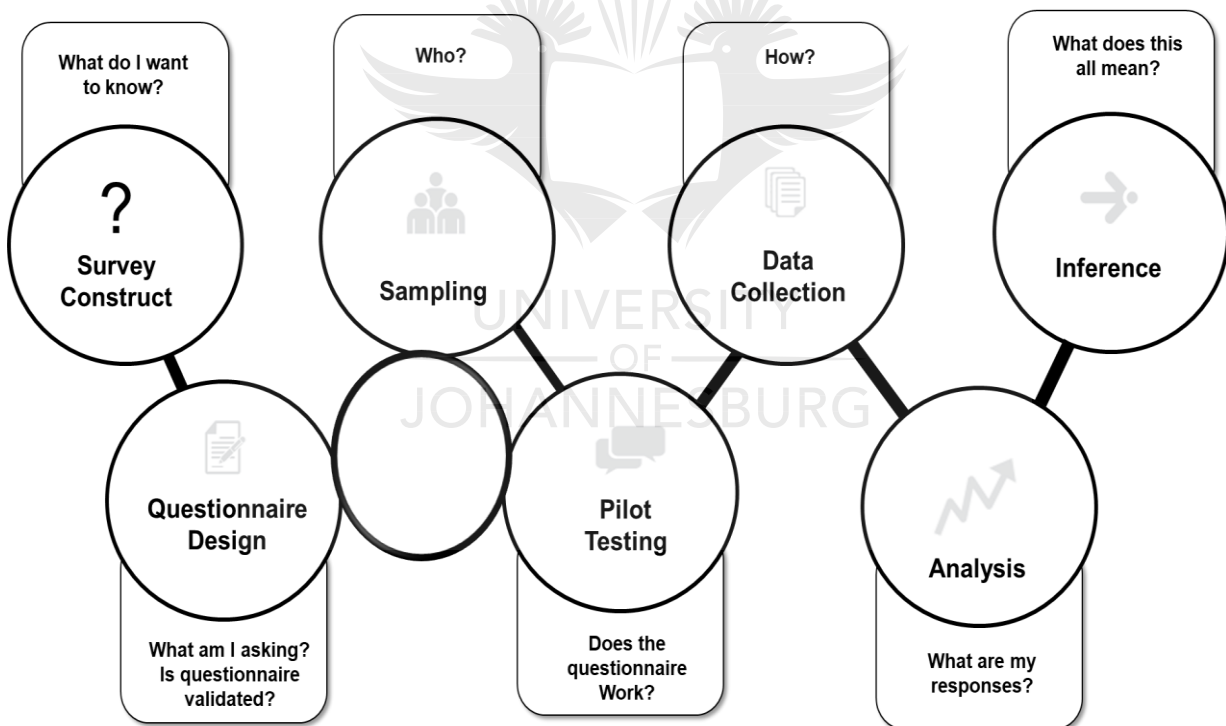


Figure 9: Schematic of the process of conducting a survey-based study (Shankar et al., 2018: 752)

### 3.13 Sampling

Sampling is defined as a process of choosing a section of the population for the research investigation (Etikan, Alkassim and Abubakar, 2015; Rahi, 2017). The authors further note that in a sampling process, the sample units are chosen from a collection of related information to quantify the characteristics, opinions and attitude of individuals from the selected sample. The selection of a sampling method considers the nature of the research undertaken. Probability sampling and non-probability sampling are the two types of sampling methods.

Probability sampling is utilised in survey-based research strategies and the target samples are chosen from the population with the same probability (Takhtravanchi, 2017). As such, the probability sampling makes it possible for the researcher to roughly calculate the qualities of the population from the sample which will then guide the researcher to achieve the objectives and provide answers to the research questions. On the contrary, with the non-probably sampling, the probability of each unit to be selected in the sample population is unknown.

Firstly, the researcher used the snowball sampling technique by making initial contact with a small group of individuals relevant to the research topic and the same individuals used as referrals to contact other individuals. The research electronic questionnaire is distributed to these individuals and self-administered by the researcher.

Secondly, the sample participants for the online questionnaire was randomly selected through the database of the South African Council for the Project and Construction Management Professions (SACPCMP) to eliminate any bias linked with choosing specific sub-populations. A random sampling strategy provides an opportunity for each participant of the chosen population to have an equal chance or likelihood of being chosen to participate by answering the research questionnaire (Tanner, 2017b).

A total of 93 stakeholders with experience in construction project were targeted and gave their feedback regarding the key factors and benefits of project post mortems in construction projects. The respondents were contacted by e-mail and requested to return the questionnaire using the online Google Form survey tool. SACPMP as a juristic body established to regulate construction management and construction project management professionals has a database of professionals with experience in

construction projects. The sample was thus selected to include people of interest and eliminate those who do not suit the purpose.

Subsequent to collecting the research questionnaires, the data was analysed to identify the key factors of an effective and successful project post mortem process based on the responses from the research participants.

### **3.14 Reliability and Validity**

Reliability and validity are the two critical elements for evaluating the quality of research (Takhtravanchi, 2017). Tanner (2017) indicates that reliability refers to the consistency of results created by a measuring instrument when it is utilised in the same situation on repeated occasions. Snyder (2019) argues that assessment of various kinds of literature reviews can become a difficult to deal with, especially when an applicable field of research, few journals or years are disregarded as this can result in major ramifications for the outcomes and conclusions of the research. This study will follow the protocol design indicated in section 3.7 whereby the data collected was through the same data collection procedure and the consistent set of questions used for data collection.

The questionnaire responses from the participants were checked and verified and entered into database. Cronbach's coefficient alpha ( $\alpha$ ) was used to measure the internal consistency of the questionnaire. According to Enshassi *et al.* (2016) the normal range of Cronbach's coefficient alpha is between the values 0.0 and 1.0. The scholars further emphasise that the higher values Cronbach's coefficient alpha values indicates a higher level of internal consistency. Liu and Cross (2016) suggest that recommended limit value of 0.7 and above as the values indicating the high level of consistency.

Validity refers to the extent to which an instrument measures what it is required to be measuring in a quantitative research (Enshassi, Falouji, AlKilani and Sundermeieri, 2016). In this research, the validity of the study will be achieved by comparing the conclusions drawn from the research against the findings of the other researchers from literature.

### **3.15 Ethical Consideration**

University of Johannesburg's minor dissertation – research ethics and data collection give the guidelines on the principles and procedures for conducting a research. Research ethics are a framework or theory of good behaviour about the regulations and standard that guide human conduct in research, communicated in purposeful motives and actions, stated publicly by an individual or a specific group of individuals (Johanson, 2017).

This research considers the principle of right to privacy of the participants. This refers to anonymity, confidentiality and protection of data collected. The research participants are not at any stage required to provide or disclose their personal information such as names, identity or any other confidential information. The researcher will provide the research participant with the participant information sheet and consent form for the participant to be familiar with the purpose of the research. The participants are not obliged to take part in this research and have the choice to decide whether they would like to partake in this research or not.

With regards to transparency and honesty, the researcher will not plagiarise other researcher's ideas or thoughts but will recognise their contribution through referencing and citations.

### **3.16 Limitations**

This research is limited to organisations carrying out construction projects in Gauteng, South Africa. Although this research presents valuable information towards understanding the key factors of an effective and successful post mortem processes for organisations in the power generation construction industry, the research has limitations due to the fact that it is based on the views of the selected participants and the reliability of the questionnaire depends on the openness and honesty of feedback given back by the research participants as well as the knowledge of the researchers in mapping out the research questionnaire (Yang, Huang and Hsu, 2014).

### 3.17 Summary

Chapter 3 presented the overview of the research procedure considered for carrying out the research to accomplish the research objectives. The chapter further highlighted various research methods and the justification for selecting a specific research philosophy and strategy. A brief discussion on data collection method and analysis, ethical considerations and limitations of the research has been provided. Chapter 4 is the next chapter focusing on data collection and analysis in detail.



## **CHAPTER 4: RESEARCH RESULTS – ANALYSIS AND INTERPRETATION**

### **4.1 Introduction**

Chapter 4 provides an analysis, interpretation and discussion of the research results. The data obtained and the information from the existing literature will be presented as part of the research results analysis. The research questionnaire results will also be summarised graphically through the percentage representation for each question based on the overall responses received.

The conclusions on this chapter will be based on the discussions and interpretation of the research results which will be linked or correlated with the results of similar studies from literature review. Chapter 5 is the final chapter of the research which will present the recommendation from this study.

### **4.2 Response Rate**

Kameraho (2015) highlights that the response rate demonstrates the number of study tools expected against the real number obtained in the study. The author further notes that the response rate shows the representativeness of the study relative to the total sample utilized from a given population.

The online questionnaire was randomly distributed via the SACPMP network to the participant. The total number of research questionnaire sent was 140 as noted on the online questionnaire tool with a total of 93 responses and useable questionnaires received on time. The 93 useable questionnaires indicated the roles of the participants in construction projects were considered in this study giving a response rate of 66%. A high response rate implies a satisfactory and acceptable representation of the sample population (Kameraho, 2015). Figure 10 indicates the response rate as received:

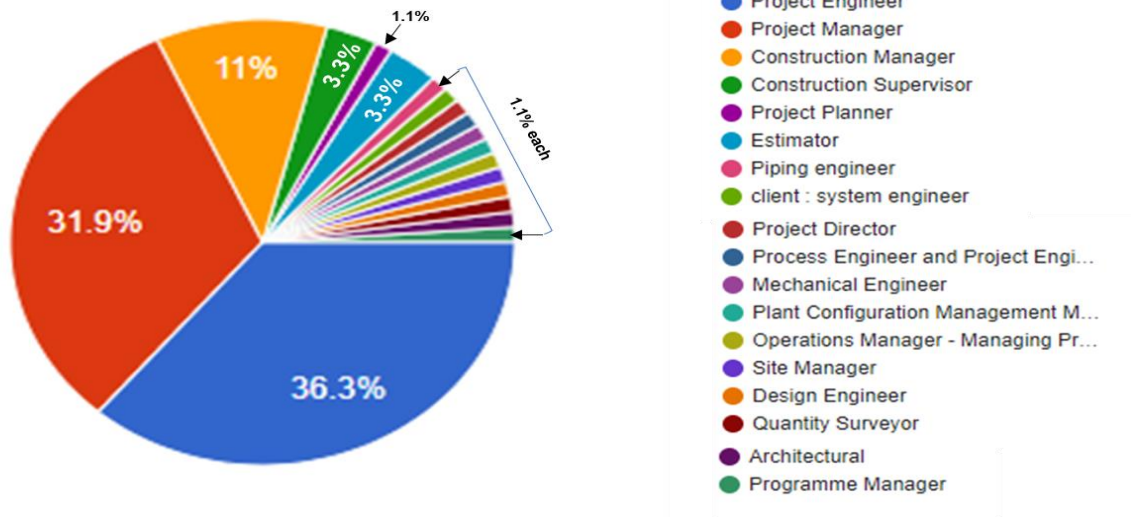


Figure 10: Response Rate

### 4.3 Background information about the Respondents

This sub-section provides the demographic information about the research respondents such as the level of education, years of experience and their job designations or role in construction project.

#### 4.3.1 Respondents roles in construction projects

Table 5 below and as noted in Figure 9 above is the summary of the roles of the research respondents as per the response received.

Table 5: Role of the research respondents in construction projects

<b>Item</b>	<b>Description</b>	<b>Number</b>
<b>1. Designation/Role in construction projects</b>	Project Engineer	33
	Project Manager	29
	Construction Manager	10
	Construction Supervisor	3
	Project Planner	1
	Estimator	3
	Piping Engineer	1
	Client System Engineer	1
	Project Director	1
	Process Engineer	1
	Mechanical Engineer	1
	Plant Configuration Management	1
	Operations Manager	1
	Site Manager	1
	Design Engineer	1
	Quantity Surveyor	1
	Architectural	1
Programme Manager	2	
	<b>Total</b>	<b>93</b>

Table 5 indicates that majority of respondents who indicated their roles in construction projects were the Project Engineers (33%) and Project Managers (29%), followed by 11% who were Construction Managers. The least number of respondents were Construction Supervisors and Estimators with 3% respectively and 1% representing various designations such as Project Directors, Quantity Surveyors, Programme Managers and Site Managers. However, it shows that part of the data received was from top management and the rest of it from other operational project team members who have a considerable amount of experience in construction projects and deemed to be knowledgeable with construction projects processes including project post mortems.



#### 4.3.2 Respondents educational background

Table 6 indicate that the majority of 46% of the respondents has attained postgraduate qualification followed closely by 33% who had attained university bachelor's degree as their highest level of education. 18% of the respondents achieved a diploma and the least number of respondents who attained matric certificate as their highest level of education were noted as 1%. However, the other 1% of the respondents were noted to have attained project management certificate and mechanical engineer's certificate of competency.

Table 6: Respondent's educational background

Level of Education		
Item	Description	Number
2. Level of Education	Matric Certificate	2
	Diploma	17
	Bachelor's degree	31
	Postgraduate degree	43
	<b>Total</b>	<b>93</b>

#### 4.3.3 Respondents level of experience in construction projects

Table 7: Years of experience in construction projects

Participant's years of experience		
Item	Description	Number
3. Years of experience in construction projects	Less than 2 years	1
	More than 2 years and less than 5 years	11
	Over 5 years and less than 10 years	28
	Over 10 years	53
	<b>Total</b>	<b>93</b>

From the research results in Table 7, 57% of the respondents have worked in construction projects for over 10 years followed by 30% who have between 5 to years 10 years of experience in construction projects. Only 12% have between 2 to 5 years of experience followed by 1% who have less than 2 years of experience in construction projects. For this research the all respondents including those with less than 2 years of experience were also included in the analysis. All respondents are considered to have gained experience in construction projects and are likely to respond to the research questions effectively.

The length of working experience in construction projects or an organisation influences the extent to which an individual is aware of the factors sought by this research. The results obtained indicate that the respondents had adequate experience in the construction environment, are knowledgeable about the factors influencing effective and successful project post mortems process for organisations in the construction industry.

#### **4.4 Evaluation-Critical Success Factors for Effective Project Post Mortems**

The objective of the study was to identify the key factors of an effective and successful project post mortem for organisations in construction environment as well as identify the benefits of a successful project post mortem. This research used the 5-point Likert scale to ranging from 5 – Strongly Agree, 4 – Agree, 3- Neither Agree or Disagree, 2- Disagree and 1-Strongly Disagree to measure the each of the factors that contribute to an effective project post mortem based on the knowledge and experience of the participants.

The key aspects as per the research questionnaire were split into two aspects namely, People and Systems. The people aspect consisted of key factors relating to organisational learning, culture and social activities, whereas Systems consisted of key factors such as technology, processes and infrastructure. The third section of the questionnaire looked at the benefits of a successful project post mortems.

#### **4.5 People Aspect – key factors for effective project post mortems**

In this category, the research sought to establish the various people related factors that influence the success of post mortems in construction projects. These factors included: Learning – the willingness of the project team members to share and learn from each other, mentoring/coaching; Culture – this refers to a culture of helping people, positive and supportive tone from leadership teams, a culture of trust between team members and leadership teams, teamwork; and Social activities – promoting a high level of communication between team members and management, rewarding and recognition of work achieved by individuals/teams.

The following questions (Questions 4 to 13) were developed covering all three people aspects, and a Likert-type scale of 1 to 5 was used to ascertain what the research participants considered to be most important factors. Table 8 and Figure 12 below indicate the data analysis of the people aspects key factors that has an impact on effective project post mortems.



Table 8: Data analysis for People aspects – factors for effective project mortems

#	Key Factor	Question	Total number of responses	Agree	Neither agree nor disagree	Disagree	Total
Q4	-	Do you work in project in the construction industry?	93	87%	4%	9%	100%
Q5	Learning from mistakes (lessons learned)	Do you personally think it is important to conduct project post mortems in the construction industry?	93	91%	2%	7%	100%
Q6	Team Work	The internal project team worked effectively together?	93	77%	12%	11%	100%
Q7	Active participation - clients	The project team worked effectively with the client and/or stakeholders?	93	74%	16%	10%	100%
Q8	Trust	There was a high degree of trust within the team and the team openly shared knowledge amongst themselves.	93	75%	0%	25%	100%
Q9	Communication/ common understanding	Were the goals of the project clear to you? (Clear requirements, planning, common goal)	93	87%	7%	6%	100%
Q10	Technical support - experienced people	Were you satisfied with the level of technical support in the project?	93	75%	10%	15%	100%
Q11	Top management support/commitment	Were you satisfied with the level of management support in the project?	93	66%	16%	18%	100%
Q12	Information sharing-willingness to share	Was project communication handled efficiently and effectively in disseminating information at all levels of decision-making within the team?	93	51%	21%	28%	100%
Q13	Incentive and reward system	Did you feel appreciated, recognised and rewarded for your efforts?	93	42%	30%	28%	100%

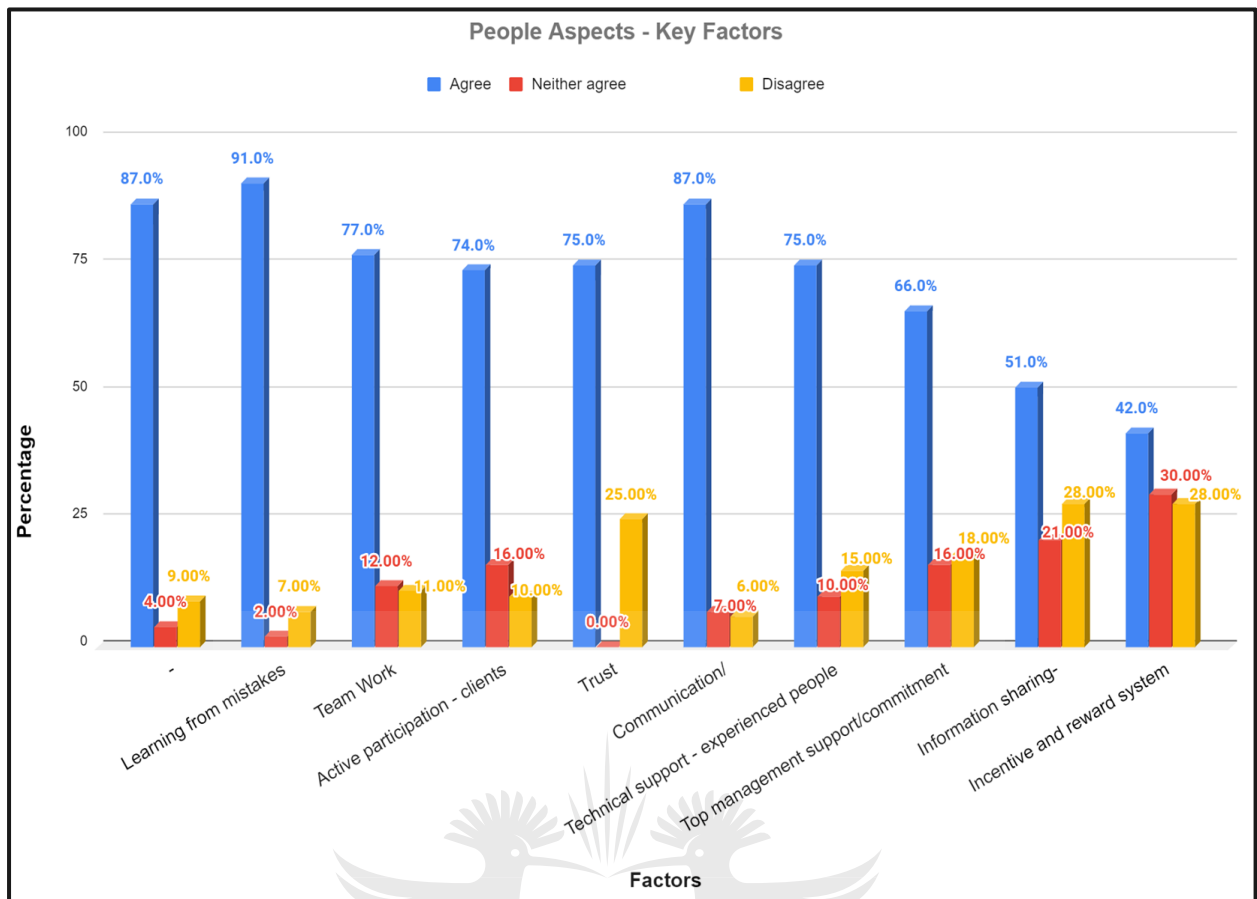


Figure 11: Data analysis of people aspect – factors for effective project post mortems in percentages

#### 4.6 Results Analysis: People Aspect – key factors for effective project post mortems

The results indicated in Table 8 and Figure 11 reveal that all people related factors noted are crucial for organisations in the construction industry to achieve effective project post mortems. It can be noted that the participants were requested to indicate if they work in project in the construction industry and the majority with 87% agreeing that they are working in the construction industry and 9% disagreeing not to be working in projects in the construction industry.

According to the results and comparing the response rate of each factor based on the percentage agreed or disagreed by the respondents, 91% of the research respondents agreed that learning from mistakes is most significant factor for effective and successful project post mortem. Terzieva (2016) emphasise that project reviews afford the project team members to share information, dissect potential remedial actions to

implement in order to resolve the issues identified and acquire knowledge from the successes and mistakes that were experienced in past projects.

The second key factor is communication and common understanding with 87% agreeing that it is key for the success of project post mortems. Collaboration, open communication and trust among the project team members are the key factors that can enhance effective knowledge transfer (Bellini, 2016).

The third significant factor is noted to be team work with 77% agreeing that team work is key in project post review. According to Eken *et al.* (2015) the construction industry is knowledge intensive and project-based with qualities of multi-disciplinary groups of people with various ideas of significant worth, thus making team work important. The factor technical support by experienced individuals was agreed to be the fourth significant factor with 75% followed closely by trust factor with 75%. Taking guidance from experienced individuals, learning from mistakes is one of the factors that encourages learning in projects (Yap, Abdul-Rahman and Chen, 2017).

Buvik and Tvedt (2017) noted that if project team members trust their fellow colleagues and believe in their abilities, they are more likely prepared to commit themselves and apply more effort important and required to make sure that the project becomes a success.

The study results indicate that 74.% agree that factor active participation by the clients/project owners contribute to the effective and successful post mortems processes. Kameraho (2015) emphasised that the active participation by all project team members contribute to organisational learnings. The respondents further rated the factor top management support and commitment at 66% to be an important factor and agreed that the level of management support in the project also has an impact on the success of post mortems in construction projects. A study by Enshassi *et al.* (2016) highlighted top management leadership and commitment as one of the crucial critical knowledge management enablers for organisations in the construction environment. Factors, willingness to share information and incentive and reward system at 51% and 42% respectively, were agreed to be the last two significant factors. Interesting to note that approximately 30% of the respondents disagreed that dissemination of information/project communication was not handled effectively. Further, 30% of the respondents further indicated that they felt not appreciated or were not recognised or rewarded for their efforts in the construction projects. A study by Chron er and

Backlund (2015) indicated that a significant number of research respondents indicated that there was lack of incentives for individuals or project team members sharing their experiences and feedback on project, which resulted in sharing of experiences done only by limited individuals or project leaders only.

#### **4.7 Systems Aspect – key factors for effective project post mortems**

The research further sought to establish the factors related to systems that needs to be put in place for effective project post mortems by organisations in the construction industry. The results are shown in Table 9. These factors included information technology (IT), procedures/standards, projects assessment tools, knowledge database and collaborative forums that enables the organisations to obtain, process, store and disseminate information within the organisation itself and with external partners.



**Table 9: Data analysis for organisation management systems – factors for effective project mortems**

#	Key Factor	Question	Total number of responses	Agree	Neither agree nor disagree	Disagree	Total
Q14	Information Technology	Do you think the organisation has knowledge management strategies and tools in place for knowledge capturing? (Including tools enabling retrieval of information, lessons and logs from past projects).	93	45%	15%	40%	100%
Q15	Procedures/Standards	Was the process for reporting challenges/problems clear, easy to follow and efficient?	93	50%	24%	26%	100%
Q16	Procedures/Standards	Were the issues dealt with and resolved in a timely and satisfactory manner?	93	43%	19%	38%	100%
Q17	Knowledge capturing/database/ knowledge extraction systems	The project issues and decisions taken were well documented.	93	59%	19%	22%	100%
Q18	Knowledge transfer	Was the information easily accessible?	93	54%	25%	21%	100%
Q19	Knowledge transfer	There was use of lessons learnt from previous projects by the team.	93	44%	24%	32%	100%
Q20	Workshops/Projects assessments	The project team held post-mortems during the project to discuss the successes and failures of a project.	93	37%	16%	47%	100%
Q21	Workshops and meetings/ projects assessments reports	The project team held post-mortems to discuss the successes and failures of a project at the end of the project.	93	44%	15%	41%	100%
Q22	Workshops and meetings/ projects assessments reports	The project sub-teams conducted their own post mortems.	93	31%	19%	50%	100%
Q23	Workshops and meetings/ projects assessments reports	All project sub-teams took part in larger post-mortem sessions involving all teams.	93	32%	18%	50%	100%
Q24	Lessons learnt register and key performance indicators	The project team followed through on the outcomes/recommendations of post mortems.	93	25%	29%	46%	100%
Q25	Method/Practice	It is better and effective for individual/smaller teams to conduct their own post mortems.	93	71%	12%	17%	100%
Q26	Method/Practice	It is better and effective to conduct project post mortems as a larger team representing all disciplines.	93	74%	15%	11%	100%
Q27	Post Mortems Sessions	Project post-mortems are a beneficial tool in construction projects.	93	92%	2%	6%	100%



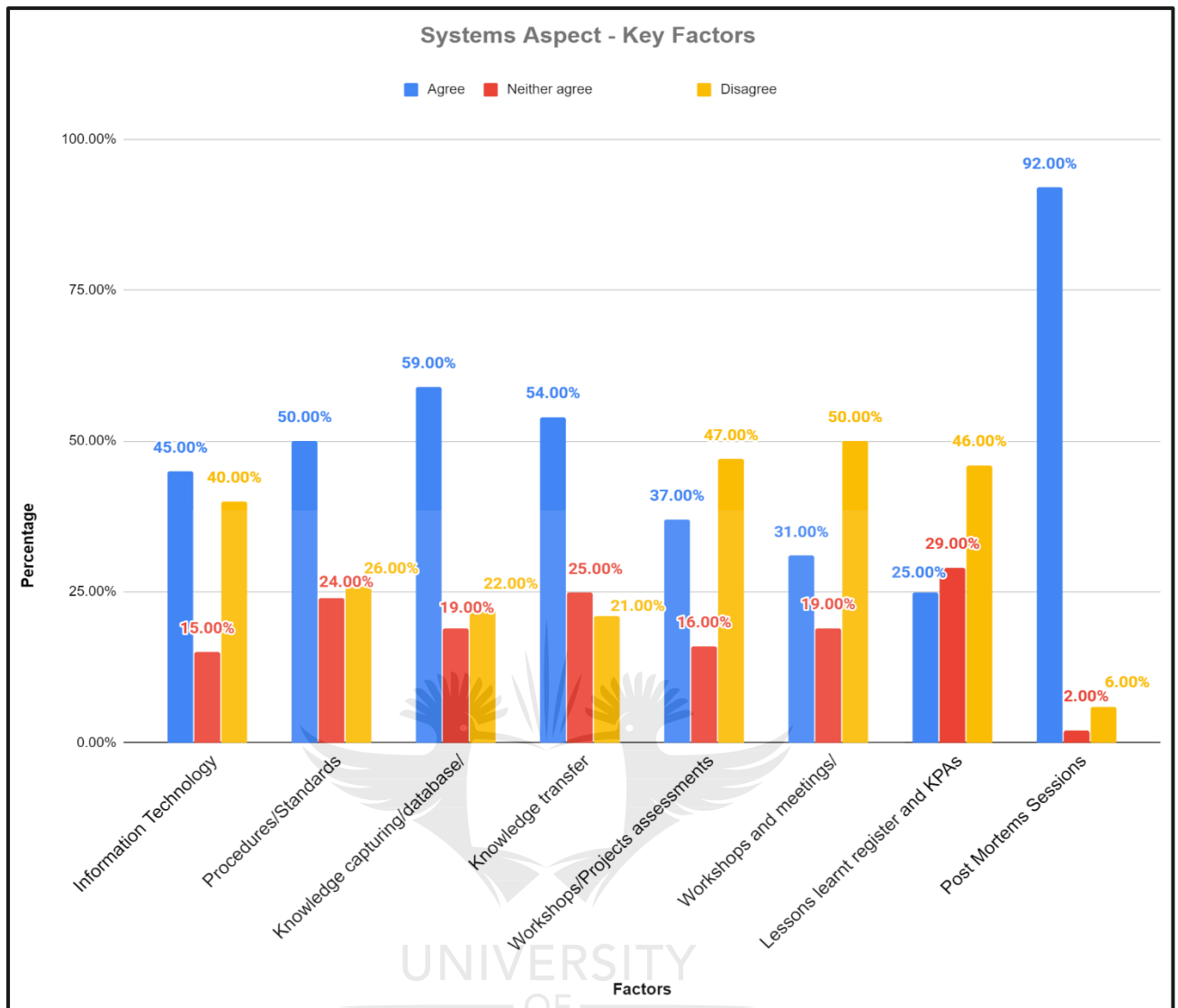


Figure 12: Data analysis of Systems aspect – factors for effective project post mortems in percentages

#### 4.8 Results Analysis: Organisational Systems - Key Factors for effective project post mortems

From the study, 45% of the respondents agree that organisations do have knowledge management strategies and tools in place for knowledge management, compared to 40% who disagree that organisations have knowledge management strategies and tools in place. Zouari and Dakhli (2018) in their study noted that the primary driver for the lack of success for the implementation of knowledge management strategies is attributed to the low support of knowledge management process activities, especially due to inadequate consideration of human resources and organisational features of information management systems. However, Ferrada *et al.* (2016) suggests that

knowledge management systems provides an organised method of keeping information as well increasing the amount of information kept in the organisation.

With regards to the efficiency of the procedures outlining the processes for reporting of challenges experienced in the projects, 50% of the respondents agree that the procedure was clear, easy to follow and efficient compared to 26% of the respondent who disagreed. Practical and robust procedures should be implemented to ensure long-term effective information sharing in project (Bellini, 2016).

The research participants further agreed that establishment of a knowledge capturing database is crucial for the documentation of projects issues and decisions made during the projects, as shown by a scoring of 59%. Whilst 54% of the research participants agree that systems that enables easy access and transfer of knowledge in projects are crucial factors for the success of the projects. An information system constructed on lessons learned database is a viable solution or technological method encouraging organisational learning and knowledge management utilising telecommunications for spreading information (Eken, Bilgin, Dikmen and T. Birgonul, 2015).

On the workshops/project assessments factor, the participants were asked to rate three questions around the same factor to better understand how and when the project team conducted their workshops/project assessments, as follows:

- a) The project team held post-mortems during the project execution phases to discuss the successes and failures. It is interesting to note that 47% of the participants disagree compared to 37% who agreed that the workshops/project assessment were continuously conducted as part of the project.
- b) Secondly, the research participants were requested to indicate if they agree or disagree if the project workshops/assessment were only held at the end of the project. 44% of the participants agrees compared to 41% who disagrees.
- c) 50% of the research participants disagree that the project sub-teams conducted their own post mortems or the sub-teams participated in the workshops/project assessments that involves all other teams. it is interesting to note that the research participants agree that it is better and effective for smaller teams to conduct their project assessment/workshops, and also as a large team

representing all project team disciplines, as noted with the scoring of 71% and 74% respectively.

Common or lessons that occur again repeatedly has to be recorded, shared and reviewed at the start, throughout and towards the project end and if it can be done, it must be done across different projects (Darfeuille, 2017). However, it is also interesting to highlight that 46% of the research participants disagree that although the workshops/project assessment are conducted, the project team does not follow through the recommendations of the project assessment/workshops, which could impact negatively on the success of the projects. The contributory factors are lack of clear procedures and lack of instrument or drive to use lessons learned from past experiences.

#### **4.9 Benefits for effective project post mortems**

The research was interested in identifying the benefits of a successful project post-mortem for organisations in construction industry. The identified benefits for successful project post-mortems are noted as -collaboration and increased customer relations, cost reduction and time savings, better and faster decision-making process, active participation of all stakeholders, reflection and closure of the project, improved project team productivity levels and efficiency, continuous learning and improved organisational processes or capabilities. The results are shown in Table 10 and Figure 13.

**Table 10: Data analysis – benefits of effective project mortems**

#	Benefit	Question	Total number of responses	Agree	Disagree	Total
Q28	Cross-collaboration and increased customer relations	Do you think that sharing of information can influence the level of participation of other project team members and better communication with customers?	93	83%	17%	100%
Q29	Cost reduction and time saving	Re-use of internal available knowledge obtained from project post mortems reduces the repetition of errors and result in time-saving/costs.	93	94%	6%	100%
Q30	Better and faster decision making	Do you think the involvement and support of top management for project post mortem processes has an impact on organisational performance?	93	80%	20%	100%
Q31	Active participation-all stakeholders	Discussion about the project challenges and celebrating the achievements brings the project team closer together?	93	54%	46%	100%
Q32	Improved communication and teamwork.	Project post-mortems makes the project team members feel more engaged and allows the organisation to capitalise on the lessons learnt.	93	90%	10%	100%
Q33	Closure on the project and reflection	Performing a post-mortem brings clarity and improvement opportunities on its processes after a project is closed?	93	95%	5%	100%
Q34	Improved productivity and team's efficiency	Collective improvement and individual contributions through project post mortems receives appropriate recognition in projects?	93	94%	6%	100%
Q35	Continuous learning and improved organisational processes/capabilities.	Active participation of senior management and the project team in the review and collaboration process promotes continuous improvement in the organisational learning process.	93	96%	4%	100%

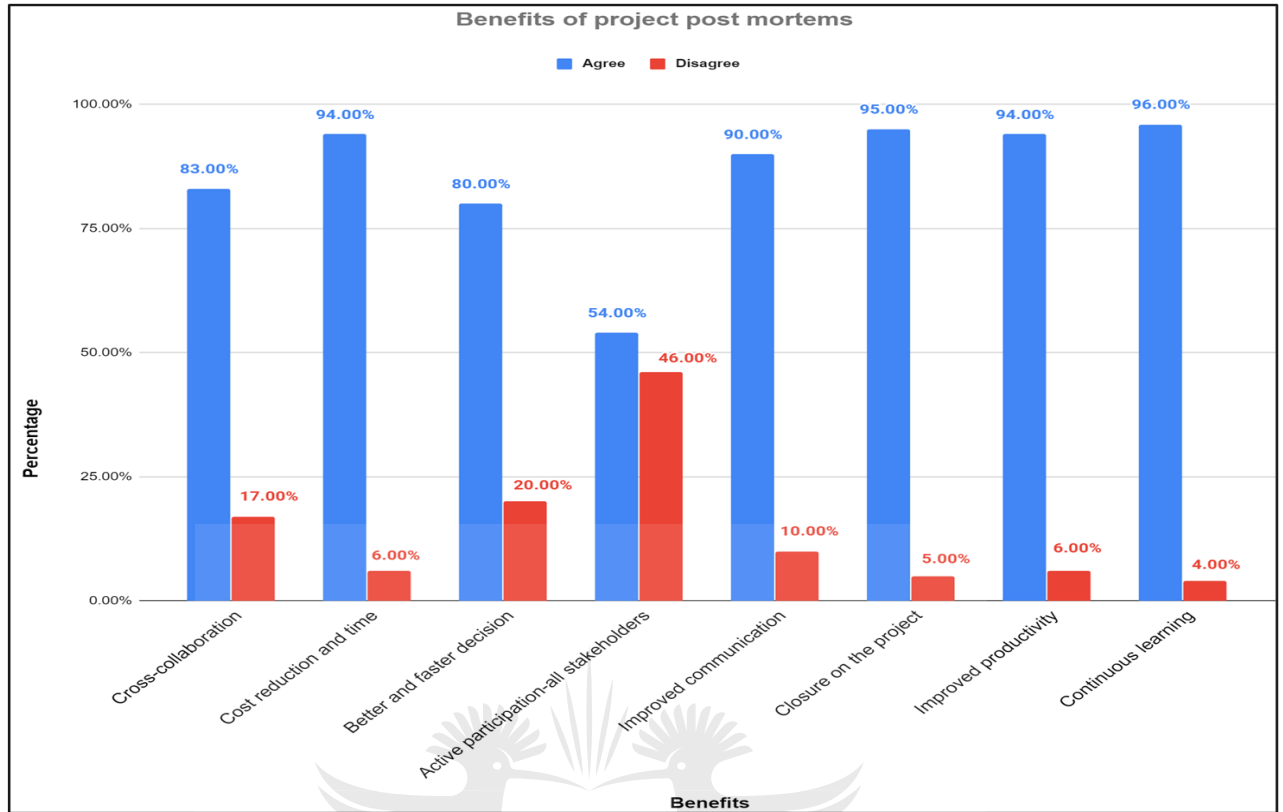


Figure 13: Data analysis of Systems aspect – benefits of effective project post mortems in percentages

#### 4.10 Results Analysis: Benefits of successful project post mortems

As shown in Table 10 and Figure 13, 96% of the research participants agreed that continuous learning and improved organisational processes/capabilities is a benefit that organisations can gain from successful project post-mortems, whilst the remaining 4% disagreed. The lack of support from top management to acquire the necessary resources to assist with implementation of organisational learning (OL) and the lack of support from the individual project team members are some of the obstacles that makes it difficult to promote organisational learning (AlMaian and Qammaz, 2019).

Reflection and closure on the project with a score of 95%, reduction of cost and saving of time as well as improvement on the project team’s productivity and efficiency with the individual scores of 94%, were agreed as the second most benefits. Knowledge can be acquired only if they are the result of a detailed and careful analysis shared amongst the project team members as well as the organisation as a whole and initiating processes of doing things differently (Darfeuille, 2017).

Although 5% of the research participants disagree that reflection and closure on the project is a benefit that an organisation can gain from successful project post-mortems, the research by McClory, Read and Labib (2017) suggest that lessons learned at project closure is seen as measurable values that demonstrate the ability of an organisation for continuous improvement on its processes. Furthermore, 6% of the research participants disagree that reduction of cost and saving of time as well as improvement of the project team's productivity and efficiency, are most unlikely to yield any gains.

The fourth benefit scored noted as improved communication and teamwork with a scoring of 90% was agreed to be a benefit that promotes continuous engagements between the project team members and allowing organisations to capitalise on the lessons learnt, whilst 10% of the research participants disagreed. Cross-collaboration and increased customer relations with a score of 83% and better and faster decision-making process with a score of 80% were agreed to be the fifth and sixth benefits of successful project post-mortems. 17% and 20% of the research participants disagreed with the two benefits. Open communication, collaboration and trust are some of the important factors for can enhance sharing of information in an organisation (Bellini, Aarseth and Hosseini, 2016).

54% of research participants agree that active participation of all stakeholders has an influence on achieving successful project post mortems, whereas 46% believe this is not the case. The high level of participation by project team members in post mortem analysis is achieved through a brainstorming group process in which the members repetitively use post and graphics to establish the root causes of the challenges (Vignos, 2014; Enshassi *et al.*, 2016). Cronbach's coefficient alpha was equal to 0.935, suggesting that reliability of the research questionnaire was acceptable.

#### **4.11 Summary**

Chapter four analysed and interpreted the data collected. The literature which was consulted in this research generally support the outcomes thus far. The following chapter five will give the summary of the findings, conclusions and recommendations of the research based on the objectives of the research.



## **CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Introduction**

Chapter 5 is the final chapter of the research and concludes the research by analysing whether the research objectives were met. It further provides the summary of the findings and recommendations of this research based on the objectives of the research. Chapter 5 comes after chapters 1 where the background of the research and research objectives were outlined, chapter 2 where literature review was conducted, chapter 3 which outlined the research methodology for collecting data and chapter 4 in which the data collected from the research was analysed.

Finally, chapter 5 presents suggestions for future studies. The research aimed to identify the key factors of effective and successful project post mortems for organisations in the construction environment as well as identify the benefits of a successful project post-mortem.

### **5.2 Summary of research findings**

This research identified the people and systems related factors that contribute to effective and successful project post mortems for organisations in the construction industry. Learning from mistakes, communication and having common understanding, team-work, technical support by experienced individuals, trust between project team members, active participation in projects by clients/project owners, top management support and commitment, information sharing and incentive/rewards systems are the important people-related factors for the successful project post-mortems.

With regards to systems related factors, the study revealed that information technology is one of the knowledge management tools organisations can contribute to the success of effective project post mortems. The study also found that clear and easy to follow procedures/standards for reporting challenges or problems in projects as well as resolving issues are important factors. It was clear from the study that knowledge capturing/transfer database, workshops/project assessments and lessons learnt registers (e.g. following up on the outcomes and recommendations of post mortems) are significant systems-related factors that are significant for the success of the project



post-mortems. The study also ascertained that project post mortems is a beneficial tool for organisations in construction environment.

Further, the study found that continuous learning and improved organisational capabilities is one of the advantages organisations can gain from successful project post mortems. From the study, leadership commitment or top management support is key for promoting continuous learning processes and creating a culture within an organisation that promotes sharing of information. Further, the study indicated that through reflection and analysis of the project performance, an organisation comes to understand itself better and find an opportunity for continuous improvement. Cost reduction, saving of time and improvement in the project team's productivity are some of the end results for continuous learning and improvement.

The study further established that improved/open communication, teamwork, cross-collaboration and increased customer relations, better decision-making and active participation by all project team members are significant improvements that results from undertaking project post mortems in the construction industry.

### **5.3 Conclusions**

The objectives of this research were to identify the key factors that lead to an effective and successful project post mortem for organisations in construction environment and identify the benefits of a successful project post-mortem. A closed-ended questionnaire was developed in order to address the objectives of this research. The people-related and systems-related factors as well as the benefits of a successful project post-mortem were identified. The people-related factors such as learning from mistakes, communication and common understanding, teamwork, top management support and commitment, technical support from experience individuals, active participation by clients/project owners, trust, willingness to share information and incentive and reward initiatives were identified as contributing to the effectiveness and successful project post mortems.

Information technology, procedures/standards, workshops/project assessment, information capturing database and lessons learnt registers are the systems related factors used by organisations for effective and successful post-mortems. Further, cross-collaboration and increased customer relations, cost reduction and time

savings, better decision making, active participation by all stakeholders, improved communication, reflection and closure on project, improved productivity and continuous learning are the key benefits that organisations can benefit from successful project post mortems. The research found that project post mortems is a beneficial tool and methods by which organisations can learn and improve its capabilities to achieve accomplish better results in future projects. Table 11 illustrate the summary of the findings

**Table 11: Summary of the findings**

<b>1. People related factors</b>	
<b>#</b>	<b>Factors</b>
1.1	Learning from mistakes
1.2	Communication and common understanding
1.3	Team-work
1.4	Technical support – experienced personnel
1.5	Trust between team members
1.6	Active participation in projects by clients/project owners
1.7	Top management support and commitment
1.8	Sharing of information between the team members
1.9	Incentive and reward system
<b>2. Systems related factors</b>	
<b>#</b>	<b>Factors</b>
2.1	Information Technology
2.2	Clear procedures and standards
2.3	Knowledge capturing/transfer database
2.4	Workshops/project assessments
2.5	Lessons registers (following up on recommendations from previous projects)
<b>3. Benefits of successful project post-mortems</b>	
<b>#</b>	<b>Benefits</b>
3.1	Continuous learning and improved organisational capabilities
3.2	Reflection and analysis of project performance
3.3	Cost reduction and time saving/improvement on team productivity
3.4	Improved/open communication
3.5	Teamwork
3.6	Cross-collaboration and increased customer relations
3.7	Better decision making
3.8	Active participation by all project team members

## 5.4 Recommendations and Future Research

From the findings and conclusions, the study recommends the following:

- a. To ensure that organisations learn from mistakes, organisations must consider investing on improving their knowledge management systems and continuously review the implementation processes. Organisational learnings can be promoted when an organisation tracks its failures and successes and is able to convey these learnings within the entire organisation,
- b. Teamwork and collaborative effort are one of the key elements that contribute to successful post project reviews. Trust is crucial to teamwork.
- c. Clear and effective communication between all stakeholders is essential for the success of project post mortems.
- d. The level of support and commitment from top management as well as the experienced personnel has an impact on the success of project post mortems. The inclusion and involvement of the client is also an essential part of post mortems. Without their participation, it is very likely that the project team will overlook some crucial inefficiencies in the organisation's processes.
- e. A key outcome of any project post mortem lies in motivating the project team by also recognising and rewarding the team's successes. A highly motivated and engaged team will always be ready to go the extra mile to ensure the project's success.

The study further recommends that future research be conducted to test the findings obtained by comparing two or different organisations that conducts projects in the construction industry. It would be interesting for future research to analyse the application of project post-mortems by different organisations within the construction industry. Further research may follow a case study approach with both a questionnaire and interviews in the research to better understand how organisations facilitate and incorporates project post mortems in order to perform better in future projects.

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## APPENDIX A: RESEARCH QUESTIONNAIRE

### MEng in Engineering Management (CW)

Research topic: The importance of post mortems in construction projects.

Annexure A: Closed-ended questionnaire

This research questionnaire has been developed for the purpose of collecting data to answer the research questions. The research questionnaire is developed from the literature review and research questions.

\* Required

1. Email address \*

\_\_\_\_\_

#### Section A: Demographic Information (Research Participants)

2. 1. What is your educational background? (Please select only one)

*Check all that apply.*

Matric certificate

Diploma

Bachelor's degree

Postgraduate degree

Other:

3. 2. How many years of experience do you have in construction projects?

*Check all that apply.*

Less than 2 years

More than 2 years and less than 5 years

Over 5 years and less than 10 years

Over 10 years

4. 3. Your role in a construction project?

Mark only one oval.

- Project Engineer
- Project Manager
- Construction Manager
- Construction Supervisor
- Project Planner
- Estimator
- Other: \_\_\_\_\_

Skip to question 5

Sections B:  
Key factors  
and benefits  
of an  
effective  
and  
successful  
post  
mortems for  
construction  
project.

Guideline for answering questions in Section B:

The aim is to identify the key factors and benefits of an effective and successful post mortem process in a construction project, based on your knowledge and experience in construction project post mortems. This research uses the 5 point Likert scale that allows the participant to express how much he/she agrees or disagrees with each of the statements. (Please read each statement and select only one answer that describes how much you agree or disagree with that statement). The key aspect is split into two categories, People and Systems. People aspect includes organisational learning, culture and social activities, whereas, Systems includes technology, process and infrastructure. Please be open and honest in your responding.

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Key aspect 1: People (Organisational learning, culture and social activities)

5. 4. Do you work in project in the construction industry?

Mark only one oval.

- Strongly disagree
- Disagree
- Neither agree or disagree
- Agree
- Strongly agree



6. 5. Do you personally think it is important to conduct project post mortems in the construction industry?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

7. 6. The internal project team worked effectively together?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

8. 7. The project team worked effectively with the client and/or stakeholders?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree



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9. 8. There was a high degree of trust within the team and the team openly shared knowledge amongst themselves.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

10. 9. Were the goals of the project clear to you?(Clear requirements, planning, common goal)

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree



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11. 10. Were you satisfied with the level of technical support in the project?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

12. 11. Were you satisfied with the level of management support in the project?

*Mark only one oval.*

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

13. 12. Was project communication handled efficiently and effectively in disseminating information at all levels of decision-making within the team?

*Mark only one oval.*

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

14. 13. Did you feel appreciated, recognised and rewarded for your efforts?

*Mark only one oval.*

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

**Key aspect 2: Systems (Technology, process and infrastructure)**

15. 14. Do you think the organisation has knowledge management strategies and tools in place for knowledge capturing? (Including tools enabling retrieval of information, lessons and logs from past projects).

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

16. 15. Was the process for reporting challenges/problems clear, easy to follow and efficient?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree



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17. 16. Were the issues dealt with and resolved in a timely and satisfactory manner?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

18. 17. The project issues and decisions taken were well documented.

*Mark only one oval.*

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

19. 18. Was the information easily accessible?

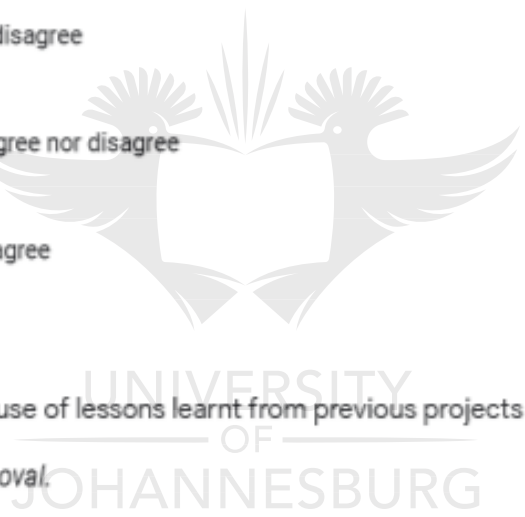
*Mark only one oval.*

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

20. 19. There was use of lessons learnt from previous projects by the team.

*Mark only one oval.*

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree



21. 20. The project team held post-mortems during the project to discuss the successes and failures of a project.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

22. 21. The project team held post-mortems to discuss the successes and failures of a project at the end of the project.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

23. 22. The project sub-teams conducted their own post mortems.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree



24. 23. All project sub-teams took part in larger post-mortem sessions involving all teams.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

25. 24. The project team followed through on the outcomes/recommendations of post mortems.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree



26. 25. It is better and effective for individual/smaller teams to conduct their own post mortems.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

27. 26. It is better and effective to conduct project post mortems as a larger team representing all disciplines.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

28. 27. Project post-mortems are a beneficial tool in construction projects.

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree



Section C:  
Benefits  
of  
successful  
project  
post  
mortems.

Guideline for answering questions in Section C:

The aim is to identify the benefits of a successful project post-mortems, based on your knowledge and experience in construction project post-mortems. This research uses the 5 point Likert scale that allows the participant to express how much he/she agrees or disagrees with each of the statements. Please be open and honest in your responding.



29. 28. Do you think that sharing of information can influence the level of participation of other project team members and better communication with customers?

*Mark only one oval.*

- Strongly disagree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly agree

30. 29. Re-use of internal available knowledge obtained from project post mortems reduces the repetition of errors and result in time-saving/costs.

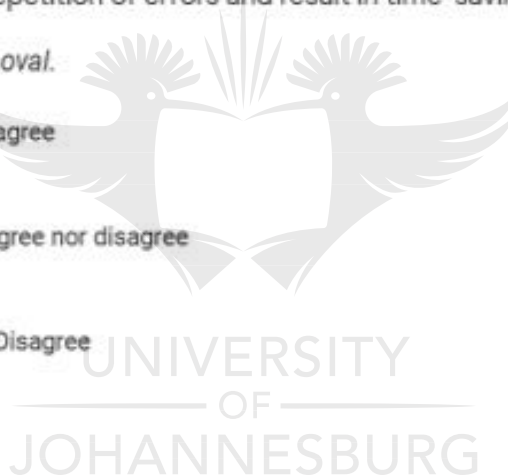
*Mark only one oval.*

- Strongly agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly Disagree

31. 30. Do you think the involvement and support of top management for project post mortem processes has an impact on organisational performance?

*Mark only one oval.*

- Strongly agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly disagree



32. 31. Discussion about the project challenges and and celebrating the achievements brings the project team closer together?

*Mark only one oval.*

- Strongly Agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly Disagree

33. 32. Project post-mortems makes the project team members feel more engaged and allows the organisation to capitalise on the lessons learnt.

*Mark only one oval.*

- Strongly Agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly Disagree



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34. 33. Performing a post-mortem brings clarity and improvement opportunities on its processes after a project is closed?

*Mark only one oval.*

- Strongly Agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly Disagree

35. 34. Collective improvement and individual contributions through project post mortems receives appropriate recognition in projects?

*Mark only one oval.*

- Strongly Agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly Disagree

36. 35. Active participation of senior management and the project team in the review and collaboration process promotes continuous improvement in the organisational learning process.

*Mark only one oval.*

- Strongly Agree  
 Disagree  
 Neither agree nor disagree  
 Agree  
 Strongly Disagree

**End of questionnaire, thank you!**

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## APPENDIX B: ETHICS CLEARANCE CERTIFICATE




### Ethics Approval Clearance Certificate

The ethics approval application submitted by

<b>Name of Researcher</b>	Gavin Motswadi
<b>Name of Organization</b>	University of Johannesburg
<b>Name of Faculty</b>	Faculty of Engineering and the Built Environment
<b>Name of Principal Investigator</b>	Dr. Hannelie Nel
<b>Name of the Research Project</b>	The importance of post-mortems in construction projects in Gauteng Province, South Africa

Has been

- APPROVED without the need for any modification by the Ethic Committee.
- APPROVED in principle but requires modification / additional information as indicated below in the comments section by the Committee.
- NOT APPROVED and requires modification / additional information as indicated below in the comments section by the Committee. Resubmission is required before approval can be granted.
- DISAPPROVED without the possibility for resubmission – the information indicated below in the comments section by the Committee highlights the reasons for this decision.

  
Signature (Chair of the FEBE FEPC)

November 19, 2019  
Date of FEBE FEPC meeting