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The extent of the PMBOK® Guide application by CPMs within South Africa's built environment

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Research submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science in Building (Project Management in Construction).



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University of the Witwatersrand, School of Construction Economics and Management,

Johannesburg 31 January 2016

Declaration

Research project submitted in partial fulfilment of the requirements for the degree of Master of Science in the Built Environment (Project Management in Construction) by coursework and research report in the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, 2015.

I declare that this research is my own, unaided work. It has not been submitted before for any other degree, part of degree or examination at this or any other university.

_____

Chrys Andobia Azozama

Date: 30 December 2015

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ABSTRACT

The construction industry is one of the key drivers of economic development in any country. Yet the prevalence of construction project delays and cost overruns continues to be a worldwide chronic problem within the industry. The aim of this study is to evaluate the extent of application of *A Guide to the Project Management Body of Knowledge* (PMBOK® Guide) by construction project managers (CPMs) within South Africa's built environment.

The increase acceptance of project management as a profession indicates that the application of knowledge, processes, skills, tools, and techniques can have a significant impact on project success. Hence, it is imperative to ascertain whether or not CPMs in South Africa built environment are structurally applying PMBOK® Guide' processes, tools and techniques when managing their construction projects. This study uses the term "structurally applying PMBOK® Guide" to mean appropriate application of the PMBOK® Guide's knowledge, processes, tools and techniques.

The sample population consists of 120 CPMs within South Africa's built environment drawn from the nine provinces of South Africa. The result of this study confirm conclusions of previous studies that the prevalence of construction project delays and cost overrun is still high in South Africa's built environment. The results also show that some CPMs do apply the PMBOK® Guide partially, but that, in general, CPMs do not apply the PMBOK® Guide structurally. The findings indicate that this limited structural application of the PMBOK® Guide is one of the major reasons for the prevalence of project delays and cost overruns within South Africa's built environment.

Therefore, this study stresses that stakeholders within South Africa's built environment and in particular the South African Council for the Project and Construction Manager Professions (SACPCMP) should take measures to address these prevailing challenges attributable to inadequate PMBOK® Guide application as demonstrated in this study.

Amongst the measures to address these challenges, this study recommends: firstly, the introduction of the PMBOK® as a compulsory component of a Construction Project Management course. Secondly, that the SACPCMP considers the Project Management Institute's Project Management Professional exam as one of the Pr. CPM registration requirements as a demonstration of improved theoretical knowledge. Finally, that the built environment fraternity should review the structure of the Built Environment Bill of Quantity so that it is strictly aligned with the Work Breakdown Structure approach. This will assist CPMs to appropriately estimate and control the schedule and cost of each piece of work to avoid project delays and cost overruns.

Key words: *A Guide to the Project Management Body of Knowledge* (PMBOK® Guide), generally recognised, structurally, Built Environment, Construction Project Managers (CPMs).

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List of Acronyms

Body of Knowledge: Knowledge within a profession or subject area that is generally agreed as both essential and generally known (Oliver, 2012)

Construction Project Management: The management of projects within the built environment from conception to completion, including management of related professional services. The construction manager is the one point of responsibility in this regard (SACPCMP, 2006)

Construction Professional: Any person registered with any council within the Council for the Built Environment (CBE)

Guidelines: A document containing recommendations for methods that should be used to achieve a desired goal

Management: An act of coordinating the efforts of people to accomplish desired goals and objectives using available resources efficiently and effectively

Methodology: A system of practices, techniques, procedures and rules used by those who work in a discipline

Project: A temporary endeavour undertaken to create a unique product, service or result

Standards: A document approved by a recognised body that provides guidelines for common and repeated use, rules, or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. Compliance with a standard is not mandatory but is helpful.

Regulation: An official document that provides guidelines that must be followed. Compliance with a regulation is mandatory.

Abbreviations

CBE:	Council for the Built Environment
CPM:	Construction Project Management
CPMs:	Construction Project Managers
ECSA:	Engineering Council of South Africa
NDP:	National Development Plan
NGP:	National Growth Path
NIP:	National Infrastructure Plan
PA:	Principal Agent
PICC:	Presidential Infrastructure Coordinating Commission
PM:	Project Management
PMBOK® Guide:	A Guide to the Project Management Body of Knowledge
SACAP:	South African Council for the Architectural Profession
SACPCMP:	South African Council for the Project Construction Management Profession
SACQSP:	South African Council for the Quantity Surveying Profession
UK:	United Kingdom
US:	United States

CHAPTER 1: INTRODUCTION

1.1. Background to the study

The construction industry is one of the key drivers of economic development in any country (Baloyi and Bekker, 2011; Shirazi and Hampson, 1998). Yet the prevalence of construction project delays and cost overruns continues to be a chronic problem worldwide in the construction industry and hamper project objectives (Apolot, *et al*., 2010; Olatunji, 2010; Ramabodu and Verster, 2013; Sunjika and Jacob, 2013). Due to the importance of the construction industry (Baloyi and Bekker, 2011) and considering the challenges that the industry is facing (Apolot *et al.*, 2010), Construction Project Management (CPM) profession has been recognised as a distinct profession within the built environment in South Africa to alleviate the challenges of poor construction project management (Act, 48 of 2000).

With aim of professionalising the CPM profession, the South African Council for the Projects and Construction Management Profession (SACPCMP) was established by an Act of Parliament in 2000 (Projects and Construction Management Act 48 of 2000, hereafter Act 48 of 200). One of its main purposes is to regulate the CPM professions, to provide for the registration of professionals, candidates, and specified categories in CPM profession. This purpose is being fulfilled by creating an environment that will encourage and facilitate, amongst other things, access for individuals engaged in CPM profession to obtain the necessary skills as well as promoting research and development to improve CPM best practices, procedures and stakeholder satisfaction. The intention is to improve competency amongst CPMs who are capable of delivering construction projects on time, within cost and at required quality, an aspect that is not yet evident (Rwelamila, 2007).

Similarly, additional Acts for other professions within the built environment in South Africa have also been passed. Such Acts include Act 44 of 2000 for the establishment of the South African Council for the Architectural Profession (SACAP), Act 46 of 2000 for the establishment of the Engineering Council of South Africa (ECSA), and Act 49 of 2000 for the establishment of the South African Council for the Quantity Surveying Profession (SACQSP).

The Act 48 of 2000 requires any person wishing to practise CPM work in South Africa to register with the SACPCMP. The SACPCMP prescribes the nature of work that may only be performed by persons registered. The SACPCMP has established mechanisms to ensure that individuals practising the CPM profession acquire and demonstrate both technical competence and project management (PM) competence before registering as professionals. “Project management” is defined as the application of knowledge, skills, tools and techniques to project activities to meet the project requirements. This application of knowledge requires effective management of the PM processes (PMI, 2013).

The SACPCMP requests proof of such competencies in the form of reports that display the candidate’s proficiency of the project management body of knowledge (SACPCMP, 2009). It should,

however, be noted that the SACPCMP does not prescribe a specific standard or methodology that each individual has to follow when managing projects. Nonetheless, at the time of this study, the SACPCMP required that the registration reports must be aligned with nine specific project management knowledge areas prescribed by the Project Management Institute's (PMI) standards contained in the Guide to the Project Management Body of Knowledge (i.e., PMBOK® Guide, 4th Edition).

The PMI's PMBOK® Guide has been identified as the most popular body of knowledge worldwide in project management fraternity (Zwikael, 2009). The PMI's processes, tools and techniques as contained in its PMBOK® Guide are generally recognised as good practice (PMI, 2008). "Generally recognised" means that the knowledge and practices described are applicable to most projects and there is consensus about their value and usefulness (PMI, 2008). Furthermore, the PMI recognises that applying effective established processes, tools and techniques within each knowledge area can have a significant impact on project success. Effective application of the PMBOK® Guide's knowledge means applying all the processes as prescribed, not choosing to perform only those processes, tools or techniques that the individual is most familiar with or that are easier to perform (Zwikael, 2009).

This study uses the term "structurally applying" PMBOK® Guide to mean appropriate application of the PMBOK® Guide's processes, tools and techniques. This decision is based on the understanding that according to the PMI's recommendations, to successfully complete a project a CPM should systematically follow all the PMBOK® Guide's processes (PMI, 2008). Moreover, it is noted that PMI's Project Management Professional (PMP) exam passing score is set above 61% for each processes group. Obtaining Less than 61% in any process group means below proficiency, therefore a fail and not ready to be PMP certified (Mulcahy *et al.*, 2013). Hence, this study's view that to structurally applying PMBOK® Guide; the individual should effectively apply at least 61% of each PMBOK® Guide's processes.

As indicated before, the SACPCMP requirements for professional registration involve an applicant or candidate writing a report indicating project successes. A second report should present the challenges experienced on the projects executed and explain how these challenges were overcome. Both reports must follow the nine PM knowledge areas, as contained in the PMI's PMBOK® Guide. The nine PMI's knowledge areas are: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resources Management, Project Communication Management, Project Risk Management and Project Procurement Management.

After an assessment of these two reports by experienced SACPCMP panellists, who must be convinced that the candidate has a good understanding of the PM body of knowledge and its application in project delivery, the candidate is then recommended for a panel interview. The objective of the interview is to assess and confirm whether the candidate understands the application of the

PMBOK® Guide. Only after successful panel interviews will such a candidate be recommended for registration as a professional CPM and be allowed to use the acronym Pr. CPM.
By virtue of the Act 48 of 2000 that created the SACPCMP, any person practising CPM work in South Africa must be registered with the SACPCMP. Furthermore, any person performing CPM work in South Africa, irrespective of his or her specific academic background, registration with any other council or types of standard and process or method being used, is expected to be conversant with the PMBOK® Guide.

It is therefore unfortunate that despite the SACPCMP's efforts to adhere to the best practices within the built environment (SACPCMP, 2009), project delays and cost overruns are still very prevalent within the South African construction industry (Baloyi and Bekker, 2011; Ramabodu and Verster, 2013). Project delays and cost overruns generally culminate in construction projects not achieving their objectives and ultimately in poor service delivery, hence the importance of this study. This study evaluates the extent to which the PMBOK® Guide, particularly the application of the PMI's nine PM knowledge areas, are applied by CPMs practising within the built environment industry in South Africa.

The extent of application of the PMI's PMBOK® Guide' knowledge areas by CPMs will be evaluated to determine:

1. Whether or not CPMs are structurally applying all the processes, tools and techniques within each knowledge area as recommended in the PMBOK® Guide.
2. Whether or not project delays and cost overruns experienced within the construction industry in South Africa can be attributed to a lack of appropriate application of the PMBOK® Guide.

1.2. Research problem

1.2.1. Defining the research problem

Rwelamila (2007) ascertained that from time immemorial, construction projects are managed by technical experts within the built environment, including engineers, architects, quantity surveyors and construction managers. In South Africa, these technical experts are expected to be registered as professionals with their different councils within the built environment as discussed earlier. The SACPCMP is the council for those who want to integrally manage the full spectrum of a construction project (SACPCMP, 2009).

Rwelamila (2007) recognises that, though the technical part of a construction project is important and necessary, it is often the smallest and easiest part when compared to the full spectrum of a project environment. Rwelamila (2007) further affirms that technical success does not necessarily lead to construction project success: it is necessary but not sufficient. As a consequence, most projects are increasingly being mismanaged to the extent that mismanagement appears to be the norm. This reflection led Rwelamila (2007) to conduct a study of CPM education programmes in South Africa.

Based on the study of Higher Education Institutions (HEIs) providing PM programmes in South Africa, Rwelamila (2007) suggests that though these institutions provide adequate technical knowledge, the programmes are dismally weak in various prominent aspects of PM knowledge bases. Worse, recent studies still indicate the prevalence of project delays and cost overruns (Apolot *et al.,* 2010; Olatunji, 2010; Ramabodu and Verster, 2013; Sunjika and Jacob, 2013). These findings mean the challenge of project delays and cost overruns within South Africa's built environment are not yet resolved.

1.2.2. Problem context

Existing research findings have confirmed that appropriate application of the PM body of knowledge, including processes tools and techniques, increases the chances of project success (Olatunji, 2010; Rwelamila, 2007; Zwikael, 2009). Furthermore, within the South African context, the SACPCMP recognises the importance of the PMBOK® Guide; registration eligibility as a Professional Construction Project Manager (Pr. CMP) with the SACPCMP is therefore based on the candidate's capacity to apply the nine PM knowledge areas (SACPCMP, 2009).

Nonetheless, CPMs' performances when managing construction projects do not necessarily indicate a considerable improvement. Persons managing construction projects are still failing to complete construction projects successfully on time, within the stipulated budget at the required quality (Akinsiku and Akinsulire, 2012; Apolot *et al.*, 2010; Arcila, 2012; Baloyi & Bekker, 2011). This may be an indication that CPMs are not structurally applying the recommended PMBOK® Guide when managing construction projects.

1.2.3. Consequences

Any failed project deprives the community of the required structure and wastes scarce resources. It must be conceded that completing a project on time, within cost and at the required quality is a daunting task that cannot be taken for granted (Mulcahy *et al.*, 2013). However, Mulcahy *et al.* (2013) suggest that despite various challenges and constraints inherent to any project, the successful delivery of a project rests on the shoulders of the CPM, who is assumed to be a professional, knowledgeable and capable of delivering successful construction projects. Though many studies have been conducted to identify the factors and causes of project delays and cost overrun in South Africa, the issue of project delays and cost overruns has not yet been resolved (Apolot *et al.,* 2010; Akinsiku and Akinsulire, 2012). As a consequence, not only are the country's resources wasted, but also and most importantly, the country's social and economic development is affected.

1.3. Aim of the study

The aim of this study is to evaluate the extent of application of the PMBOK® Guide by CPMs within the built environment industry in South Africa. In that regard, this study seeks to determine and examine the possibility that individuals who practise CPM work are not structurally applying the PMBOK® Guide.

Most of the challenges identified in previous studies causing projects to fail (Akinsiku and Akinsulire, 2012; Apolot *et al.*, 2010; Olatunji, 2010; Othman and Ahmed, 2013; Rwelamila, 2007) are inventoried as an integral part of the challenges of a PM environment (Mulcahy *et al.*, 2013). Therefore, only by ascertaining whether or not CPMs are structurally applying readily available knowledge, tools and techniques can possible remedial actions be considered.

1.4. Research objective

With the indication that construction project management training in South Africa might be limited (Rwelamila, 2007), the first palliative remedy for CPMS to successfully deliver construction projects depends on each CPM's capacity to structurally apply existing project management body of knowledge. PMBOK® Guide contains necessary project management processes, well-tested tools and approved techniques, which, if well applied, will ensure project success. Therefore, this study argues that the limited application of PMBOK® Guide when managing construction projects lead to the prevalence of project delay and cost overrun that the profession is experiencing in South Africa.

Therefore, the main objective of this study is to determine means to enforce CPMs to adhere to and abide by an appropriate application of the PMBOK® Guide when managing construction project.

1.5. Research question

Derived from the problem and the objective of this study, the primary research question of this study is:

> Considering the prevalence of project delays and cost overruns in the built environment in South Africa, to what extent do CPMs performing CPM work structurally apply the PMBOK® Guide's processes?

From the above question, this research hypothesis is: Structural application of PMBOK® Guide's processes, tools and techniques result to project success. Therefore, this study seeks to determine whether or not CPMs within South Africa's built environment structurally adhere to PMBOK® Guide's application.

Resulting from this primary question, the following secondary research questions, relating to the nine knowledge areas, emerged:

> To what extent do CPMs performing CPM work structurally apply?
>
> 1. *All the* project integration management processes?
> 2. All the project scope management processes?
> 3. All the project time management processes?
> 4. All the project cost management processes?
> 5. All the project quality management processes?
> 6. All the project human resource management processes?
> 7. All the project communication management processes?
> 8. All the project risk management processes?
> 9. All the project procurement management processes?

These questions are based on the fact that within Pr. CPM registration with the SACPCMP, candidates are requested to briefly report on their understanding of these nine projects management knowledge areas as contained in the PMBOK® Guide.

Furthermore, this study considers that a respondent does structurally apply a specific process only if, on a scale of 1 to 5, the respondent applies a specific process at level 4 and above. Any application below 4 for a given process is considered as not structurally applying that specific process. As said before in section 1.1, this decision is informed by the understanding of the PMP exam format. The PMP exam is based on the PMBOK® Guide. Though the PMI does not publish the passing score, it is speculated that it is above 61% to 65% for each process group (domain) (Mulcahy *et al.*, 2013). Any score below 60% is interpreted as being below proficiency and therefore a failure.

1.6. Research scope

1.6.1. Delineations

In the PM environment, there are a number of Project Management bodies of knowledge (PMBOK) used. There is PMBOK such one of the Association for Project Management's Body of Knowledge (APMBOK), PRINCE2 (Matari, 2014). However, within the context of this study, when reference is made to "PMBOK" it means the one from PMI.

Moreover, within the South African context the SACPCMP registration requirement is exactly aligned with the PMI's nine PM knowledge areas as contained in the PMI's PMBOK® Guide Fourth Edition. Therefore, this study inclusively evaluates the extent of the application of the PMI's PMBOK® Guide by all individuals practising CMP work, not only CPMs registered with the SACPCMP. This is because section 26, Subsection 3 (a) of the Act 48 of 2000 restricts CPM work to be performed only by SACPCMP registered persons, though, the subsection 4 of the same Act refrain that prohibition sub-clause by stipulating that:

> Subsection (3) (a) may not be construed as prohibiting any person from performing work identified in terms of this section, if such work is performed in the service of or by order of and under the direction, control, supervision of or in association with a registered person entitled to perform the work identified and who must assume responsibility for any work so performed.

Furthermore, many scholars refute the idea of limiting project failure to delays and cost overruns only (Arcila, 2012). However, Van Der Westhuizen and Fitzgerald (2005) ascertained that delays and cost overruns are amongst the major reasons for project failures. This view is also supported by Doloi (2011), who ascertained that cost and schedule are considered the most important factors in the execution of construction projects. Therefore this study limits itself to the two parameters of cost and schedule within the PM sphere, as the two parameters are easily measurable.

1.6.2. Research assumptions

The following assumptions are made:

- Considering the SACPCMP registration requirement, it is assumed that the PMBOK® guide from the PMI is the recognised PM standard applied within the South African built environment industry for CPM work.
- Though coaching and mentoring should be encouraged in CPM professionals, they must not be construed as replacement of the professional person. Therefore, this research assumes that if the person performing CPM work is not competent, the supposed control and supervision of a registered Pr. CPM in a bid to influence the project delivery has a limited effect. Hence, this study did not consider the implication of the supervisory aspect, but was limited to individuals practising CPM work.
- Finally, this study assumes that any extension and / or addition approved or not, inconveniences the end users, who are expecting a specific structure at a determined

time, within a determined budget for a definite reason. Change might be inevitable in the project, but CPMs should work to prevent the root cause of changes whenever possible (Mulcahy *et al.,* 2013).

1.7. Research methodology

With regard to the question posed in this research, the quantitative method was found to be an appropriate method as the research has to use statistical means to answer the research question (Saunders *et al.,* 2021). An online questionnaire was used to collect data.

Quantitative research is generally associated with positivism, especially when used with predetermined and highly structured data collection (Saunders *et al.,* 2012), as in the case of this research. It might also be associated with a deductive approach, where the focus is on using data to test theory. It examines relationships between variables, which are measured numerically and analysed using a range of statistical techniques. By evaluating the extent of CPMs' PMBOK® Guide's application, this study will deduct whether or not CPMs are structurally applying PMBOK® Guide as recommended by PMI.

Furthermore, the research is also explanatory and descriptive in nature. Explanatory studies seek to establish causal relationship between variables (Saunders *et al.*, 2012). This study must be seen as a process of enquiry to establish causal relationships between the prevalence of project delays and cost overrun and application of PMI's standards, particularly in alignment with its nine project management. The object of descriptive studies is to gain an accurate profile of events, persons or situations (Saunders *et al.,* 2012). This study seeks to understand the extent of use of the PMBOK® and processes as applied by CPMs during the delivery of construction projects and, by extension, there competencies relative to the discipline of construction project management. The choice of this approach is therefore dictated by the nature of the problem, which is the poor project delivery outcomes on one hand with regard to the extent of CPMs' application of the PMBOK® Guide, when managing construction projects on the other hand.

1.8. Research limitations

The following limitations are applicable to this study:

- The PMBOK® Guide is not the only body of knowledge and framework in the PM environment. Others include the International Project Management Association's (IPMA) (IPMA, 2006); the Office of Government Commerce (OGC) (OGC, 2007); and Prince2. The result of this study cannot be generalised for CPMs applying these other bodies of knowledge or frameworks.

- The PMBOK® Guide published its fifth edition in 2013. Only the PMBOK® Guide's fourth edition is used in this study, therefore the results of this study cannot be generalised for the fifth edition.

- The PMI has since published a construction extension to the PMBOK®, which is already in its third edition. It has not been considered, therefore the result of this study cannot be generalised as being representative of the application of the whole of PMI's PMBOK® because it is possible that if the PMBOK® Guide is used in conjunction with the construction extension, the result might be different.

Furthermore, it is understood that due to the no-prohibition option within the Act 48 of 2000, logically, any person can perform CPM work if supervised and controlled by a registered professional. Therefore, this study is not limited to registered Pr. CPMs only; it is extended to all individuals practising CPM work within the built environment industry in South Africa. This includes registered construction professionals within the following built environment councils: the South African Council for the Project and Construction project (the SACPCMP); the Engineering Council of South Africa (ECSA); the South African Council for the Quantity Surveying Profession (SACQSP); and the South African Council for the Architectural Profession (SACAP).

1.9. Ethical considerations

Ethical considerations in research are of capital importance, particularly when dealing with human subjects, e.g. confidentiality, dignity, benefit-to-risk ratio and informed consent (Behi and Nolan, 1995). In the context of research, ethics are the standards of behaviour that guide the researcher's conduct in relation to the rights of those who become the subjects of the research (Saunders *et al.*, 2012). This study ensured it followed ethical considerations when conducting this research.

To comply with ethical standards, all respondents were informed of the objective of the research in the body of the questionnaire and it was indicated that their reply constituted consent to participate in this research. In addition, the questionnaires that were sent directly to random CPMs went through the relevant council's administrative office for approval before being sent to their members. All data have been treated in a way that protects the confidentiality of the respondents. The study complied with quality assurance in respect of the competency of the respondents, the correctness and completeness of the questionnaires (Saunders *et al.*, 2012). All information pertaining to the respondents will remain the property of the researcher and the School of Construction Economics and Management and will not be used for any purpose except for the execution of this study. Lastly, an ethical clearance certificate was obtained through the School's ethics committee (attached in Annexure 2).

1.10. Rationale and significance of the study

The prevalence of construction project delays and cost overruns within the built environment in South Africa is still a concern (Olatunji, 2010). There are various causes, such as lack of adequate planning, lack of prompt payment to contractors, lack of sponsorship and stakeholder buy-in, insufficient or vague requirements collection and management, scope creep, inadequate planning, poor communications and risk management, ineffective monitoring and control, and poor supervision (Arcila, 2012; Magruder, 2011; Olatunji, 2010). Nevertheless, it has been confirmed that the PMBOK® Guide if structurally applied would assist to overcome most of these challenges that CPMs are facing (Mulcahy *et al.*, 2013).

1.11. Outline of the study

The outline of this study is described below:

The first chapter provides a generic overview of the research relative to the background of the study. The chapter presents the research problem, research question, the research delimitation and rationale behind the research. The research objectives and scope are also outlined in this chapter, together with assumptions made.

A review of the relevant literature of the study area is presented in Chapter Two. Findings from previous studies that have a direct bearing on this study area are presented and the different knowledge areas as explained in the PMBOK® Guide fourth edition are also reviewed in this chapter.

Chapter Three discusses the research methodology. The research philosophy, paradigm and approach adopted in this study are discussed. Furthermore, the research population and its sampling as well as the development of the different questionnaires are explained in this chapter.

The summary of the most important findings and their analyses as obtained from the questionnaire survey is given in Chapter Four.

Chapter Five presents the conclusions and recommendations and suggests topics for further research. Thereafter, all the relevant references are outlined and the appendices are attached.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

Evidence exists to suggest that future growth in both the public and private sectors in Africa will originate from the delivery of successful infrastructure projects (Rwelamila and Purushottam, 2012). These projects will generate new facilities and related services, which will create a positive environment to attract investment, new products and services required for development (Rwelamila and Purushottam, 2011). Hence, the South African government has recognised that infrastructure development is a key priority to both the National Development Plan (NDP) and the New Growth Path (NGP) as stipulated in the Presidential Infrastructural Coordination Commission (PICC) (PICC, 2012).

To enhance the contribution of infrastructure development within the NDP and NGP programmes to address South Africa's triple challenges of unemployment, poverty and inequality, government has initiated the PICC to plan and coordinate the delivery of the National Infrastructure Plan (NIP) (PICC, 2012). However, considering experience of past project outcomes, the success of infrastructure projects in achieving expected goals within the NDP and NGP schemes is not very certain because most recent reports still indicate a high rate of construction project delays and / or cost overruns in South Africa (Mokoena, 2012; Olatunji, 2010; Ramabodu and Verster, 2013).

2.1. Previous studies relating to project delays and cost overruns

Indications from previous studies confirm that project failure is still unacceptably high in South Africa (Ramabodu and Verster, 2013). Different studies have highlighted project failures in the built environment (Graham and Englund, 2004; Ramabodu and Verster, 2013; Rwelamila and Purushottam, 2011). In particular, Rwelamila and Purushottam (2012) group project failures in South Africa into four different but interrelated categories as follows:

- Inefficient projects: projects that experience uncontrolled delays and cost overruns, which fail to deliver on time and within cost;
- Weak impact on customers / stakeholders: projects that are unable to meet technical specifications, unable to address customer / stakeholders needs, and unable to satisfy customer / stakeholders' needs;
- Unsuccessful business / unsuccessful development strategy: projects that do not achieve significant commercial success for the private sector or development projects unable to achieve developmental goals for public sector; and
- Unsustainable potential: projects that is unable to add value due to a mismatch between the project outcome and the final stakeholders' needs.

Although all of these project failure categories are not acceptable, "inefficient projects" is the most prevalent category of project failure in South Africa and continues to be a chronic problem worldwide

in the construction industry (Apolot *et al.*, 2010; Olantunji 2010; Ramabodu and Verster, 2013; Sunjika and Jacob, 2013). Therefore, this study is particularly focused on these two factors of project delays and cost overruns, characteristic of inefficient projects.

The challenge of project delays and cost overruns is not unique to South Africa. Ramabodu and Verster (2013) mention some prominent projects with cost overruns around the world, including Denver Airport in the US, which was planned for US $5 billion but completed at over 200% cost overrun; the Oresund Bridge between Denmark and Sweden, which experienced a 68% cost overrun and the Scottish Parliament building was actually completed three years after the planned completion time with a 900% cost overrun. Arcilla (2012) reports that the British Library project completed in 1998 exceeded its initial budget more than three times. In its 2015 global construction project owner's survey, KPMG (2015) reported that 90% of public-sector projects around the world suffer underperformance in one or another project performance delivery objective. The same survey reports that only 31% and 25% of the respondents' projects were delivered within 10% of the original budget and deadlines respectively in the years preceding the study.

In other industries, the situation is no better either. For example, in information technology (IT), it has been reported that only 32% of IT projects were completed on time, within budget and with the required features and functions requested by the client (Golorath, 2009). The same report indicates further that 44% of projects were late, over budget and with incomplete features or functionality. The remaining 24% were complete failures because they were either cancelled before completion or were delivered and never used due to lack of the required functionality.

Although this trend is common in most of industries all over the world, Ali *et al.* (2011) suggest that it is more severe in developing countries. Memom (2012) concurs with this suggestion by reporting that, on average, close to 90% of all projects undertaken in Malaysia experience delays and / or cost overruns. Frimpong, Oluwoye and Crawford (2003) indicate that 75% of groundwater projects completed between 1970 and 1999 in Ghana exceeded the original project schedule and cost. In Kampala, the Northern By-pass Project which was scheduled to be completed within 30 months took as long as 60 months and the cost had almost doubled by the time it was completed (Apolot *et al.*, 2010).

The situation in South Africa is no different. For example, the cost of the Gautrain rapid rail link project was budgeted at R4 billion when started. At the time of the completion of the project, its cost had escalated to R30 462 billion (Fombad, 2013).

Another such project is the Medupi Power Station Project in Medupi, Limpopo province. The project was under way at the time of this study. Graumann (2010), reports that the Medupi project is affected by delays and cost overruns. According to that report, construction started in May 2007, the first unit was scheduled to be synchronised to the grid by April 2012 and the last unit by August 2015. At the time of writing, the project is behind schedule and the cost fluctuates between R105 billion and R125 billion (Graumann, 2010).

The 2010 FIFA World Cup Stadiums Project is another project that suffered delays and cost overruns. Although these stadiums were completed on time for the 2010 tournament, Baloyi and Bekker (2011) report that some were still not completed as scheduled; hence, they were not ready to host the pre-FIFA World Cup African Confederation Cup tournament in 2009 as planned. Furthermore, the same study reports that almost all of the 10 stadiums were completed over the planned budget, with some costs spiralling 200% over the initial budget.

Some of projects that experienced excessive cost overruns are presented in Figure 2.1.

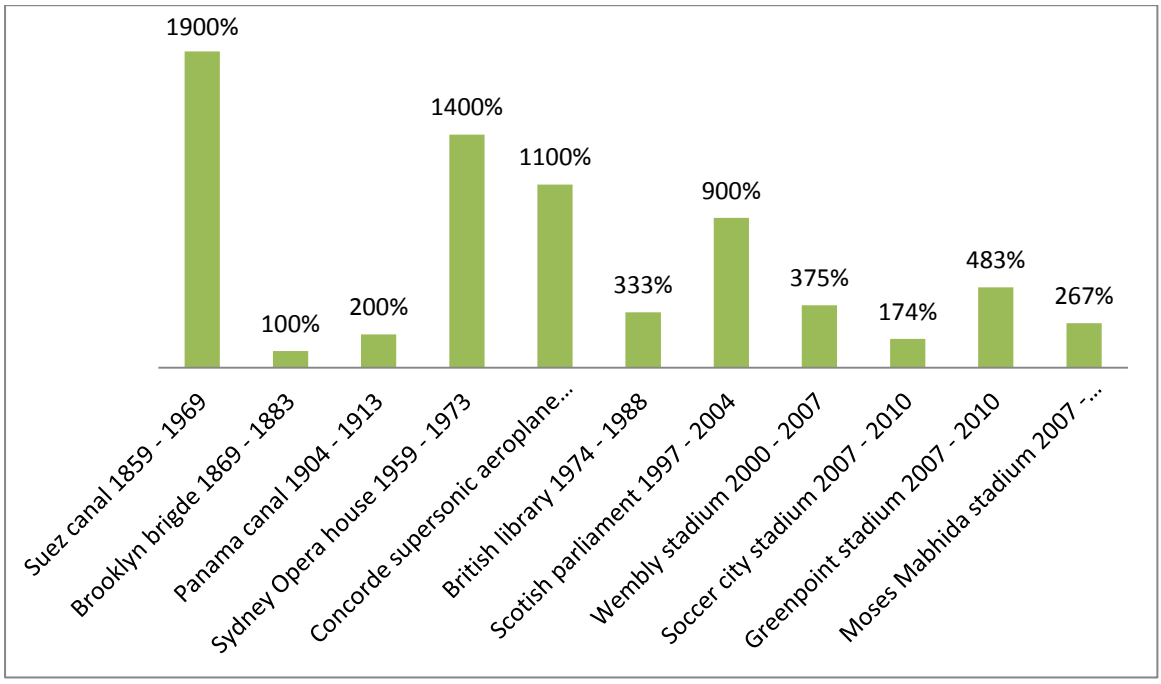


Figure 2.1: Some projects that experienced cost overruns from 1859 to 2010
Source: Ramabodu and Verster (2013:50)

2.2 Factors influencing project delays and cost overruns

The application of sound PM practices provides construction project team with the means to meet their objectives. When sound PM practice is lacking, it leads to delays and cost overruns (King, 2013). According to Arcila (2012), for years there has been a debate around the world amongst built environment stakeholders on the common issues that cause delays and cost overruns in construction projects, particularly at conferences and seminars. Yet the challenge is still extensive in the industry (Akinsiku and Akinsulire, 2012) with no meaningful resolution to date (Apolot *et al.,* 2010).

Previous studies have identified some factors responsible for project delays and cost overruns. These studies include research conducted by Apolot *et al.* (2010), who report that there are four factors that impact on projects and cause project delays and cost overruns. These factors are changes in scope, delayed payment to contractors, poor monitoring and control and high inflation and interest rates. This is in agreement with the findings of Ramabodu and Verster (2013), who also indicate that the change in scope of work, incomplete design at the time of tender, and contractual claims such as extension of time with cost attract delays and cost overruns. Furthermore, Ramabodu and Verster (2013) indicate that some extension of time and cost overruns are due to multiple reasons such as delays in responding to contractors' information requests, delays in project decision making, lack of proper cost planning and monitoring of funds, and delays in costing variations and additional works as important factors. On the other hand, Olatunji (2010) suggests that lack of adequate planning, management style, lack of constructability reviews and designs, inadequate motivation of workers, economic policies, lack of prompt payment to contractors, and quality of management during design and construction are some of the main factors that negatively influence project delivery time and cost.

As varied as the recognition of different causes for project delays and cost overruns are, research studies have not provided a definitive solution to this acute problem within the built environment (Baloyi and Bekker, 2011). Various studies in South Africa have identified factors affecting project delays and cost overruns, yet none of them has focused particular attention on the potential benefits of the application of sound, tested and readily available PM standards and best practices (Zwikael, 2009). Standards such as those of the PMI, contained in the PMBOK® Guide, provide PM processes that are easy to understand and implement; if structurally applied, these would increase the chance of completing projects on time, within cost and of the required quality. However, previous findings of chronic project failures (Baloyi and Bekker, 2011; Mokoena, 2012; Olatunji, 2010), call into question the methodology applied by industry professionals, particularly CPMs, during project implementation.

2.3. CPM work regulation in South Africa's built environment.

In South Africa built environment context CPM work is regulated. In its point 26 section 3 related to identification of work reserved to only registered person, the Act 48 of 2000 stipulate that: A person who is not registered in terms of this Act, may not:

(a) Perform any kind of work identified for any category of registered persons;

(b) Pretend to be, or in any manner hold or allow himself or herself to be held out as a person registered in terms of this Act;

(c) Use the name of any registered person or any name or title referred to in section 18 or 21; or (d) perform any act indicating, or calculated to lead persons to believe, that he or she is registered in terms of this Act.

Unfortunately, the same Act on section 4, introduced the notion of no prohibition and state that the sub section (3) (a) may not be construed as prohibiting any person from performing work identified in terms of this section, if such work is performed in the service of or by order of and under the direction, control, supervision of or in association with a registered person entitled to perform the work identified and who must assume responsibility for any work so performed.

Though there is indication that in general there is always a registered person who sign for contractual agreement purpose, most of the time it is a no registered person who is managing projects on day to day. Considering the high prevalence of project failure (Ramabodu and Verster, 2013), there is no evidence to suggest that no registered CPMs are strictly supervised by registered person. Therefore, though CPM work is regulated in South Africa's built environment, this regulation is not strict and anybody may perform CPM work (Rwelamila, 2007).

2. 4. The importance of a body of knowledge in construction project management

In any construction project, there is always a need to combine the effort of a certain number of different organisations working together towards a common goal to complete a specific project (Truman, 2015). These organisations include the client, end users, engineers, architects, contractors, CPMs and other stakeholders (Akinsiku and Akinsulire, 2012). It is not rare in a construction project to observe that different stakeholders hold different and competing interests (Dobie, 2007). Despite being in a conflicted environment, Dobie (2007) maintains that a CPM is still expected to deliver the project as agreed in terms of schedule, cost and other qualities. Within such an environment, the appropriate use of a body of knowledge will assist in ensuring project success (Grau, 2012).

As discussed earlier, the PMI's standards enhance the project team's chances of success despite possible challenges that CPMs might face in a construction project (Mulcahy *et al.*, 2013). For the same purpose, different PM professionals and standardisation bodies have developed standards for use in the PM environment. The most widely used are:

- Capability Maturity Model (CMM) from the Software Engineering Institute: This standard focuses on a specific degree of formality and optimisation of processes. The model's aim is to improve existing software development processes, but it can also be applied to other processes and industries.
- Global Alliance for Project Performance Standards (GAPPS): Globally applicable performance-based competency standards for PM. It complements existing knowledge-based standards for PM personnel in different industries (GAPP, 2007).
- Project in Controlled Environment (PRINCE2): This was developed by the UK government agency Office of Government Commerce, known as OGC. PRINCE2 is used in more than 150 countries and in different industries (Matari, 2014). It is now the de facto standard for PM in many UK government departments, across the United Nations system and in the private sector around the world (Matari, 2014).
- Recently, the world's leading International Organisation for Standardisation (ISO) released ISO 21500, which gives guidance on PM and can be used by any type of organisation, including public and private, and for any type of project, irrespective of complexity, size and duration (Zandhuis and Stellingwerf, 2013). ISO 21500 provides high-level descriptions of concepts and processes that are considered to form best practice in PM (Rehacek, 2014).

Comparing the ISO 21500 and the PMBOK® Guide, Rehacek (2014) found that the two standards are very close; they present a set of processes that have been organised in the same manner, by PM stage and PM topic. Moreover, Matari (2014) suggests that PRINCE2 and the PMI's PMBOK® Guide are the two PM standards that are mostly used in the PM environment. PRINCE2 is composed of seven principles, seven themes, and seven processes as presented in Figure 2.2. The principles in PRINCE2 are aspects of the project that tend to be applied, and if any one of them is not applied, then the project is not being run using PRINCE2 (OGC, 2009).

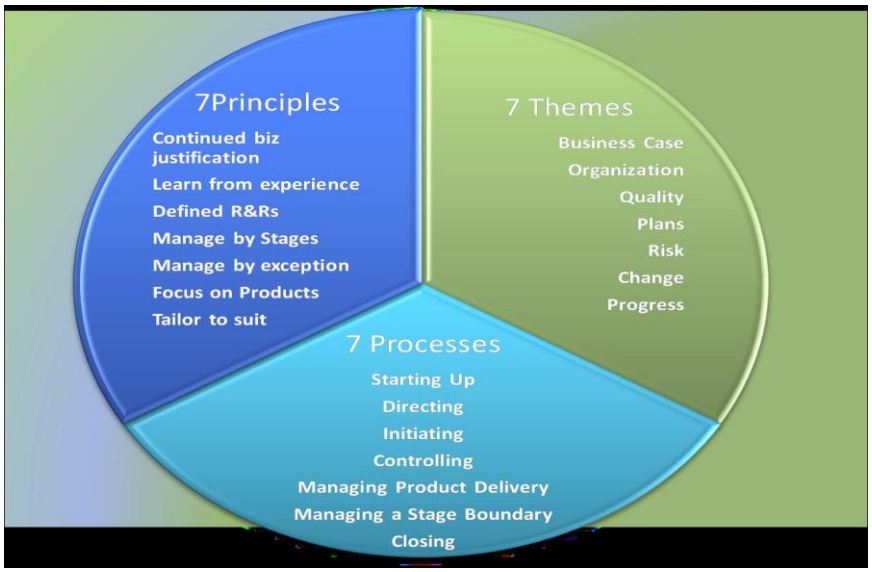


Figure 2.2: Basic structure of PRINCE2

Source: Matari (2014)

All of the aforementioned standards and others not mentioned here are available to CPMs and the project team to develop the necessary processes and control project works and activities with a view to completing a construction project successfully. To be successful a construction project must accomplish its objectives, including reaching its technical performance, maintaining its schedule, and remaining within the planned budget (Frimpong *et al.*, 2003).

2.5. Overview of PMI standards as contained in the PMBOK® Guide

According to PMI standards, PM is “a balancing act” that requires the management of competing demands or constraints and an assessment of impacts in the event that any one of them should change (PMI, 2013). This phenomenon is known as the triple constraint or the iron triangle, as presented in Figure 2.3. The triple constraint concept is that a change on any side of the triangle will likely result in a change on one or more other sides.

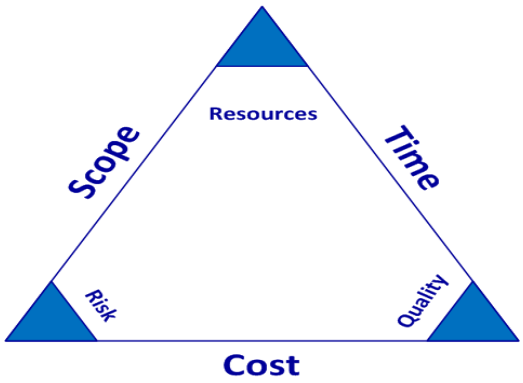


Fig. 2.3 Project management triple constraints
Source: The Knowledge Academy (2013)

The PMI standards contained in the PMBOK® fourth edition recommend 42 processes within nine knowledge areas: Integration, Scope, Time, Cost, Quality, Human Resource, Communication, Risk and Procurement, spanning the five process groups: Initiating, Planning, Executing, Controlling and monitoring and Closing, as shown in Table 2.1. To ensure project success, the PMI requires that the project manager and his or her project team members should address every process using a structured approach to obtain a significant impact (PMI, 2008). As indicated earlier, reports presentation requirement for Pr. CPM and Pr. CM registration with the SACPCMP follows the nine knowledge areas in the PMI PMBOK® Guide, fourth edition (see Table 2.1).

Table 2.1: Project management process groups and mapping of knowledge areas

Source: PMI (2008: 43)

Knowledge Areas	Project Management Process Group				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & controlling Process Group	Closing Process Group
4. Project integration management	4.1 Develop project charter	4.2 Develop project management plan	4.3 Direct and manage project execution	4.4 Monitor and control project work 4.5 Perform integrated change control	4.6 Close project or phase
5. Project scope management		5.1 Collect requirements 5.2 Define scope 5.3 Create WBS		5.4 Verify scope 5.5. Control scope	
6. Project time management		6.1 Define activities 6.2 Sequence activities 6.3 Estimate activity resources 6.4 Estimate activity duration 6.5 Develop schedule		6.6 Control schedule	
7. Project cost management		7.1 Estimate cost 7.2 Determine budget		7.3 Control costs	
8. Project quality management		8.1 Plan quality	8.2 Perform quality assurance	8.3 Perform quality control	
9. Project human resource management		9.1 Develop human resource plan	9.2 Acquire project team 9.3. Develop project team 9.4 Manage project team		
Project communication management	10.1 Identify stakeholders	10.2 Plan communication	10.3 Distribute information 10.4 Manage stakeholder expectations	10.5 Report performance	
Project risk management		11.1 Plan risk management 11.2 Identify risks 11.3 Perform qualitative risk analysis 11.5 Plan risk responses			
Project procurement management		12.1 Plan procurement	12.2 Conduct procurements	12.3 Administer procurements	12.4. Close procurements

Despite the PMI's recommendation to address all 42 processes with each knowledge area, as shown in Table 2.1, Zwikael (2012) points out that most project managers choose to perform only those processes that they are most familiar with or that are easier to perform. In doing so, they may give lower priority to knowledge areas or processes that have a higher impact on project success. The PMI does not support the perception that if a particular process is not required it should not be addressed (PMI, 2013). This means that, to ensure conformity and enhance the chance of project success, individuals using PMI standards should structurally deal with all the knowledge areas and their individual processes.

It must be noted that the PMI has revised its standards to include a tenth knowledge area in the PMBOK® Guide's fifth edition. However, at the time of this research, the SACPCMP was still using the nine knowledge areas as per the PMBOK® Guide fourth edition; therefore, this study only refers to the nine knowledge areas in the PMBOK® Guide fourth edition (2008).

2.5.1. Project Integration Management

In the PM context, the integration management knowledge area defines the project boundaries and has the characteristics of unification, consolidation, articulation, and integrative means of all activities that are crucial to complete the project successfully (PMI, 2008). This is the principal role of any project manager. It means that a project manager must be able to pull together all the pieces of a project into a cohesive whole (Mulcahy *et al.*, 2013). According to the PMBOK® Guide as presented in Table 2.1, integration management knowledge areas contain six processes: develop project charter, develop PM plan, direct and manage project execution, monitor and control project work, perform integrated change control and close project or phase.

The integration management knowledge area requires an overall view of the project from initiation to closure. For example, in the beginning of the project the client's requirements, budget and expected timing are indicated at a high level without full details, which most of the time are not necessarily certain. Based on these high-level indications, the CPM should integrate all parts of the project in a progressive manner to establish realistic and coherent baselines to achieve the client's objectives in terms of time, cost and scope. This balancing act, as explained above, is the function of the CPM and hence he or she should determine it, communicate it and agree upon it with the client at an early stage of the project (Mulcahy *et al.*, 2013). The PMBOK® Guide defines progressive elaboration as continuously enlightened and detailed planning as more detailed and specific information becomes available as the project progresses. This is a very important concept in CPM, particularly in large projects, as requirement collection might be carried out over an extended period of time, sometimes years on large projects (Truman, 2015).

Within the project integration knowledge area the project boundaries should be determined. Assumptions, success criteria, the extent of the project manager's authority and so forth are defined. Without an appropriate application of integration management knowledge, a CPM cannot integrate all the project constraints (Mulcahy *et al.,* 2013). The constraints to integrate include cost, time, scope,

quality, risks and resources. Without appropriate integration, during the project implementation changes will be introduced without control, leading to scope creep. As a result, expectations will not be met and the project will not be completed at the expected time and within the expected cost, resulting in project failure.

The Gautrain project presents a typical example of the importance of project integration management. The scope of the project comprised two links, one between Pretoria and Johannesburg and the other between OR Tambo International Airport and Sandton, with seven stations in between. Despite having different sub-stations, the project had to be integrated into one. This process requires integrated coordination to achieve the stakeholders' objectives and deliver the project successfully on time, within cost and at the required quality. Different processes within the integration management knowledge play an important role in ensuring project success: for example, how the project charter is being developed, how the PM plan is being developed, and how the different parts of the project are to be directed and managed during the project execution phase. A delay in one station will impact the project holistically. A discrepancy at one station might disrupt the link and cause project delay and / or cost escalation.

The prevalence of project delays and cost overruns experienced within the built environment in South Africa (Ramabodu and Verster, 2013) raises questions on competencies within the construction industry, particularly the way CPMs undertake each process in their project integration management knowledge area.

Experiencing similar unsatisfactory results in Malaysia's built environment, Shiau *et al.* (2004) advocate the advantages of construction project integration management software in managing construction projects. The authors argue that such tools facilitate integration of the different parts of a construction project all along the project life cycle. Integration through such software includes activities such as planning and recording information from different parts of the project, bidding and procurement processes, scheduling, site management, valuation and so on. Shiau *et al.* (2004) developed the Construction Integrated Manage System (CIMS) for the Taiwan construction market. In South Africa, similar software programs are also in use. Amongst them are the Microsoft Project (MS Project), Primavera and Win QS particularly for estimating and other cost-related activities.

If used to their full capacity, such software programs have the potential to facilitate integration management within the built environment. However, as for any innovative technological tool, the success of such software programs still depends on the individual's knowledge of the system, the viability of its inputs and the understanding of the processes, flow and procedures. The PMI (2008) refers to such tools or systems as Organisational Process Assets (OPA). To be efficient and effective, such OPAs must also take into consideration what the PMI refers to as Enterprise Environment Factors (EEF). EFF are both internal and external environmental factors that surround or influence a project's success (PMI, 2008). Some of these factors include the national and global economic situation, the competition, supplier behaviour, company culture and company infrastructure and

capability. The PMBOK® Guide provides detailed processes within the integration management knowledge area in a way that, if followed rigorously, will increase the chance of project success.

2.5.2. Project scope management

Scope management of a project is a combination of the processes required to ensure that the project includes all the work and only the work that is required to successfully complete the project (PMI, 2008). Managing the project scope is primarily concerned with defining and controlling what is included and what is not included in the project. This principle of what is in and what is out is key for any construction project scope management. When a construction project is initiated, the client's requirements / needs are not always fully defined. Often, at that early stage, the client's requirement is an amalgam of incomplete and sometimes inaccurate information (Williams, 2011). It is the CPM's responsibility to assist the stakeholders to define what they want and what they do not want at this early stage and to record these wishes. This is the only way that the CPM can avoid scope creep at a later stage.

The PMBOK® Guide provides detailed processes that CPMs can apply to ensure successful scope management. These processes include collecting requirements, defining scope, creating a WBS, verifying scope and controlling scope (PMI, 2008). Structurally applying all processes of this knowledge area is a key to project success. Previous researchers have identified scope change as one major reason causing construction project delays and cost overruns (Apolot *et al.*, 2010; Ramabodu and Verster, 2013). This indicates the importance of this process.

Nonetheless, Bieg's (2014) study shows that many organisations still lack maturity in scope management and the necessary resources to do it properly. They fail to develop the relevant skills in the people they do have. The study suggested that, executive management and sponsors do not yet have the patience and do not fully value the importance of excellence in proper scope management. In 2009, IAG Consulting conducted a Business Analysis Benchmark survey amongst PM firms globally. The results indicated that 74% of companies have a low level of scope management processes, particularly collect requirements process. This limited emphasis in scope management results in missed deadlines, budget overruns and wasted resources. The study reported that these companies achieved their business objectives a mere 54% of the time, while taking 35% longer to deliver these disappointing results (IAG, 2009).

Similar examples of project failure due to poor scope management have been registered in Qatar. In a study conducted by Hussain (2012), it was reported that poor scope management has a serious negative impact on project delivery, particularly on government construction projects. Amongst other things, the study recommends that the project scope be identified by the right people at the right time. A stakeholder's analysis has to be completed before requirements collection and the scope definition is finalised. The project team must use an effective and clear communication system as the project progresses to integrate the inputs of all involved parties.

The situation in South Africa is similar. Ramabodu and Verster (2013) suggest that poor scope management is one of the main causes of project cost overruns and project delivery delays. The study found that 35% of cost overruns in construction projects in South Africa are directly linked to poor scope management. To resolve the issue, the authors recommend that designers should have the best possible interaction with clients, especially at the design brief stage, to take all stakeholders needs' and requirements' in consideration into the project scope management processes.

According to the PMBOK® Guide, it is the project manager's responsibility to ensure that everything that is required in the project is clarified and taken into consideration at the requirement collection stage at the beginning of the project. A contingency for uncertainties is added either in each activity estimate or work package level to form the project baselines (Dobie, 2007). Mulcahy *et al.* (2013) maintain that following the collection requirement process structurally will avoid recurring change once the project has started. However, in exceptional cases where a change can be requested, appropriate integrated change control must be followed to either reject or undertake the change, but strictly within the project's agreed parameters (Williams, 2011).

Previous research confirms that organisations that structurally apply all the processes within the scope management knowledge area increase their chances of project success and better business outcomes (Bieg, 2014).

2.5.3. Project time management

According to the PMBOK® Guide, project time management deals with all the processes necessary to ensure that the project is completed on time. Unfortunately, in the built environment, delivering a construction project on time and within the planned cost is becoming the exception rather than the rule (Olantunji, 2010). Previous studies established that the problem of delays in the construction industry is a global phenomenon (Ali, 2011; Olantunji, 2010). Olantunji (2010:12) suggests that out of 8 000 projects surveyed by the Standish group, only 16% were able to meet the goals set in terms of time, budget and quality.

Olatunji (2010:17) has identified several research studies that were conducted in different parts of the world prior to 2000 with respect to construction delays, examining the causes as well as the effects of delays in construction project delivery. Despite the fact that the results of these studies left much to be desired, not much has changed. In the same study, the author confirms that beginning in the year 2000, a concerted effort has been made all over the world to determine remedies to the issues of project delays. Amongst different studies conducted, Olatunji (2010:17) has highlighted the following: Aibinu and Jagboro (2002) in Nigeria; Belout and Gauvreau (2003) in Canada; Koushki and Kartam (2004); Assaf and Al-Hejji (2005); Faridi and El-Sayegh (2006) in Saudi Arabia; Frimpong *et al.* (2002) in Ghana; and Bryde and Robinson (2005) in the UK. In general, the results are depressing and unacceptable.

The Medupi Power Station Project is one of the recent prominent projects currently experiencing delays in South Africa. The project comprises six 800 megawatt (MW) units to provide a total installed

capacity of 4 800 MW. In November 2007, Eskom stated that the first unit was scheduled to be commissioned in 2012, with the last unit scheduled for commissioning by 2015. Unfortunately things did not go as planned. The new Acting Chief Executive Office of ESKOM, Mr Molefe, has announced that the Medupi power station completion date is expected to be extended to 2021. This delay contributes to the country's continuous power outages and load shedding, causing amongst other things the drastic negative economic implication of downgrading of South Africa's credit rating by Fitch (Maswangani, 2015)

Though there are not yet drastic consequences for CPMs in the public sector when they and the project team underperform, this seeming freedom from accountability has now come under scrutiny (Fombad, 2013). In other spheres, particularly in the private sector, the consequences of delays in project delivery are not always pleasant. Parties to the contract can end up in dispute, litigation, outright abandonment, cost overruns, loss of opportunity or the closing of a business (Olantunji, 2010).

Once again, it is the project manager's responsibility to ensure that the project achieves its stakeholders' objectives, particularly the time objective. PMI standards provide processes, tools and techniques designed to assist project managers to undertake project time management and ensure that the project is completed within the agreed time. These processes indicate how the project schedule should be planned, developed, executed and controlled in order to communicate and propose corrective measures if there are changes. These processes include define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedules and control schedules. Furthermore, PMI standards provide two major techniques employed to reduce schedule duration when the project faces time duration challenges. These techniques are crashing, which advocates adding resources to shorten duration, and fast-tracking, which requires re-planning activities (or phases), initially planned sequentially, to overlap or even run in parallel (PMI, 2008).

These tools and techniques, if properly utilised, can go a long way to assist CPMs with schedule management and empower them with the skills to determine accurate project times, enabling them to control the project schedule and in the case of deviations to apply corrective measures to catch up.

2.5.4. Project Cost management

The successful completion of a project at the agreed time and within the planned budget is not always an easy task and depends to a large extent on the implementation of a sound project planning process right from the initiation stage. The prevalence of cost overruns and schedule delays leaves many stakeholders dissatisfied (Ramabodu and Verster, 2013) and does not honour the CPM profession. Mulcahy *et al.* (2013) point out that in a project environment there is a strong connection between project time management and project cost management. That is why in most projects, when there is delay there are most probably cost overruns as well.

Kerzner emphasises that "project estimates are not blind luck, but well-thought-out decisions based on the available data, the correct type of estimating tools and a good knowledge of estimating

processes" (Kerzner, 1998). According to the PMBOK® Guide, project cost management is the combination of processes necessary to ensure that the project is delivered within the cost baseline. The PMBOK® Guide emphasises that this knowledge area is expected to include estimate cost, determine budget and control cost. CPMs are expected to lead the process of cost estimation and be accountable for any deviations.

Considering the high rate of project cost overruns within the building industry in South Africa, the accuracy of cost estimates is questionable. It appears as if the cost estimates in most construction projects are left to chance. Reporting on the Medupi Power Station Project cost overruns, Ensor (2014) indicates that the latest estimate has escalated from R70 billion that was forecast in 2007 to R105 billion in December 2014. By 2010 this figure was estimated at R125 billion. In the same article, it is also reported that Ms Brown, then the South African Public Enterprises Minister, justified this cost escalation on account of site conditions, particularly an unexpected volume of rock. The minister went further to confirm the inadequacy of project planning and lack of the necessary environmental study, geotechnical surveys and subsequent design work that should have been completed before the project began. This error in process raises serious concerns about the methodology and approach being applied in the implementation of the Medupi project. This study argues that if the PMBOK® Guide had been followed structurally, cost estimates would not have been completed without a proper geotechnical report estimating the quantity of rock in first place. This exercise would have avoided the exorbitant cost escalation.

According to the PMBOK® Guide, the work involved in performing the three processes of project cost management is preceded by a planning effort by the PM team. This planning effort is part of the developing PM plan process, which produces a cost management plan that sets out the format and establishes the criteria for planning, procedures, estimating, budgeting and controlling costs. Related to the PMBOK® Guide recommendation, it is advisable that before the appointment of a contractor, the CPM should establish its range of estimates at the planning stage. Therefore, any bidder who is out of the estimate range, even on the lower side, is avoided. It is this study's view that any bidder who does not estimate his or her bid properly will create more challenges to completing the work and ultimately cause the project delays and/or cost overruns. That is why this study firmly supports that an appropriate application of the PMBOK® Guide will increase the chances of completing the project within the budget.

2.5.5. Project Quality management

Arditi and Gunaydin (1997) point out that excessive time and resources, both human and material, are wasted each year because of inefficient or non-existent quality management procedures. Hendrickson (2008) report that poor project quality management results in very high costs and delays. A previous study showed that quality management practices save money and expedite project schedules (Safa *et al.,* 2015). According to the PMBOK Guide, quality should be planned, designed and built in, not inspected in. The cost of preventing mistakes is generally much lower than the cost of correcting them when they are found through inspection (PMI, 2008).

Unfortunately, as pointed out by Mulcahy *et al.* (2013), there are indications that most project managers do not have the time to spend managing quality. Furthermore, it is suggested that many organisations do not have a formal quality management plan in their OPA. In a study conducted by the Construction Industry Development Board (CIDB) on the quality of construction in South Africa, though it was found that in general the client was satisfied with the quality of construction, around 20% of projects are regarded as inappropriate due to the quality of the final product (CIDB, 2011).

The PMBOK® Guide recommends three specific processes to ensure project quality: plan quality, perform quality assurance and perform quality control. Structurally applying these processes would enhance the project's quality from the planning stage and avoid rework and the associated increased time and cost overruns.

2.5.6. Project Human Resource management

Although the construction industry is one of the most labour-intensive and accounts for a sizeable proportion of worldwide economic activity, unfortunately human resource management issues in the construction industry are still being given inadequate attention (Loosemore, Dainty and Lingard, 2003). Loosemore *et al.* (2003) recognise the difficulty and complexity of managing people in the construction industry.

In order to complete a construction project successfully, CPMs depend heavily on other specialists and professionals within the built environment such as quantity surveyors, engineers, architects and contractors to complete the project under their leadership / authority / direction. However, it is not unusual to have consultants and contractors working on the project having direct contact with the client, expecting to get instructions from the client and obey only these instructions. However, in spite of this recognised challenge, the project manager is still expected to excel and to complete the project on time, within cost and at the required quality.

Kendrick (2010) argues that military generals and admirals cannot always expect automatic obedience from their soldiers, and thus questions the project manager's ability to automatically command the respect of the project team members. In most cases, CPMs find themselves in at the deep end especially when managing projects without direct authority. Nonetheless, with or without authority, the responsibility of delivering the project successfully ultimately falls on the project manager's shoulders.

The PMBOK® Guide provides four distinct processes within the human resource management knowledge area that might assist CPMs to ultimate project success. These four processes are: develop a human resource plan, acquire a project team, develop the project team and manage the project team.

To ensure that the project is effectively and efficiently run, the CPMs and the project team (including consultants and contractors) must be capable of performing their respective duties notwithstanding the skills shortage challenges in South Africa. Pointing fingers and citing the incompetence of other

team members when a project fails is a futile exercise. The PMBOK® Guide provides processes, tools and techniques that should assist CPMs to ensure that their team is productive, effective and efficient.

2.5.7. Project Communication management

Dobie (2007) defines managing a project as a means of achieving desired outcomes through the combined efforts of a team of different people or organisations. Communication is the only way to share information among all role players on a project. The PMBOK® fourth edition indicates that effective communication creates a bridge between diverse stakeholders involved in a project by connecting various cultural and organisational backgrounds, different levels of expertise and various perspectives and interests in the project execution or outcome.

As stated in the PMBOK® Guide, communication management is needed to ensure timeous and appropriate treatment of all project information. Communication procedures include planning, generation, collection, creation, distribution, storage, retrieval, management, control, monitoring and ultimate disposition of project communications. Appropriate communication processes should ensure timeous collection and distribution of information between clients, consultants, contractors and all other stakeholders to avoid delays. Nonetheless, Sunjika and Jacob (2013) find that despite the guidelines, delays due to failure to issue information timeously either by consultants and / or by the client are not exceptions within the construction project environment. Procrastination and lack of proper communication lead to project delays and cost overruns (Sunjika and Jacob, 2013). Understanding the importance of communication management is of paramount importance for any CPM because everything they do relies on communication. It is estimated that project managers spend up to 90% of their time communicating (Mulcahy *et al.*, 2013).

With communication being so important, it is critical that CPM's communication management processes are robust. The PMBOK® Guide recommends five distinct processes to follow to ensure a smooth communication management in a project environment: identify stakeholders, plan communications, distribute information, manage stakeholder expectations and report performance. By structurally following these processes and other tools and techniques provided in the PMBOK® Guide, CPMs would increase the chances of project success.

2.5.8. Project Risk management

Risk management is one of the fundamental elements in ensuring project success, yet it is either often neglected or not given the right attention (Thompson and Perry, 1992). In research conducted in the South African engineering and construction industry, it was reported that project risk management practices are still not widely used (Chihuri and Pretorius, 2010). Amongst the reasons found to contribute to this lack of risk management application are lack of appreciation of the benefits of structured project risk management methodology and deficiency in project risk management knowledge as a result of the general lack of full understanding of the risk management processes, as well as the perception that project risk management is costly.

Amongst other global projects that experienced high risks, Chihuri and Pretorius (2010) highlight the case of Europe's channel tunnel. The project experienced excessive cost overruns that nearly made the Europe Union bankrupt. Hong Kong's Chek Lap airport is another example. The project negatively influenced not only airport revenue, but also the country's GDP.

In South Africa, The e-Toll project is an example of a project for which the risk management is questionable. This poor risk management is evidenced by civil disobedience call from trade unions, lobby groups and non – profit institutions as well as the court hearings against SANRAL's implementation of the e – toll project (Hommes and Holmner 2013). At the time of writing, the e-Toll saga was not yet over.

According to the PMBOK® Guide, a CPM's work should focus not on dealing with problems but on preventing them and providing solutions if problems do occur. The PMBOK® Guide provides six processes for project risk management: plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk responses, and monitor and control risks. Following these processes can assist in addressing potential threats before they occur (Stern and Aria, 2011).

Structurally applying these processes increases the chances of successfully completing a project despite the inherent probable risks. The CPM and his or her team should have a response plan in place in advance to overcome any risks that may occur.

2.5.9. Project Procurement management

In general, construction projects are not run by the end users or the project owner (buyers), but by different service providers (sellers) under the leadership of a CPM. Effective procurement management is imperative in achieving the project's objectives. Hence, procurement plays a critical role in the PM process (Pautz, Watermeyer and Jacquet, 2003).

Pautz *et al.* (2003), highlight that the government procurement system in South Africa is regulated by the Constitution. The government uses the procurement process as an instrument of social upliftment. Furthermore, Pautz *et al.* (2003) emphasise that procurement for any organ of the state should be dealt with through a system that is fair, competitive, equitable, transparent and cost-effective. This brings to the fore the challenge of balancing the objective of project delivery against the obligation to the constitutional rights of the people, such as Broad-Based Black Economic Empowerment (BBBEE). BBBEE is an initiative by the South African government to address historical imbalances in the country by facilitating the participation of black people in the mainstream economy. BBBEE is governed by the Broad Based Black Economic Empowerment (BBBEE) Act No. 53 of 2003 and the BBBEE Codes of Good Practice gazetted in February 2007. With this Act comes the preferential point-scoring mechanism in all government procurement processes, which favours historically disadvantaged people (HDPs) with intention of uplifting such people.

Although government tender documents in the built environment stipulate that the employer is not obliged to appoint the lower bidder, there is an indication that most of the time projects are granted to the lower bidders. This practice is dangerous and susceptible to causing project failure. For example, it is not unusual for a low bidder to abandon the project when he or she realises that there will be no profit half-way through the project's life cycle. Obtaining a new contractor to complete the project has cost implications that were not budgeted for in the first place.

There is also the tendency of front loading, where the contractor attempts to maximise revenue on items to be certified early in the project, while under-costing later items. Again, it is the CPM and his or her team's responsibility to address such project procurement problems early on. If not addressed, the contractor might experience financial difficulty at a later stage of the project, which will affect the project delivery targets.

Following the PMBOK® Guide's recommendations, CPMs should plan procurement in terms of the contract to be used, and the contract amount to appoint the contractor for, which must be within the project's calculated estimated range. The project manager should, in a fair manner, ensure that the project is completed successfully.

The PMBOK® Guide provides four processes that CPMs should structurally apply, considering risk management's processes and all other organisational processes as assets to ensure project success, despite challenges that might exist. These procurement processes are: plan procurement, conduct procurement, administer procurement and close procurement. Conducting procurement without following these processes is tantamount to failure.

2.6. Importance of the project manager's competency

As discussed earlier, the importance of proper PM processes cannot be overemphasised. Hans (2009) argues that construction project success still depends on the CPM's competence to apply these processes. Bieg (2014) study concludes that the success of a project requires both a project manager's competencies and organisational project maturity, and the ability to provide the project manager with the necessary tools, techniques and an environment conducive to successfully delivering the project. However, the availability of best practice and its recommendations alone do not necessarily add value to the project delivery process. Only when CPMs have the competency to structurally apply the proposed processes, tools and techniques can positive results be expected.

Unfortunately, considering the prevalence of delays and cost overruns within the building industry in South Africa, the competency of CPMs and their ability to structurally apply available PM processes, tools and techniques is questionable. Despite existing rhetoric confirming the prevalence of project delays and cost overruns that cause service delivery unrest and unhappiness within many communities, and in spite of the SACPCMP's attempts to recommend the PMBOK® Guide's processes, tools and techniques, the result is still not convincing.

CHAPTER 3: METHODOLOGY

3.0. Introduction

Research methodology deals with the logic of enquiry, of how new knowledge is generated and justified. It constitutes various aspects of the research process. This section explains the research methodology adopted in this study. It describes the research philosophy and paradigm, the research approach and how the overall research process was executed.

3.1. Research philosophy, paradigm and approach

3.1.1. Research philosophy

There are many research philosophies within the academic environment, the three major ones being ontology, epistemology and axiology (Saunders *et al.*, 2012). The term "research philosophy" relates to the development of knowledge and the nature of that knowledge (Saunders *et al.,* 2012). Furthermore, Saunders *et al.* (2012) advise that the selection of the best research philosophy should depend on the research question(s) that the study seeks to answer. As such, ontology is concerned with the nature of reality and includes objectivism and subjectivism, while epistemology is concerned with what constitutes acceptable knowledge in a field of study and includes positivism, realism and interpretivist philosophies.

This study is inclined toward positivism, because in positivism the researcher collects data about an observable reality and searches for causal relationships in the data to generalise the findings (Gill and Johnson, 2010). For this study, data were collected from CPMs to ascertain their projects' delivery performance, particularly in terms of construction project delays and cost overruns. Furthermore, the study evaluated the extent of appropriate application of the PMBOK® Guide by CPMs when managing their projects. Subsequently, a causal relationship was established between project delivery performance and the extent of appropriate application of the PMBOK® Guide by CPMs as they manage construction projects.

3.1.2. Research paradigm

Saunders *et al.* (2012) define a research paradigm as a way of examining social phenomena from which particular understandings of these phenomena can be gained and a means to attempt to explain them. Burrell and Morgan (1982) developed four paradigms for analysis of social theory: radical humanist, radical structuralist, interpretive and functional. Figure 3.1 shows how these four paradigms can be arranged as a matrix corresponding to the two conceptual dimensions: the subjectivist–objectivist dimension and the radical change–regulation dimension. Burrell and Morgan (1982) note that the purposes of these four paradigms are:

- to assist researchers to clarify their assumptions about their view of the nature of science and society;

- to offer a useful way of understanding the ways in which other researchers approach their work; and
- to assist researchers plot their own route through their research, to understand where it is possible to go and where they are going

<table>
<tr><td colspan="4">Radical Change</td></tr>
<tr><td rowspan="2">Subjectivist</td><td>Radical Humanist</td><td>Radical Structural</td><td rowspan="2">Objectivist</td></tr>
<tr><td>Interpretive</td><td>Functionalist</td></tr>
<tr><td colspan="4">Regulation</td></tr>
</table>

Fig. 3.1 Four paradigms for the analysis of social theory
Source: Burrell and Morgan (1982) as presented by Saunders *et al*. (2012: 141)

From this matrix, Saunders *et al.* (2012) explain that the subjectivist–objectivist dimension deals with the theoretical and practical approaches to organisational culture. An objectivist researcher would tend to view the culture of an organisation as something that the organisation has or should have, while a subjectivist researcher tends to view the organisational culture as a result of a process of continuing social enactment (Millmore *et al.,* 2007). With that understanding in mind, this research leans towards the objectivist dimension, as this study is of the view that CPMs are expected to be conversant with the PMBOK® Guide containing processes, tools and techniques to be utilised.

On the side of the radical change–regulation dimension, Saunders *et al.* (2012) explain that radical change relates to a judgement about the way organisational affairs should be conducted and a suggestion of ways to make fundamental changes to the normal order of things. This means the radical change dimension adopts a critical perspective. On the other hand, the regulatory perspective seeks to explain the way in which organisational affairs are conducted and offer suggestions as to how they may be improved within the framework of the way things are done at present.

Based on this explanation, within the radical change–regulation dimension, this research tends towards the regulation perspective. This is because this research does not intend to pass a judgement on CPMs, but seeks to understand the causes of the poor construction project delivery performance in terms of schedule and cost performance. It looks in particular at the extent to which CPMs structurally apply each of the existing PMBOK® Guide's processes, tools and techniques at their disposal.

Building from the preceding discussions' understanding, this research, therefore, adopts a functionalist paradigm, which is located within the objectivist and regulatory dimensions. Being in this paradigm, the research is more concerned with a rational explanation of why a particular problem occurs and tries to develop a set of recommendations to attempt to resolve the problem going forward (Saunders *et al.*, 2012). This means the problem of project delays and cost overruns in the construction industry (Baloyi and Bekker, 2011; Olatunji, 2010; Rwelamila, 2007; Ramabodu and Verster, 2013) is investigated in light of the processes, tools and techniques that CPMs are expected

to apply to rationally discover the reasons for this problem. This is done with a view to developing a set of recommendations to resolve the problem of poor project delivery within the South African built environment.

3.1.3. Research approach

There are two research approaches, deductive and inductive. The selection of one of these two research approaches depends on the reasoning the researcher wishes to adopt (Sanders *et al.*, 2012). A deductive approach is selected when the researcher intends to reach a conclusion logically from a set of premises, the conclusion being true when the premises are true (Ketokivi and Mantere, 2010). Within this approach, this research is conducted from the perspective of an existing theory developed from prevailing academic literature, and then a research strategy is designed to test that existing theory. Conversely, an inductive approach starts by collecting data to explore a phenomenon and generate or build a theory, often in the form of a conceptual framework (Ketokivi and Mantere, 2010). Moreover, it is possible to have a situation where the researcher does not move from theory to data, as in a deductive approach, or from data to theory as in an inductive approach, to reach a conclusion. In such a situation, the research is constrained to move back and forth by combining deductive and inductive approaches; this is called an addictive approach (Suddaby, 2006).

This study used an inductive approach by first collecting data for two purposes: to explore first the phenomena of project delays and cost overruns and second the extent of application of the PMBOK® Guide by CPMs. The selection of this approach is justified by the requirement to start by having a feel for the problems so as to understand the nature and the magnitude of the problem better. Then the study should establish if any relationship exists between the two variables. There might be a relationship between the project performance outcome and the appropriate extent application of the PMBOK® Guide by CPMs. Alternatively, this study's results may reveal that there are other competing reasons that may or may not be related to the extent of CPMs' appropriate application of the PMBOK® Guide as supported by Zwikael (2009). Nonetheless, Mulcahy *et al.* (2013) support Zwikael (2009) assumptions that despite constraints and challenges, CPMs are expected to overcome or mitigate all constraints and challenges that they might face through appropriate planning, risk management and all other processes available. Thereafter, depending on the outcome, this study will suggest a conceptual framework in the form of recommendations to assist encourage CPMs to follow the PMBOK® Guide's processes, tools and techniques.

3.2. Research design formulation

The research design is the general plan of how the study will go about answering the research question. It must contain clear objectives derived from the research questions, specify the source from which the study intends to collect data and how data will be analysed, discuss ethical issues and the constraints the study will inevitably encounter (Saunders *et al.*, 2012).

3.2.1. Research methodological choices

A choice of the method to be used in every research depends on the hypothesis or the question that the research intends to answer (Saunders *et al.*, 2012). The methodical choice might be a mono- or single method, either quantitative or qualitative, or a multiple method combining quantitative and qualitative methods (Saunders *et al.*, 2012). The quantitative research method is often used when the research conducted uses a data collection technique such as a questionnaire or a data analysis procedure such as graphs or statistics that generate or use numerical data. In contrast, a qualitative research method is often used for data collection techniques such as interviews or data analysis procedures such as categorising data that generate or use non-numerical data. However, the two methods might be combined in the same research, known as mixed-method research (Saunders *et al.*, 2012).

With regard to the questions posed in this research, the quantitative method is appropriate as the research uses statistical means to answer the research question. Numerous studies have already found that construction projects are delayed and experience cost overruns (KPMG, 2015). Nonetheless, this study first seeks to ascertain the magnitude of the problem then evaluate the extent of the application by CPMs of the PMBOK® Guide when managing construction projects.

Furthermore, this study is explanatory and descriptive in nature. Explanatory study seeks to establish causal relationships between variables (Saunders *et al.*, 2012). This study must be seen as a process of enquiry to establish causal relationships between the prevalence of project delays and cost overruns and the extent of structural application of PMI standards, particularly in alignment with its nine PM knowledge areas. The object of descriptive studies is to gain an accurate profile of events, persons or situations (Saunders *et al.*, 2012).

With this understanding, the study therefore seeks to comprehend the extent of the use of the PMBOK® Guide as applied by CPMs during the delivery of construction projects, and by extension their competencies relative to the discipline.

Hence, the choice of this approach is dictated by the nature of the problem. The project performance outcome and the appropriate application of the PMBOK® Guide are associated with the implementation of construction works.

3.2.2. Research strategy

In general terms, a research strategy is defined as a plan of how the researcher will go about answering the research question (Saunders *et al.,* 2012). Denzin and Lincoln (2005) explain that research strategy is a methodical link between the research philosophy and subsequent choice of data collection methods and analysis thereof. There are different research strategies such as experiment, survey, archival research, case study, ethnography, action research, grounded theory and narrative enquiry. Saunders *et al.* (2012) suggest that a particular strategy selection is guided by the research questions and objectives. This strategy must enable the research to achieve a reasonable level of coherence that will enable the researcher to answer the particular questions and meet the research objective. These strategies should not be thought of as mutually exclusive. It is not unusual to use the survey strategy within a case study, or combine a number of different strategies within mixed methods.

3.2.3. Data collection

Based on the research questions, the philosophy adopted and the quantitative research design choice of this study, a survey strategy is considered most suitable to achieve the objectives of this study. Surveys using questionnaires are popular as they allow the collection of standardised data from a sample population in a highly economical way (Saunders *et al.*, 2012). Furthermore, data can be used to suggest possible reasons for particular relationships between variables and to produce models of these relationships. The survey strategy is perceived to be comparatively easy to explain and to understand. When sampling is used, it is possible to generate findings that are representative and susceptible to generalise the result to the whole population (Saunders *et al.,* 2012). Generalizability can be defined as the extension of research findings and conclusions from a study conducted on a sample population to the population at large.

Different instrument may be used to collect survey data. For this study, survey questionnaires were sent out by e-mail as an instrument to collect primary data. The benefit of an online questionnaire is that because the system to collect data has already been set up, the data is automatically updated once a response is received. This eliminates the possibility of errors in data capturing (Saunders *et al*., 2012). It also provides a very speedy approach, as the time for data capturing and analysis is also minimised. To present and analyse the findings of this study, quantitative techniques such as graphs, charts and statistics means are used.

Before sending the questionnaire to participants, it was pre-tested by sending it to PM experts who were requested to comment on it and provide suggestions to improve its representativeness and suitability. Furthermore, a pilot test was conducted amongst 10 CPMs with the purpose of refining the questionnaire to ensure that questions are drafted so that all respondents will have a common understanding in responding to the questions and to avoid any challenges when collating the data. Most importantly, the data collected must enable the researcher to fulfil the study's aim and objective.

A full details of questionnaires used as instrument to collect data for this study is provided in annexure 1.

3.2.4. Reliability

Reliability is the extent to which a variable or a set of variables is consistent in what it intends to measure (Saunders *et al.*, 2012). If multiple measurements are taken, a reliable measure will be consistent in all values (Saunders *et al.*, 2012). If random sub-samples from the original sample yield consistent or similar results when compared, the data is thus not biased or distorted by a possible unknown effect that has not been included or taken into account during the sample design (Saunders *et al.*, 2012). To address this, a pilot survey was conducted with 10 sample elements of the intended population. The pilot survey was used to determine the potential level of reliability threat, including participants' bias, participant error or the researcher's bias or error, and therefore draw a conclusion about the research's reliability.

3.2.5. Validity

Construct validity is most appropriate for this study. Construct validity is most directly concerned with what the instrument is actually measuring (Saunders *et al.*, 2012). Construct validity is ensured by the plans and procedures employed to construct the questionnaire. This is done, in part, to ensure that internal consistency is achieved.

Internal validity is established when the research demonstrates a causal relationship between two variables (Saunders *et al.*, 2012). In this study, internal validity is established as the results show a statistical relationship between CPMs' performance and the extent of their appropriate application of the PMBOK® Guide.

3.3. Time horizon

There are two time horizons to consider for any research: a cross-sectional study, which takes a snapshot time horizon or a longitudinal study, which takes a series of snapshots and the representation of events over a given period (Sanders *et al.*, 2012). Based on the question that this research seeks to answer and due to time constraints, a cross-sectional time perspective was adopted because it is assumed that participants are not necessarily responding to issues only in the present or in the future, but to existing phenomena that they know about. Therefore a cross-sectional time horizon perspective is ideal for this study.

3.4. Research population

A research population is the object of study and consists of every individuals, groups, organisations, human, products and events or the conditions to which they are exposed (Saunders, et al., 2012). The research population of this study is therefore made up of everybody practising CPM work in all the nine provinces in South Africa. Saunders *et al.* (2012) explain that a census requires collecting and analysing data from every possible case or group member concerned in the research being undertaken. Due to practicability, time constraints and budget limitations, it was difficult to undertake a census by attempting to collect data from the full population implicated in this study. For that reason, this study used a simple random sampling method, which reduces the amount of data to be collected by obtaining data from a sub-group rather than all possible cases or elements.

3.5. Research sampling

Research sampling denotes the explicit strategy of taking only part of the full population for the research data collection (Migiro and Magangi, 2011). Nonetheless, Becker (1998) cautions that for a sample to be meaningful, it should represent the full set of cases that the population embodies. In the academic research environment, there are two types of sampling technique: probability or representative sampling and non-probability sampling (Saunders *et al.*, 2012). Non-probability sampling (or non-random sampling) provides a range of alternative techniques to select samples. The majority include an element of subjective judgement. Conversely, probability sampling or representative sampling, which is mostly associated with survey research strategies, suggests that the researcher needs to make inferences from the sample about a population to answer the research questions and meet the research objectives (Saunders *et al.,* 2012). Given that distinction, a probability sampling specifically simple random sampling method is more suitable for this research. As explained above, simple random sampling method reduces the amount of data to be collected by obtaining data from a sub-group rather than all possible cases or elements (Saunders *et al.*, 2012).

The sampling frame for any probability sample is a complete list of all the cases in the population from which the research sample is drawn (Saunders *et al.*, 2012). In this study, the question is concerned with construction professionals performing CPM work within the built environment industry in South Africa. This research used a simple random sampling method to collect data from CPMs registered with the built environment professional councils, comprising the SACPCMP, ECSA, SACP and SACQSP. Membership lists are readily available from the different council offices, which offered to distribute the research questionnaires to their respective members who consented to participate in this study.

Generalisations about population from data collected using any probability samples are based on statistical probability (Saunders *et al.,* 2012). Furthermore, Saunders *et al.* (2012) indicate that statisticians have proved that the larger the absolute size of a sample, the closer its distribution will be to the normal distribution; thus, the more robust it will be. Statisticians have also shown that a sample of 30 or more will usually result in a sampling distribution for the means that is very close to a normal distribution. Stutely (2003) advises that a minimum sample size of 30 for statistical analysis provides a useful rule of thumb for an overall sample. That being the case, this study set a target of a minimum of 100 participants from the population.

3.6. Ethical considerations

The risk of exposing respondents to reprisals in their work place because of their participation to this study is a real ethical risk identified for this study. To mitigate this risk and comply with ethical standards, the researcher did not have any direct contact whatsoever with respondents and the questionnaire did not subjected the respondent to identify themselves. Invitation to participate was send through each respondent's respective built environment councils. All respondents were informed of the objective of the research in the body of the questionnaire and that their replies would constitute consent to participate in this research.

This study ensured compliance with quality assurance in respect of the correctness and completeness of the questionnaire (Saunders *et al.*, 2012). All information pertaining to the respondents has been kept anonymous and is maintained by the researcher and the School of Construction Economics and Management. The purpose of the information is solely academic. Before data collection started, an ethics certificate from the School of Construction Economics and Management was obtained and a copy is attached as annexure 2.

3.7. Research constraint and mitigation

Time is a major constraint for this study because the candidate had to complete the research within the stipulated candidature while in full-time employment. The mitigation plan adopted was to work on Saturdays and Sundays to complete the project in time. Data collection is often a time-consuming exercise in an academic study (Saunders *et al.*, 2012). As such, an online survey approach was adopted to minimise time constraints.

CHAPTER 4: FINDINGS AND DATA ANALYSIS

4.0. Introduction

In view of the prevalence of project delays and cost overruns within the built environment in South Africa, this study set to respond to the main question formulated in the first chapter and being: Considering the prevalence of project delays and cost overruns in the built environment in South Africa, to what extent do CPMs performing CPM work structurally apply the PMBOK® Guide? To respond to this primary question, this research have first to respond to the following secondary research questions relating to what extent do CPMs performing CPM work are structurally applying each of the nine knowledge areas of the PMBOK® Guides, including:

1. All the project integration management processes?
2. All the project scope management processes?
3. All the project time management processes?
4. All the project cost management processes?
5. All the project quality management processes?
6. All the project human resource management processes?
7. All the project communication management processes?
8. All the project risk management processes?
9. All the project procurement management processes?

Therefore, this study investigated the possibility that individuals who practise CPM work are not structurally applying the PMBOK® Guide's processes and procedures, thus causing project delays and cost overruns. Premised on that assumption, this study undertook a survey from August to December 2015 amongst CPM practitioners using simple random sampling method. By means of data collected from the survey, findings and analyses of the results are presented in this chapter. At the end of each result, a brief review is presented in line with the analysis of that specific result. Results are presented in the following order:

1. Respondents' demography

2. Status of CPMs' performance in terms of time and cost

3. Awareness of the PMBOK® Guide amongst CPMs within the built environment industry in South Africa

4. Extent of the PMBOK® Guide's application by CPM practitioners within the built environment industry in South Africa

As discussed earlier, an online survey questionnaire was used to collect primary data. Online questionnaires were sent to CPMs through the SACPCMP. Since other professionals within the industry also practise and render CP Management services within the built environment in South Africa (Rwelamila, 2007), questionnaires were also sent to other councils within the built environment,

namely the Engineering Council of South Africa (ECSA), the South African Council for the Quantity Surveying profession (SACQSP) and the South African Council for the Architectural Profession (SACAP).

Data analysis software called survey system as well as SPSS were used to check the data for errors. A returned questionnaire was deemed usable and, as a result, considered for the final analysis only if the following two conditions were met:

1. The respondent was practising CPM work.

2. The respondent provided answers to all the questions on the questionnaire.

Based on the above two criteria, 120 questionnaires were deemed usable for analysis out of a total of 128 responses received back. From all questionnaires randomly send out as mentioned above in chapter 3, it is electronically indicated that only 680 respondents received and opened the electronic version of the questionnaires sent out. From that 680 only 128 respondent have completed the survey of which only 120 is deemed usable responses and discussed below.

4.1. Respondents' demography

4.1.1. Respondents' composition based on professional registration

Figure 4.1 presents the percentage composition of the 120 respondents according to their professional registration. It must be noted that some respondents have double registration and 15% are not yet fully registered but candidates, therefore classified as no registered to any.

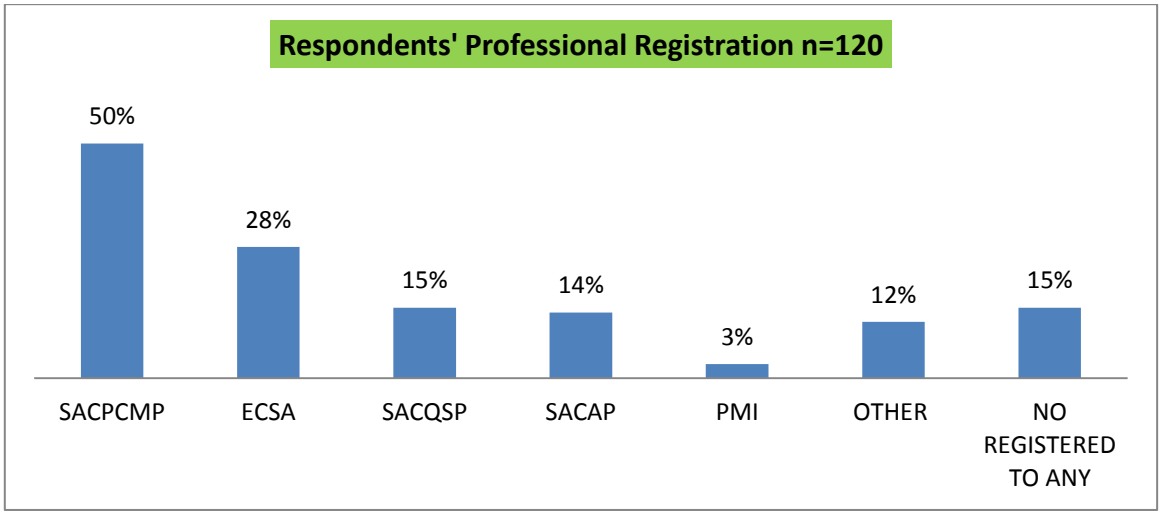


Fig 4.1 Respondents' percentage composition based on professional registration

This result suggests that a large number of the respondents are registered with the SACPCMP. The higher response from respondents registered with the SACPCMP than from those registered with other councils could be attributed to the fact that registered SACPCMP members might be more interested in this study than others, hence their greater readiness to participate.

4.1.2. Respondents' composition based on gender

Figure 4.2 presents the percentage composition of the 120 respondents according to gender.

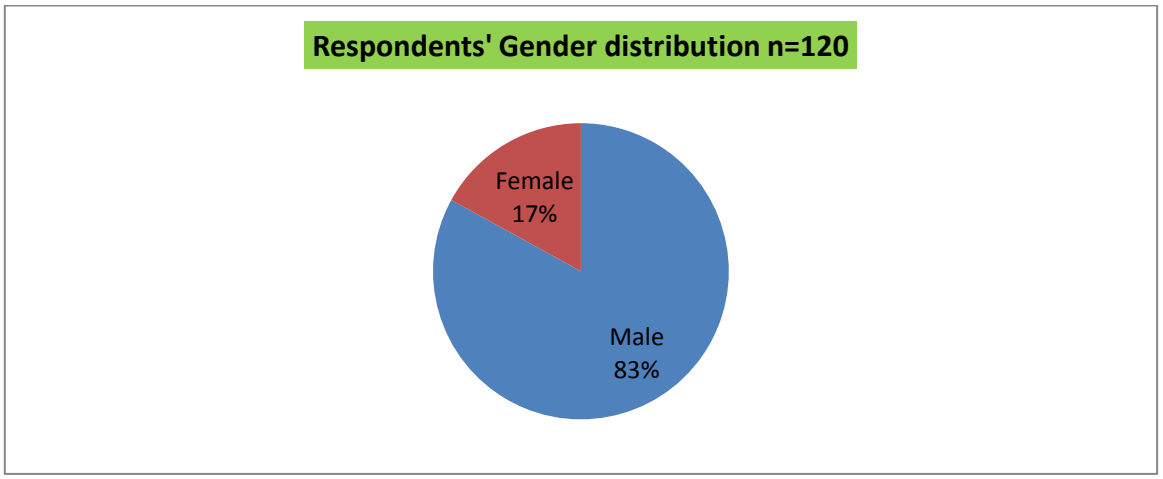


Fig. 4.2 Respondents' gender distribution

The result indicated that a large majority of respondents (83%) were male, while only 17% were female. Such a result suggests that the CP Management profession is still a male-dominated environment, which is supported by other studies.

4.1.3. Respondents' composition based on province

Figure 4.3 presents the percentage composition of the 120 distribution per province. .

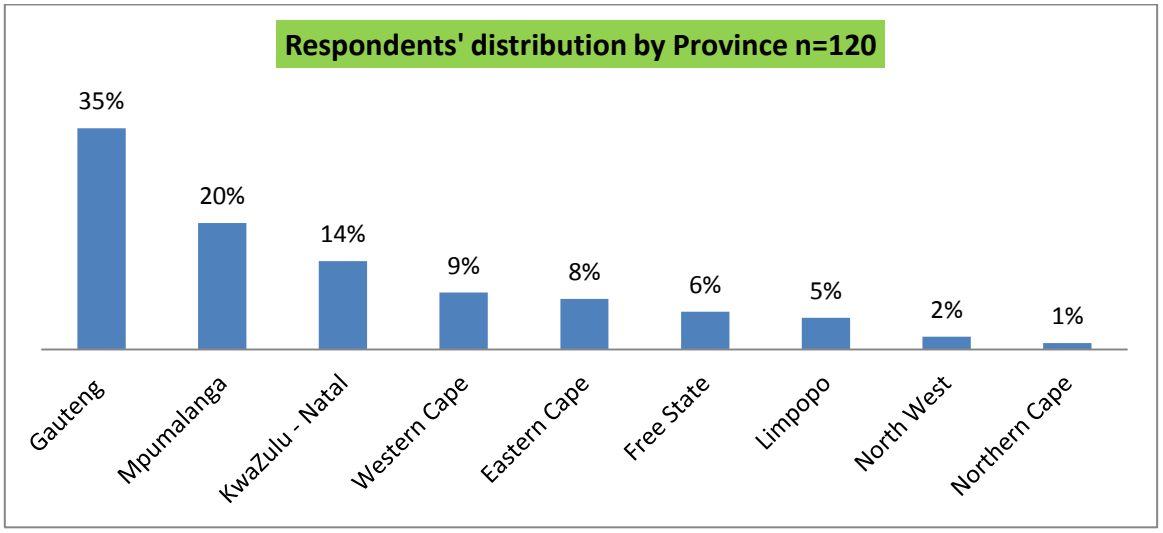


Fig. 4.3 Respondents' distribution per province

The result indicates that the majority of respondents were based in Gauteng and Mpumalanga provinces. Although Gauteng is the smallest province in South Africa relative to land mass, it is highly urbanised. It contains the country's largest city, Johannesburg, with an estimated population of nearly 12.3 million, making it the most populous province in South Africa.

4.1.4. Respondents' composition based on level of qualification

Figure 4.4 presents the percentage composition of the 120 respondents based on qualification level.

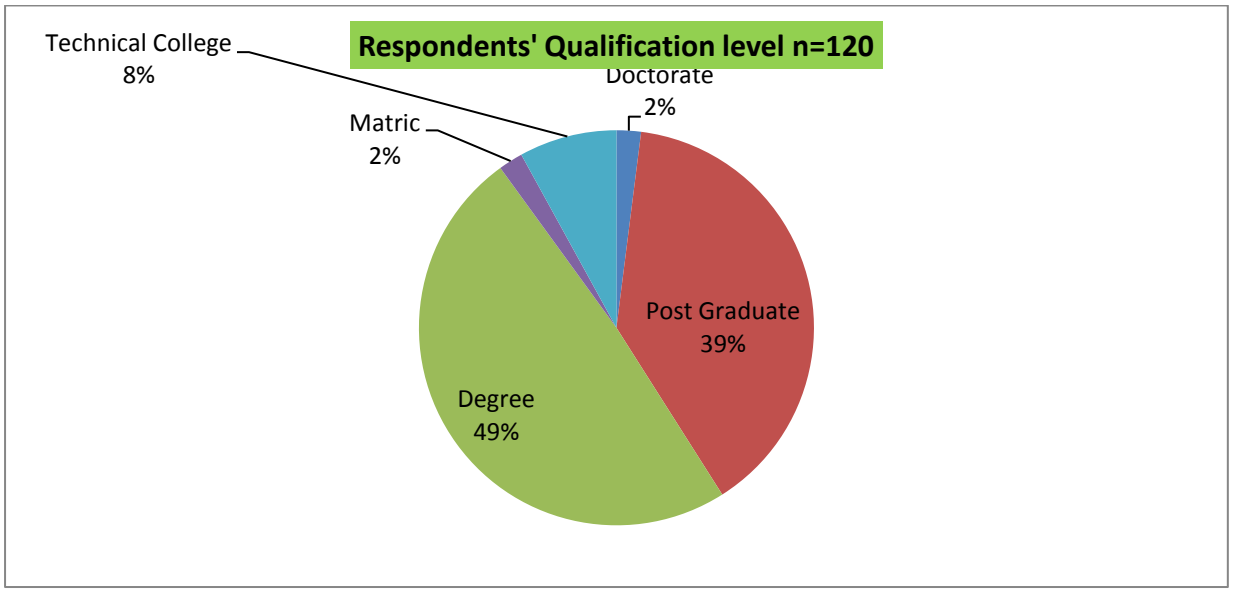


Fig 4.4 Respondents' qualification levels

The result indicates that a large number of CPMs in South Africa have at least an undergraduate degree or higher. Of the 120 participants, 49% have a university degree, 39% have a post-graduate qualification and 2% have a doctorate (PhD). Only 8% of respondents have a Technical College qualification and 2% have matric. This is a positive outlook as institutions of higher learning would be a right platform to provide both technical skills and PM knowledge to those in the PM professional field. However, as discussed earlier, Rwelamila (2007) shows that institutions of higher learning are doing well on technical skills, but not very well on PM knowledge areas. Although the SACPCMP's efforts in that direction are noted, nonetheless, construction project delivery results are not yet very encouraging. Projects are still delivered late and over budget (Akinsiku *et al.*, 2012; Apolot *et al.*, 2010; Arcila, 2012; Baloyi & Bekker, 2011; Ramabodu and Verster, 2013).

4.1.5. Respondents' percentage composition based on academic background

The results of this study suggest that CPMs practising in South Africa are from different academic backgrounds within the built environment field. Figure 4.5 presents the percentage composition of the 120 respondents based on their different academic backgrounds.

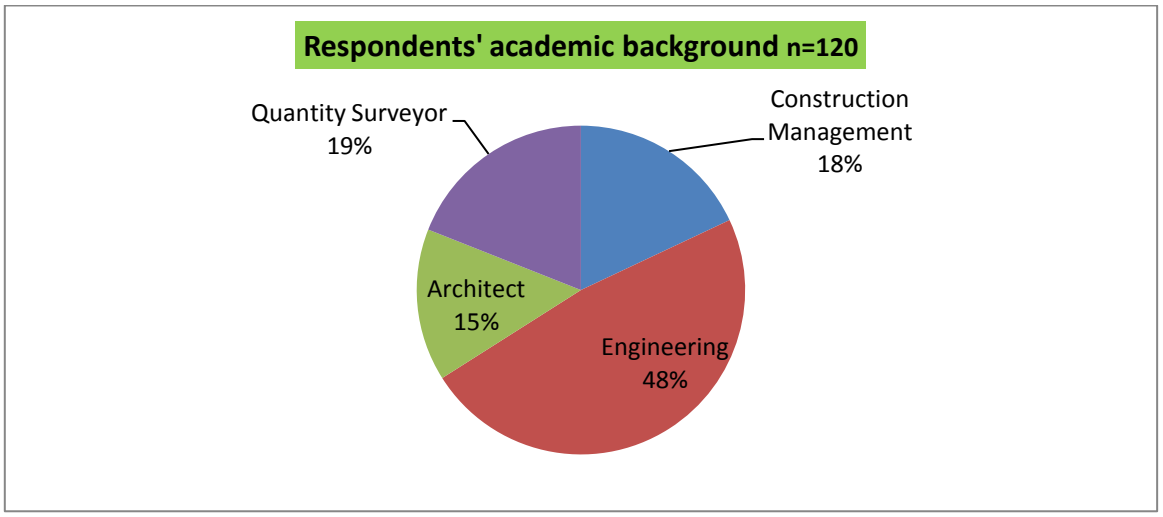


Fig. 4.5 Respondents' academic background

According to Figure 4.5, a large majority of CPMs are from an engineering academic background (48%). Engineering professionals were followed by quantity surveyors, who represent 19% of the respondents. CPMs coming from an architecture background accounted for 15%. Only 18% of respondents were from a Construction Management (CM) background.

The indication that a large majority of CPMs are still from an engineering academic background rather than CM is a concern (Bothma, 2012), particularly when considering that the curriculum at university supplies very little exposure to management training (Rwelamila, 2007). Bothma (2012) reports that in many case engineers are promoted to CPM positions without any formal development or structured training in PM. As a consequence most engineers are poor CPMs, according to Bothma (2012). In the PMBOK® Guide context, technical expertise is very important and is called expert judgement, which is considered important for all processes. These technically-trained individuals are, however, not necessarily fully prepared academically to be CPMs (Bothma, 2012; Cox *et al.*, 2009; Rwelamila, 2007). Rwelamila (2007) has rightly flagged that in South Africa, as in most other countries; simply by obtaining the technical qualifications people are elevated to CPM positions.

The PMBOK® Guide defines PM as an application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. According to the PMBOK® Guide, PM is accomplished by the appropriate application and integration of the 42 logically grouped PM processes (please refer to Table 2.1).

4.1.6. Respondents' percentage composition based on years of experience in the PM profession

Figure 4.6 presents the percentage composition of the 120 respondents based on their years of experience in the profession.

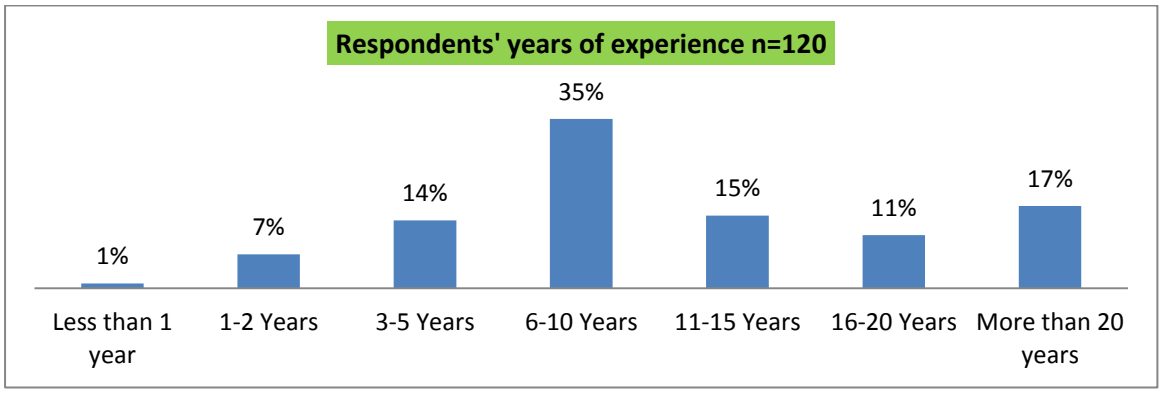


Fig. 4.6 Respondents' years of experience

There is an indication that the majority of respondent CPMs (about 92%) had more than three years' experience in CPM at the time of the fieldwork. Nonetheless within that majority, more than half had less than 10 years' experience in the CPM profession. This could be because CPM as a profession is relatively new in Africa and most institutions have only recently started offering postgraduate course(s) in it. Hence the majority of practising professionals are engaged in CPM based on their years of working experience within the industry, despite not having any professional registration.

4.1.7. Respondents' number of construction projects managed

The study requested the number of projects on average each respondent has managed, to get an indication of a CPM's capacity to learn from past projects as recommended by the PMBOK® Guide. Figure 4.7 presents the percentage composition of the 120 respondents based on the number of construction projects managed to date.

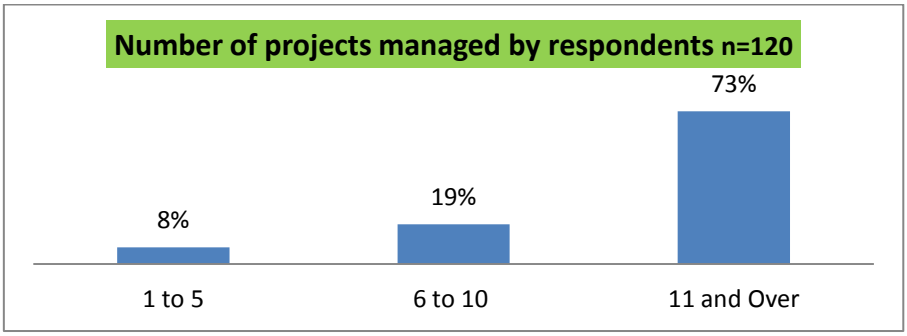


Fig. 4.7 Number of projects managed by respondents

The result suggests that, in general, CPMs within the South African built environment industry have managed a relatively large number of projects; at least 92% have managed more than six construction projects.

According to the PMI, the PMBOK® Guide attributes importance to lessons learned as part of the OPA. As such the OPA is an input in almost all PMBOK® Guide processes. It must be updated each time a project is completed to serve as knowledge repository for future projects. This means that when initiating, planning, executing, controlling and monitoring or closing a project, a project manager should take into consideration his or her own and the organisation's history (past experience) to avoid similar mistakes in the future. Therefore, it can be argued that if CPMs are applying the PMBOK® Guide processes, they should know how to use the organisational process asset as described in the PMBOK® Guide to learn from past experiences of what worked and what did not work, therefore avoiding similar mistakes subsequently.

4.1.8. Respondents' additional PM training

Since it has been stressed that institutions of higher learning are weak in their PM programmes curricula (Rwelamila, 2007), normally additional and / or continuous training in PM would assist CPMs to bridge the gaps and lapses (Bothma, 2012). Figure 4.8 shows the percentage composition of the 120 respondents based on those who have acquired additional PM training and those who have not.

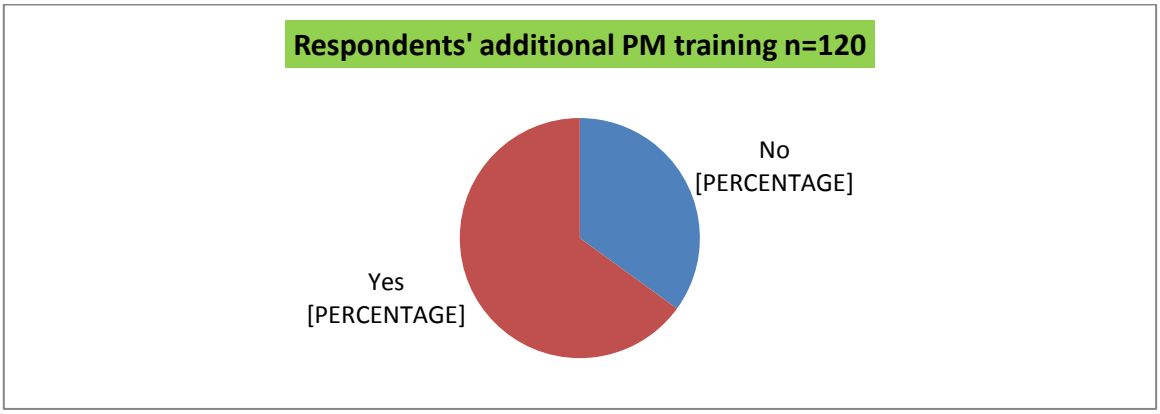


Fig.4.8 Respondents' additional PM training

The result suggests that beyond academic PM courses or qualifications, a majority of CPMs (65%) have attended more training in project management. This is a good trend to be encouraged, particularly in light of Rwelamila (2007) findings that most institutions of higher learning have weak PM programme curricula. Concomitantly, in light of the PMI's standards, even the PMBOK® Guide is regularly reviewed to introduce new items and tools. Therefore, to keep abreast with current trends within the PM sphere, it is imperative for practitioners to go for refresher courses and seminars as supported by continuing professional development.

4. 2. Performance of CPMs when managing construction projects

This section of the research sought to establish CPMs' performance when managing construction projects. As dictated by the scope of this study, this performance was limited to time and cost performance.

4.2.1. Respondents' time performance

Figure 4.9 indicates how CPMs within the built environment industry in South Africa are performing in terms of schedules when managing construction projects.

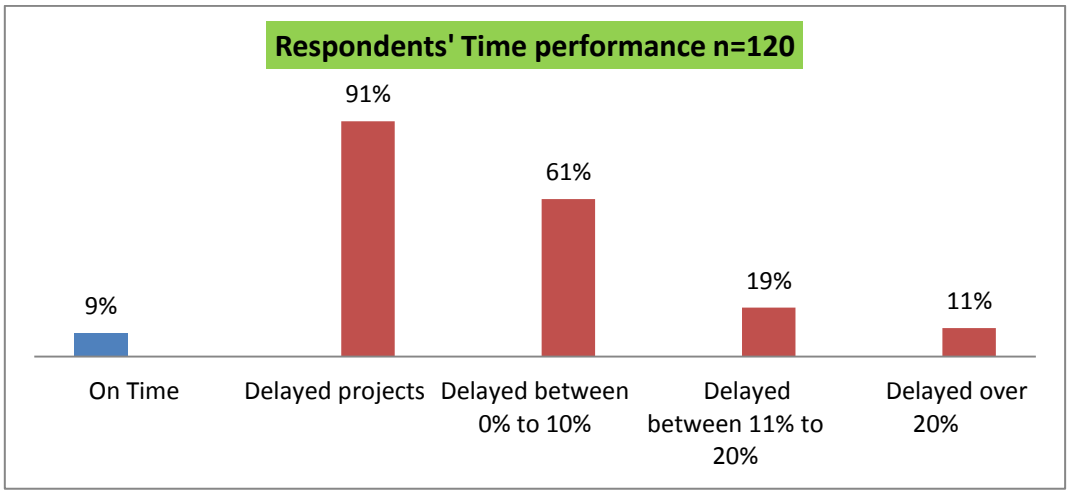


Fig. 4.9 Respondents' time performance

Though of a different magnitude, the results reveal that in general 91% of CPMs do not complete their projects on time. From that 91% not completing projects on time, 61% complete their project from 0% to 10% later than scheduled; 19% of respondents' complete projects over 11% to 20% later than the scheduled time and 11% are late over 20% of the scheduled time. This suggests that about nine out of 10 CPMs complete their projects behind the planned schedule.

4.2.2. Respondents' cost performance

Figure 4.10 presents the performance of CPMs in South Africa in relation to cost.

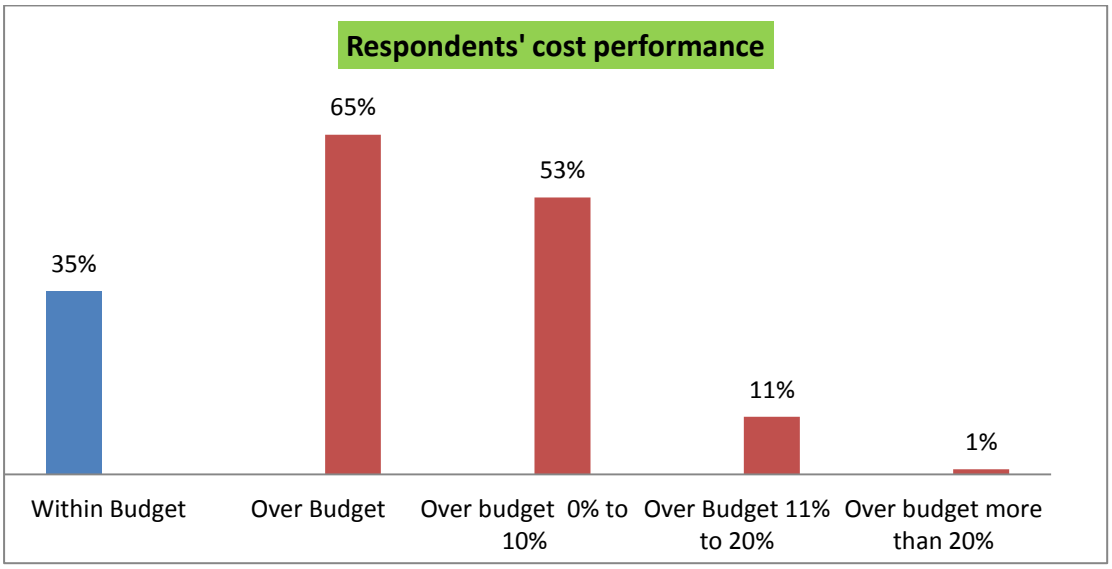


Fig. 4.10 Respondents' cost performance

The result indicates that 65% of CPMs in South Africa do no complete their construction projects within the planned budget. This means that about six to seven out of ten CPMs expend above the planned project budget. Of the respondents, 53% spend 0% to 10% more than planned for; 11% spend more than 11% to 20% of the planned budget and 1% spend more than 20% of the original budget.

In previous studies, various reasons have been put forward to explain this dismal performance. Most seem to be presented as being outside the CPMs' responsibilities or control. For example, scope creep has been identified as one very common reason for project failure (Hussain, 2012; Ramabodu and Verster, 2013). According to the PMI, this could be avoided if CPMs structurally followed a proper requirement collection process as recommended in the PMBOK® Guide.

Further reasons highlighted by Akinsiku and Akinsulire (2012) are delay in payment of interim certificates, inability of the client's representatives to take decisions or the contractor's inability to proceed diligently and efficiently. Again, though it may seem as if it is out of the CPMs' control, if the PMBOK® Guide is followed, the CPM should put processes in place to overcome these challenges from the beginning.

As discussed earlier, within the PM professional context, despite all reasons and challenges that are experienced, a project manager is responsible for ensuring project success (Zwikael, 2009). This success is measured in terms of completing the project within the constraints of scope, time, cost, quality, resources and risks as approved between the project manager and senior management (PMI, 2013).

Hence, despite all explanations that can be provided, this study's finding of CPMs' poor performance in relation to time and cost agrees with findings from previous research in relation to the prevalence of construction project delays and cost overruns within the built environment in South Africa (Akinsiku and Akinsulire, 2012; Baloyi and Bekker, 2011; Ramadu and Verster, 2013; Memom, 2012; KPMG, 2015). This is disturbing and needs to be addressed.

4. 3. Awareness of the existence of the PMBOK® Guide amongst CPMs

The last section of the survey investigated whether CPMs are structurally applying the PMBOK® Guide's processes, tools and techniques when managing construction projects or not. In addition, it was imperative to first investigate the extent of awareness of the PMBOK® Guide amongst CPMs.

Respondents' awareness of the PMBOK® Guide is presented in Figure 4.11.

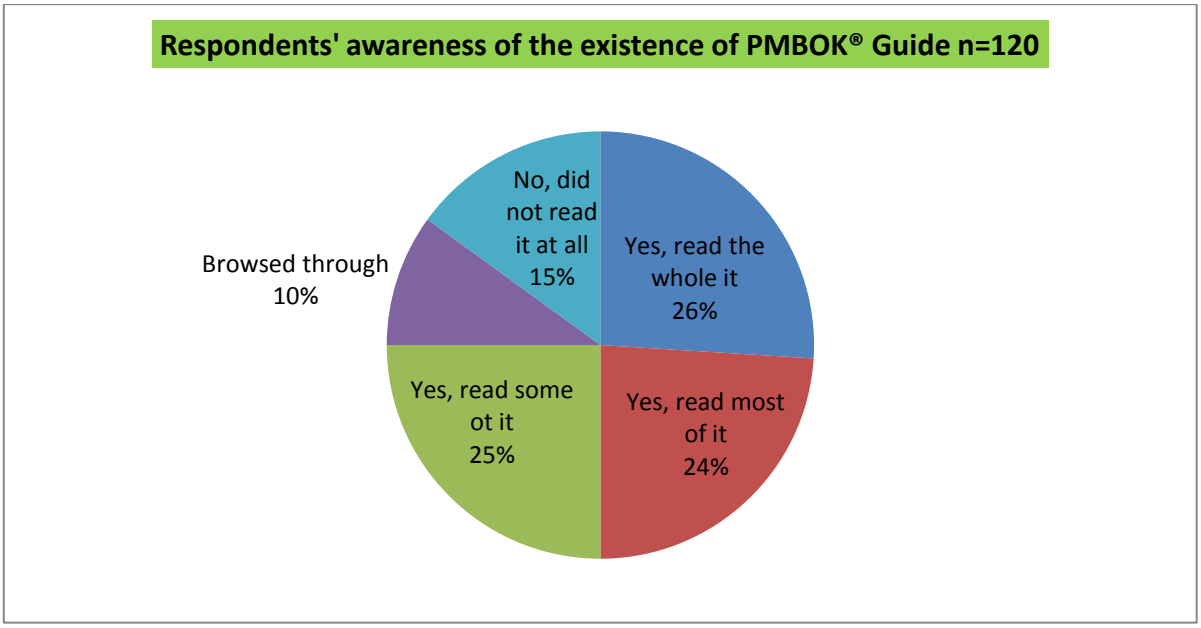


Fig. 4.11 Respondents' awareness of the existence of the PMBOK® Guide

The result suggests that at least 85% of the respondent CPMs within the built environment in South Africa were aware of the existence of the PMBOK® Guide. Twenty-six per cent have read the PMBOK® Guide, 24% have read most of it, 25% have read some of it and 10% have only browsed through it. Although some within this category claimed to be aware of it, 15% have not read it. The result indicates that, in general, a large majority of CPMs are aware of the existence of the PMBOK® Guide.

Considering CPMs' poor performance as confirmed in the above result, and bearing in mind that a majority of CPMs are aware of the PMBOK® Guide's existence, it suggests that CPMs might be aware of the PMBOK® Guide only because of the SACPCMP's insistence on the Guide as the basis for professional registration for CPMs. However, its effective application is not evident and the SACPCMP does not have measures in place to ascertain whether or not CPMs are really applying the Guide's processes, tools and techniques in their projects and not just using it for their professional registration report presentation. What is even worse is that not all CPMs are bound to be registered with the SACPCMP.

4.4. Application of the PMBOK® Guide processes by CPMs

CPMs are performing poorly (please refer to Section 4.2). Furthermore, considering that they are aware of the PMBOK® Guide as indicated in Section 4.3, this study has to determine the extent of the PMBOK® Guide application by CPMs when managing their construction projects. This study argues that a limited application of the PMBOK® Guide when managing construction project will result in project delays and cost overruns.

To respond to the research questions, participant responses to each question are reported using a 5-point Likert-style rating scale, ranging from 1 (never address this process structurally) to 5 (always address this process structurally). For a questionnaire to be acceptable and considered for further analysis, the respondent had to respond to all the 42 processes as contained in the PMBOK® Guide, fourth edition.

As alluded to in Chapter 1, section 1.5, this study considers that a respondent does structurally apply a specific process only if, in the response classification, the respondent responds 4 or 5. Any response below 4 for a given process is considered as not structurally applying that specific process. This decision is informed by the understanding of the PMP exam format, which is based on the PMBOK® Guide, to assess the candidate's proficiency. Though the PMI does not publish the passing scores, it is speculated that the passing score is around 60% to 65% for each process group (domain) (Mulcahy *et al.*, 2013). Any score below 60% is interpreted as being below proficiency and therefore a failure. This means, according to the PMI, that to be proficient in PM a candidate must obtain at least 60% for all process groups.

Using the above criterion, respondents' performance in each of the 42 processes within the nine knowledge areas contained in the PMBOK® Guide fourth edition is presented in Table 4.1.

Table 4.1 Extent of the application by respondents of the PMBOK® Guide

Knowledge Areas	Process	Structurally applying (%)	Not structurally applying (%)
Project Integration Management	Develop project charter	41	59
	Develop project management plan	58	42
	Direct and manage Project Execution	78	22
	Monitor and control project work	82	18
	Perform integrated change control	60	40
	Close project or phase	68	32
Project Scope Management	Collect requirement	67	33
	Define scope	72	28
	Create WBS	44	56
	Verify scope	76	24
	Control scope	80	20
Project Time Management	Define activities	62	38
	Sequence activities	62	38
	Estimate activity resources	50	50
	Estimate activity duration	58	42
	Develop schedule	63	37
	Control schedule	79	21
Project Cost Management	Estimate costs	72	28
	Determine budget	73	27
	Control costs	83	17
Project Quality Management	Plan quality	67	33
	Perform quality assurance	66	34
	Perform quality control	73	27
	Develop human resource plan	46	54

Project Human Resource Management	Acquire project team	57	43
	Develop project team	51	49
	Manage project team	75	25
Project communication management	Identify stakeholders	61	39
	Plan communication	57	43
	Distribute Information	79	22
	Manage stakeholder expectation	70	30
	Report performance	80	20
Project Risk management	Plan risk management	51	49
	Identify risks	57	43
	Perform qualitative risk analysis	44	56
	Perform quantitative risk analysis	44	56
	Plan risk responses	48	52
	Monitor and control risks	64	36
Project Procurement Management	Plan procurement	60	40
	Conduct procurement	67	33
	Administer procurement	64	36
	Close procurements	64	36

The model's reliability was calculated using Cronbach's alpha. Results of 0.978 as presented in Table 4.2 were considerably higher than the minimum value required by the statistical literature (Tavakol and Dennick, 2011).

Table 4.2 Cronbach's alpha calculation

Reliability statistics					
Case Processing Summary				Alpha	No. of Items
	N	%	%	Alpha	No. of Items
Case	Valid	120	100	.978	42
	Excluded	0	0		
		120	100		

Table 4.1 shows that, in almost all processes, a considerable number of CPMs do not structurally apply the PMBOK® Guide. There is not even one process where all CPMs do structurally apply the specified processes. The results indicate that more than half of the respondents do not apply some of the processes. The six processes that more than half of the CPMs were not structurally applying are indicated by the shaded cells.

This result confirms Zwikael (2013) suspicion that for different reasons, most project managers do not have the time to perform all that is required by the PMBOK® Guide. Zwikael (2013) indicates that usually project managers choose to perform only those processes that they are most familiar with or that are easier to perform. In doing so, project managers may give lower priority to processes that have a higher impact on project success and as a consequence negatively affect the project outcome.

Analysing the application of each knowledge area as per the nine sub-questions, CPMs' application limitations in each knowledge area is presented and discussed below. Within each knowledge area, the study emphasises processes where it is indicated that more than half (the majority) of CPMs do not structurally apply these processes. These supplementary explanations are provided to demonstrate the implications that not structurally applying such specific processes could have for project delivery.

4.4.1. Respondents' application of project integration management processes

Figure 4.12 presents CPMs' performance in all processes contained in the integration management knowledge area.

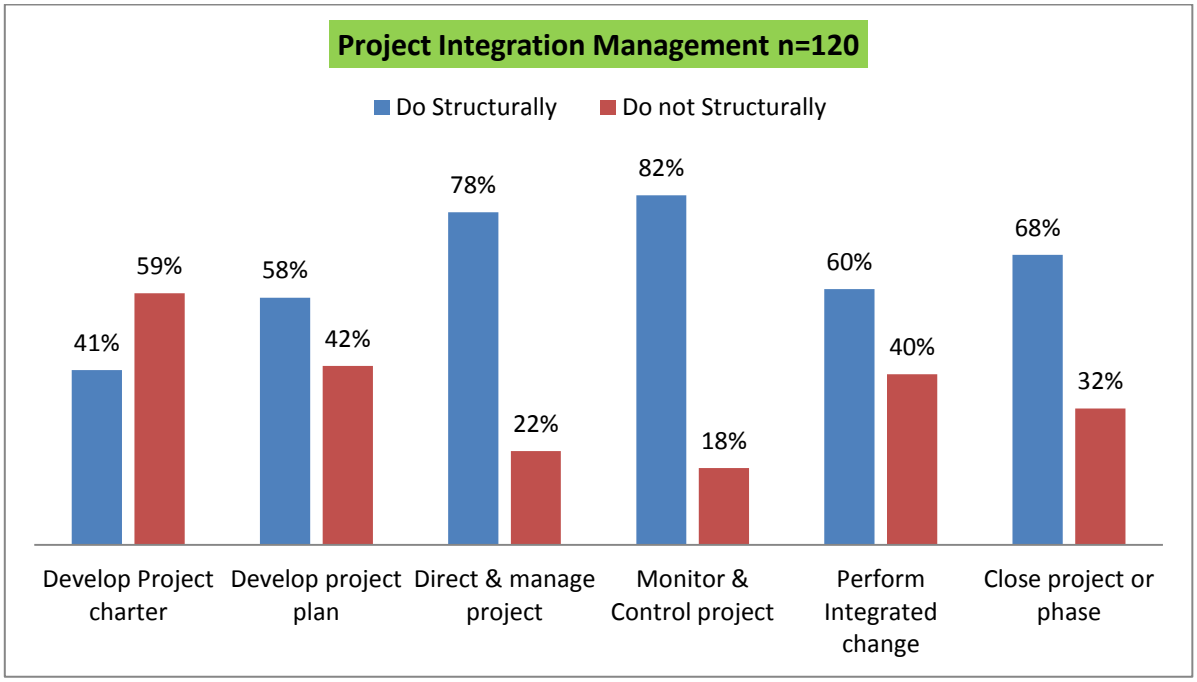


Fig. 4.12 Respondents' application of project integration management processes

Within the six processes in the integration management knowledge area, the result shows that five are followed by many CPMs. Nonetheless, it is paradoxical that a considerable number of CPMs do not apply even these processes. The result indicates that 42% of the respondents do not structurally develop a PM plan and 22% do not structurally direct and manage project execution. At least 18% of respondents do not structurally monitor and control project work. A considerable number of respondents, up to 40%, do not perform project integrated change control structurally and 32% do not structurally close their project or phase structurally. Worse, the result shows that the majority of respondents, 59%, do not structurally develop project charters when managing their construction projects. Due to the importance of developing a project charter in the success of the project (Mulcahy *et al.,* 2013), this is a major concern.

In a PM environment, not structurally completing the process of developing a project charter has a direct negative implication on the delivery of the entire project (Mulcahy *et al.*, 2013). According to the PMBOK® Guide, a project charter is the formal document that authorises the start of the project. It names and appoints the project manager, outlines initial requirements to satisfy the stakeholder's needs and expectations, assigns a summary budget, establishes a project time frame, and documents key assumptions and constraints; hence, it establishes the project boundaries and projects key deliverables.

Within the PM context, integration management is concerned with the project characteristics of unification, consolidation, articulation, and integrative actions that are crucial to project completion, as well as successfully managing stakeholders' expectations and meeting requirements (PMBOK® Guide, 2008). There is no structure that is sustainable if the base or the foundation is not fixed, and the same applies to managing a construction project without developing a structured project charter. A project without a charter is subject to being run by trial and error, according to individuals' emotions, feelings and moods of the day, because there are no established boundaries. Anybody can reduce or increase the project as he or she deems fit. This ultimately causes scope creep, which is a major cause of project delays and cost overruns (Hussain, 2012). The Project Charter serves as an important document to inform stakeholders of all of this information.

According to the PMBOK® Guide, the project sponsor is accountable for producing the Project Charter; however it is often delegated as the first major responsibility of the Project Manager (PMBOK® Guide, 2013). Nonetheless, whether a CPM participates in the project charter's development or not is irrelevant because it is the project's major document of reference (Mulcahy *et al.,* 2013). Therefore, it is the CPM's responsibility to ensure that he or she is provided with a project charter as a form of project manifesto (Mulcahy *et al.*, 2013).

In the built environment, particularly within the public-sector environment and Para state organisations, most of the project sponsors may be functional managers or political appointees who are not necessarily professionals (Sunjika and Jacob, 2013). These functional managers might not know the importance of a project charter; they may even be unable to develop one. In such cases, Mulcahy (2013) suggests that the project manager should develop one, but still ensure that it is mutually understood and agreed upon with the project sponsor and signed off by the project sponsor to confirm its understanding and its ownership.

According to the PMBOK® Guide, developing a project charter is the process of developing a document that formally authorises the project and documents initial requirements that satisfy the stakeholders' needs and expectations. The PMI suggests that the project should not formally start without a project charter. As discussed earlier, a project charter documents the high-level planning done during project initiation (Mulcahy, 2013). This is the process that determines whether or not the project can be delivered within the client's expectations and constraints of time, cost, and scope. This is the key process where the project manager has to assess whether the project has a chance of being successful before the organisation commits money and resources to it.

According to the PMBOK® Guide, the "develop project charter" process is derived from five inputs and two tools and techniques. OPA is one of the key inputs. This input assists the CPM to consider past experience and lessons learned to avoid making the same mistakes in current and future projects. This study found that the majority of CPMs have more than three years of working experience. The concern is whether or not CPMs are learning from these years of experience or are merely spending years within the project environment and repeating the same mistakes.

Another key input in developing a project charter is the business case. This is a document that provides information from a business standpoint to determine whether or not the project is worth committing resources to. It analyses the business needs and undertakes a cost–benefit analysis to justify undertaking or abandoning the project (PMI, 2008). Some unsuccessful construction projects in the South African built environment could have been avoided if a proper business case analysis had been undertaken in the first place to determine the business viability of the project and make the necessary trade-offs. E-Toll, is one example of a construction project that went ahead without taking into consideration all requirements of a project charter to determine the chances of success. As a consequence the project has a very high risk of failure from professional point of view (Hommes and Holmner, 2013).

It has been proven that improving planning processes increases the likelihood of project success (Zwikael, 2012), but no one can have a proper project plan without a proper project charter because the project plan is dependent on the project charter as one of its key inputs. Furthermore, Ramabodu and Verster (2010) and Hussain (2012) list scope change as one of the most important factors contributing to project delays and cost overruns within the built environment. A proper requirement collection and scope definition depend on the project charter, which is their key input (See Fig.4.13). Consequently, not developing a project charter has a negative impact on the project outcome.

Figure 4.13 presents a project charter flow diagram within the project environment.

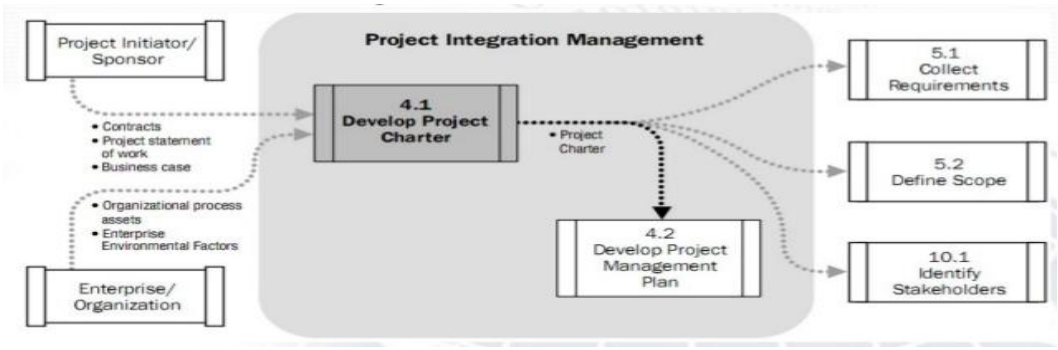


Fig. 4.13 Develop project charter flow diagram
Source: PMI 2008

4.4.2. Respondents' application of project scope management processes

Figure 4.14 presents the extent of CPMs' application of processes contained in the scope management knowledge area.

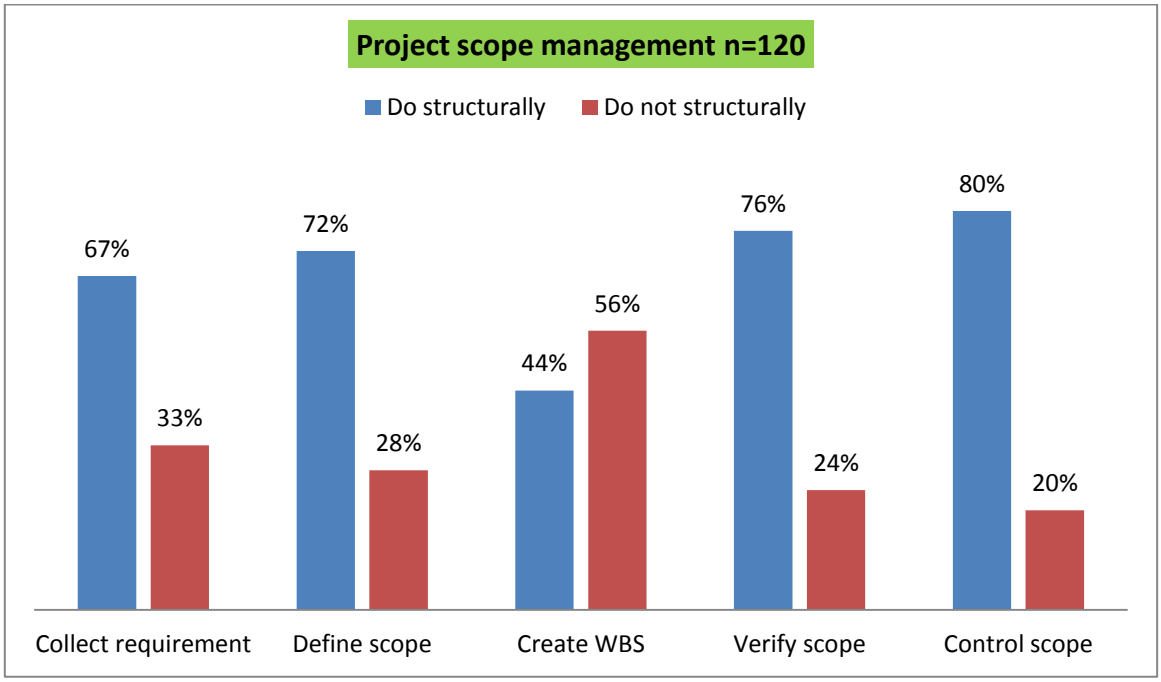


Fig 4.14 Respondents' application of project scope management processes

Within the scope management knowledge area, the result indicates a similar trend of a considerable number of respondents not structurally applying the PMBOK® Guide when managing their projects. The results show that 33% of respondents do not structurally collect requirements and 28% do not structurally define scope. A large majority, 56%, do not create a WBS and 24% do not structurally verify scope. Paradoxically, the result indicates that a large majority, at least 80%, do structurally control scope. This means that even those CPMs who do not structurally collect requirements or define scope, either create a WBS or structurally control scope.

In a PM context, scope management is a key knowledge area. It is the basis on which project goals, deliverables, features, functions, tasks and ultimately schedule and costs are determined to achieve the project objective (Mulcahy *et al.*, 2013). Within that knowledge area, Mulcahy *et al.* (2013) ascertain that a WBS is a central and key organisational tool to assist CPMs to conform to the requirement that they must collect, define and control details of each activity, its schedules and cost. A WBS shows the scope of the project broken down into manageable deliverables. Furthermore, Mulcahy *et al.* (2013) emphasise that without a WBS, the project will take longer, elements will slip through the cracks, and the project will be negatively impacted. The authors advise that all projects, even small ones, need a WBS. This result showing that a majority (56%) of CPMs do not structurally create a WBS presents an interesting view of how construction projects are managed in South Africa. This could be an indication of why many projects are completed late and with huge cost escalations.

This low level of creation of a WBS could be because most CPMs do not necessarily understand what the scope or components of the project they are responsible for are at the inception stage (Sunjika and Jacob, 2013). It may also be linked to poor understanding of PM principles (Sunjika and Jacob, 2013), such as the lack of a project charter development process or the misconception that the creation of a WBS is the contractor's responsibility. This poor understanding of PM principles is dangerous and very concerning because without a detailed WBS the project cannot be scheduled and estimated properly. Though the contractor is responsible for determining how the works will proceed when appointed, the CPM should already have a clear understanding of what the work entails, how to proceeds, the time frame for each activity and the estimated cost.

Relating to the finding that few CPMs create a WBS, this study is of the view that the readily available template of the BOQ and its structure might not necessary encourage CPMs to create a specific WBS for each project as required by the PMBOK® Guide. Standard BOQs are readily available, but structured by trade not necessarily by activities as they should be performed; therefore, CPMs and their team tend to use existing standardised BOQ templates without necessarily being encouraged or forced to create a specific WBS for each new project. As a consequence, they choose not to create a WBS.

Mulcahy *et al*., (2013) highlights some benefits of creating a WBS. It forces the team to truly identify and understand the work that needs to be delivered; it helps to test whether the project manager and his or her teams understand the scope and objectives of the project, and if their understanding is sufficient and aligned with the stakeholders' requirements and understanding. This will provide an important basis for estimation of time and cost. Furthermore, a WBS is a strong tool for communicating with all stakeholders from project planning to execution and the control and monitoring stages.

Figure 4.15 presents an example of a WBS for a typical construction project.

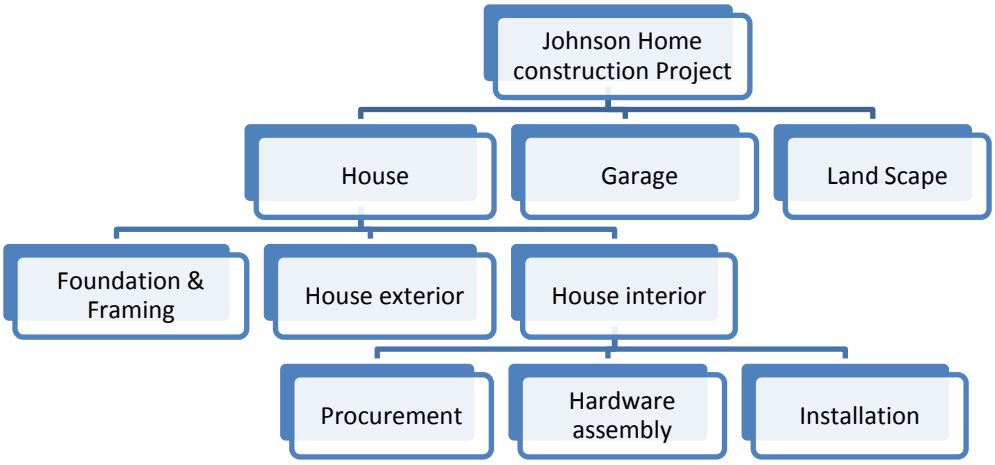


Fig. 4.15 Example of a WBS of a typical construction project

Source: The Knowledge Academy (2013)

4.4.3. Respondents' application of project time management processes

Figure 4.16 presents CPMs' performance in all processes contained in the project time management knowledge area.

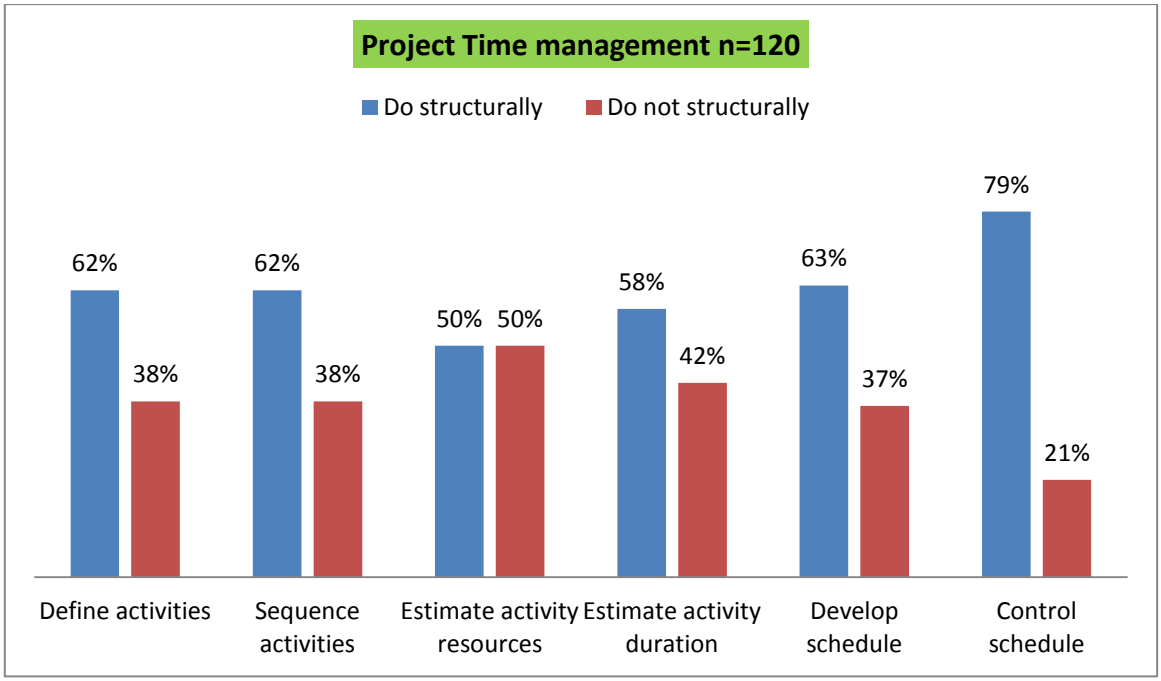


Fig 4.16 Respondents' application of project time management processes

Within the time management knowledge area, 38% of respondents do not structurally define activities of their work. In relation to sequence activity process, again 38% of respondents do not structurally sequence activities of their work. In the estimate activity resource process, the prerequisite process to estimate the resource required for each activity, half of respondents (50%) do not take this process seriously. The result indicates that a considerable 42% of respondents do not structurally estimate activity duration, which ultimately determining the full project schedule. Similarly, 37% of respondents do not develop schedules.. Paradoxically, the control schedule process project an interesting view. The result indicates that 79% of the respondents do structurally control the schedule. This means even those who did not define activities or estimate resources do control the schedule.

The processes in the time management knowledge area, like all processes in all nine of the PMBOK® Guide's knowledge areas, are linked to each other. The indication that CPMs are inconsistent in applying the recommended processes is disturbing. It is imperative to estimate project timeframes and develop a coherent schedule that can be controlled in any project (Mulcahy *et al.*, 2013). Time should be determined by the define activity process, and then sequence activity, before estimating activity durations. Only after all these processes have been completed will the CPM be able to develop a coherent schedule that will determine the project timeframe.

This inadequate application of almost all the processes within the time management knowledge area as shown in Fig 4.16 is a serious concern and indicate that most of CPMs are guess estimating their project timeframe, consequently their proposed schedule are not reliable (Mulcahy, et al., 2013). Therefore, it is not a surprise that 9 out of 10 construction projects are not completed on time as indicated in section 4.2.1, because proposed completion dates most CPM are providing are not professionally crafted but simple guesstimated.

4.4.4. Respondents' application of project cost management processes

Figure 4.17 presents CPMs' performance in all processes contained in the project cost management knowledge.

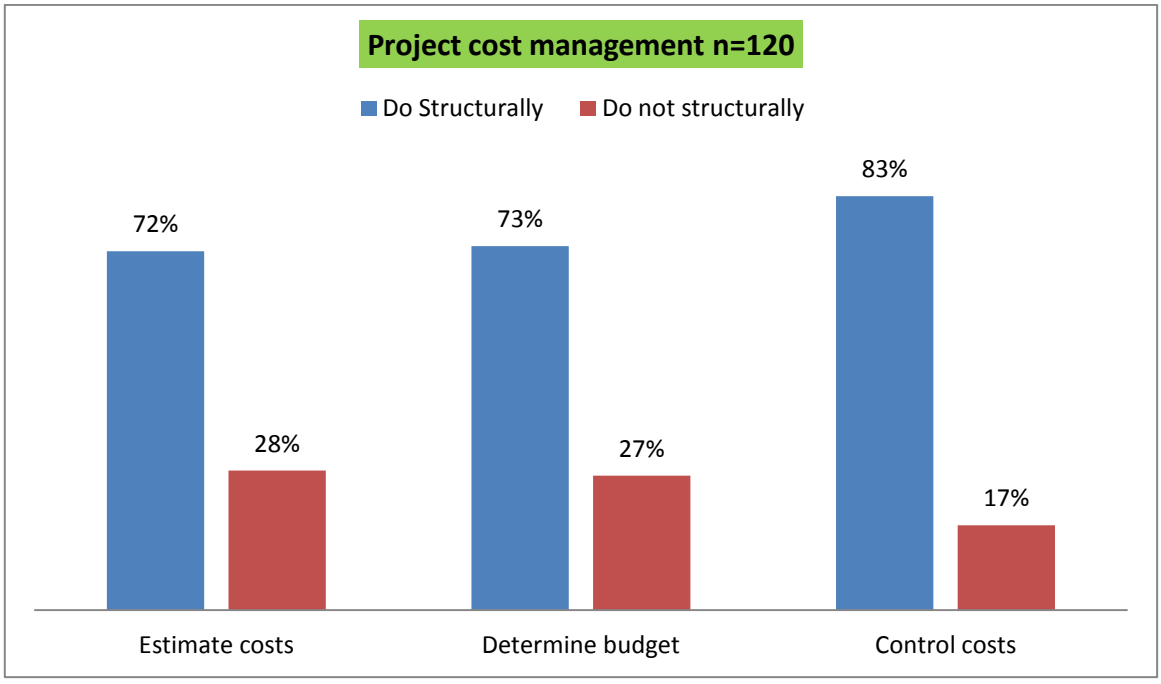


Fig 4.17 Respondents' application of project cost management processes

The result indicates that 28% of the respondents do not structurally estimate cost. 27% of the respondents do not determine budget and 17% of the respondents do not control cost. This is not a good sign, as it indicates that not all CPMs are taking their responsibility seriously, because how project can be completed within budget if CPMs are not on top of the full cost matter. This negligence of project cost affairs might be attributed to the wrong perception within the PM environment in general that specific tasks are reserved for specialists (Jarocki, 2014). Particularly within the built environment, such specialists would include: quantity surveyors for cost; architects for scope and quality; and engineers for technical matters. However, according to the PMBOK® Guide, all specialists in the project are considered to be expert judgement to provide expertise to specific areas of the project, but the ultimate accountability and responsibility rests on the project manager's shoulders.

4.4.5. Respondents' application of project quality management processes

Figure 4.18 presents CPMs' performance in all process contained in the project quality management knowledge.

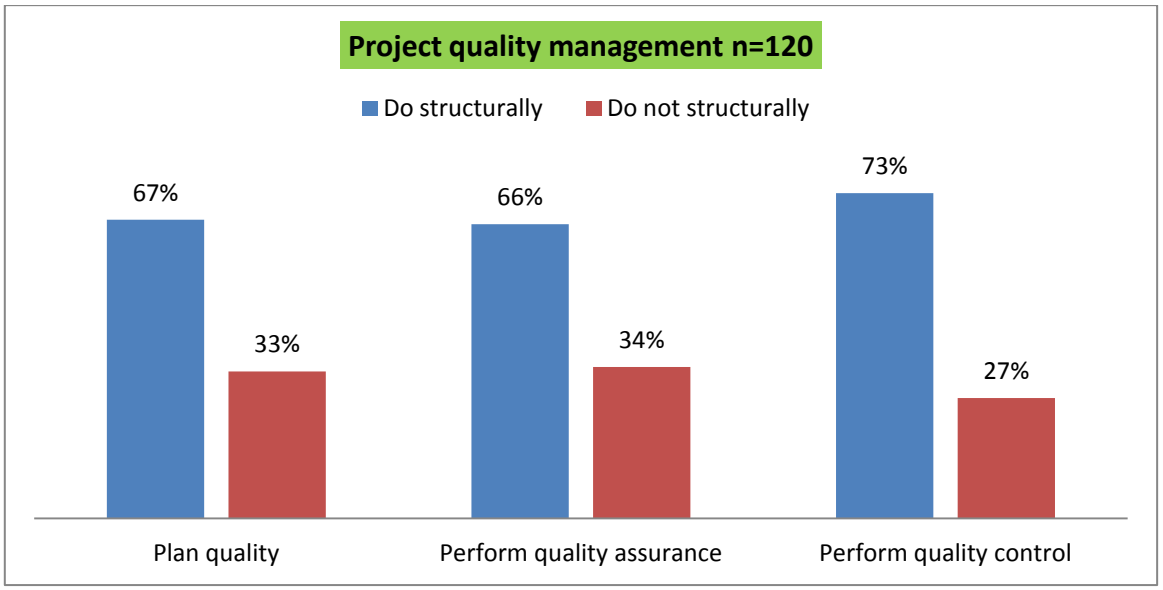


Fig 4.18 Respondents' application of project quality management processes

The result indicates that 33% of CPMs do not structurally plan quality. 34% indicate that they do not structurally perform quality assurance and 27% do not structurally perform quality control. As said in section 4.4.4, most probably these CPMs who do not structurally follow all the processes required in the quality management knowledge area expect the architect and engineers to be responsible for this aspect of the project. The importance of quality management cannot be underestimated.

Quality management includes creating and following policies and procedures to ensure that a project meets the defined objectives it was intended to in the first place from the client's perspective, which include time and cost (Mulcahy *et al.,* 2013). If the quality is not up to standard, work has to be repeated, which will result in more time and more costs than planned and budgeted for the specific work. This study is of the view that though the importance of quality management is recognised in the construction industry, there is still a perception that the responsibility for quality rests on the contractor and, as such, the contractor should be responsible of quality. Nonetheless, in the context of achieving International Organisation for Standardisation (ISO) compatibility, the PMI recommends that although the success of the project's quality management requires the participation of all members of the project team, the project manager is responsible for quality (PMI, 2013). An indication that a large number of CPMs (over 30% on average) do not structurally follow quality processes is a concern, and therefore also counts with other reasons for the poor performance of project delivery recorded in the industry as supported by Akinsiku and Akinsulire (2012).

4.4.6. Respondents' application of project human resource management processes

Figure 4.19 presents CPMs' performance in all process contained in the project human resource management knowledge.

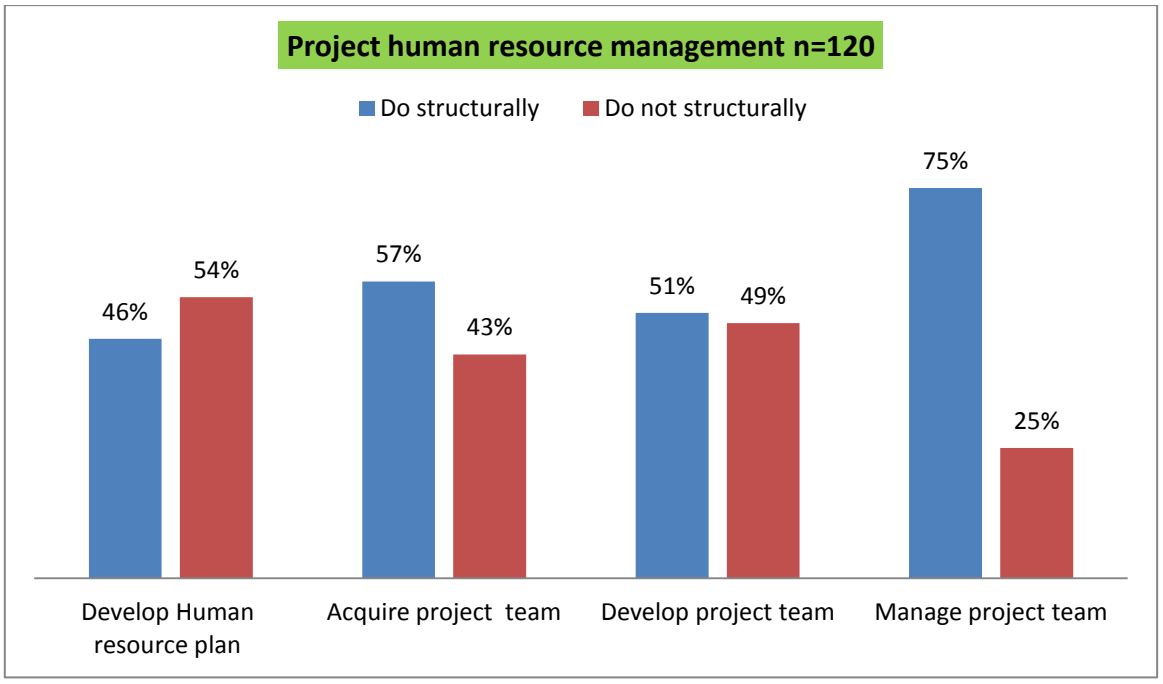


Fig. 4.19 Respondents' application of project human resource management processes

Within the project human resource management knowledge area, the result indicates that a majority of CPMs (54% in total) do not structurally develop a human resource plan. 43% of them do not structurally acquire their project team. Almost half, exactly 49% do not develop their project team. Paradoxically a large majority, 75% of them do manage the project team, which they neither planned for not acquired let alone developed.

According to the PMBOK® Guide, project human resource management is concerned with the processes that organise, manage and lead the project team. The project team comprises the people with assigned roles and responsibilities for completing the project (Mulcahy *et al.,* 2013). The indication that a considerable number of CPMs do not structurally apply most of the human resource knowledge area process is a serious concern. Worse, the indication that 54% of CPMs do not even structurally develop their project human resource plan is worrying considering that a human resource plan is the process of identifying and documenting project roles, responsibilities and required skills, reporting relationships, and creating a staffing management plan (PMI, 2008).

Various reasons could be given for this misapprehension of CPMs' human resource responsibility. One could be that most of the time in the built environment, the employer appoints different consultants from an existing panel. The CPM might not have full control over such appointments.

However, this study is of the view that even when the client has to appoint all consultants from its existing panel, to take responsibility for these consultants (technical experts), the CPM should participate on that selection process. Even if the CPMs do not freely acquire the project ream, they still have the responsibility to plan and manage the human resources.

Without a formal and proper project human resource management plan, establishing who is doing what, when, how and reporting to whom from the commencement of the project will lead to a "trial and error" style of management. The indication that, on average, more than 40% of CPMs do not apply these human resource management processes is a serious concern.

4.4.7. Respondents' application of project communication management processes

Figure 4.20 presents CPMs' performance in all processes contained in the project communication management knowledge.

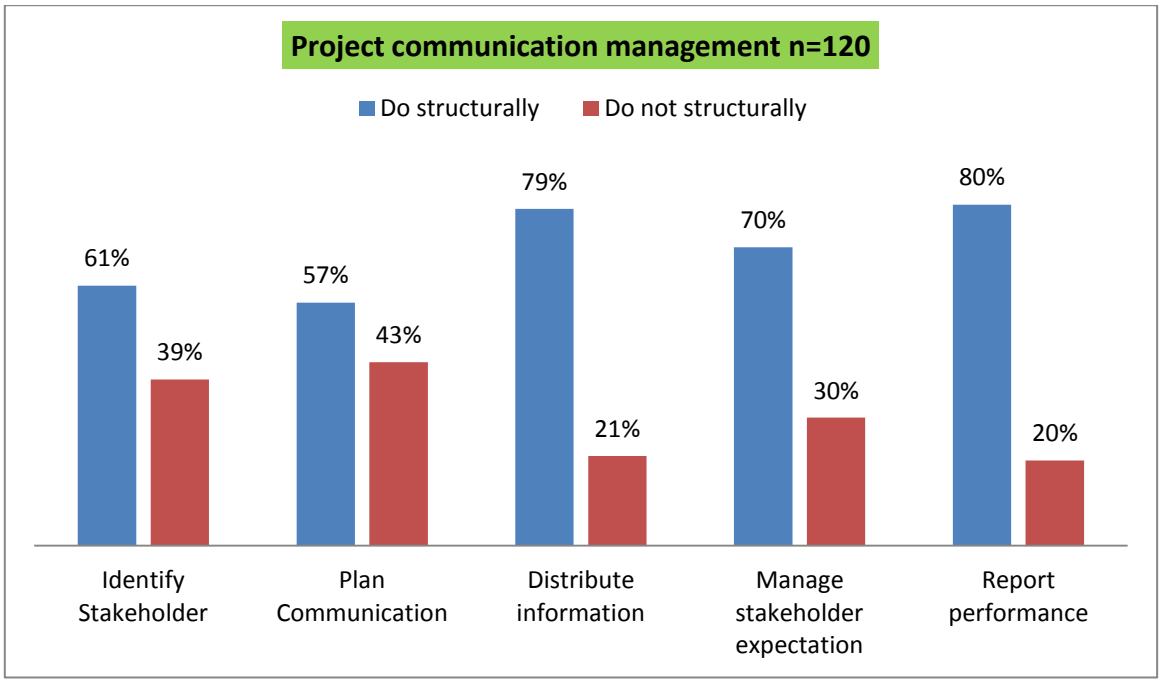


Fig. 4.20 Respondents' application of project communication management processes

The results of the respondents' application of project communication show that a considerable number of CPMs, 39% to be precise, do not structurally identify project stakeholders. Forty-three per cent of CPMs do not structurally plan communication. The findings of these two first processes in project communication knowledge are interesting when considering the next three processes. On the next three processes the results show that a total of 79% do distribute information, 70% do manage stakeholder expectation and 80% do structurally report performance. This result indicates that according to CPMs, there is no relationship whatsoever between these five processes.

It is estimated that communication takes 90% of a project manager's work time (Mulcahy *et al.*, 2013). Considering this estimation, the above result is a serious concern. If communication means distributing and reporting information, then certainly a large majority of CPMs do communicate. However, according to the PMBOK® Guide, before thinking of distributing or reporting information, all stakeholders should first be identified and their needs and communication requirements formally planned for in advance; only then should information be distributed and reported.

What the result is showing here where a considerable number of CPMs do not structurally identify stakeholders or plan their communications, but a large number do structurally distribute and report information, is tantamount to taking chances. These findings support Zwikael (2009) findings that suggest project managers do apply only the processes that are easy and familiar to them or that they feel are important. Analysing these results, although most of the CPMs neither structurally identify their stakeholders nor plan their communication, because they are obliged to report performance almost all of them (80%) do report on performance and almost all of them distribute information (79%).

The findings of this study have shown that a large number of CPMs do not structurally apply the communication processes. The results are also aligned with the global construction survey conducted by KPMG, which suggests that the biggest project failures are caused by poor scope management and inadequate communication (KPMG, 2015).

4.4.8. Respondents' application of project risk management processes

Figure 4.21 presents CPMs' performance in all process contained in the project risk management knowledge area.

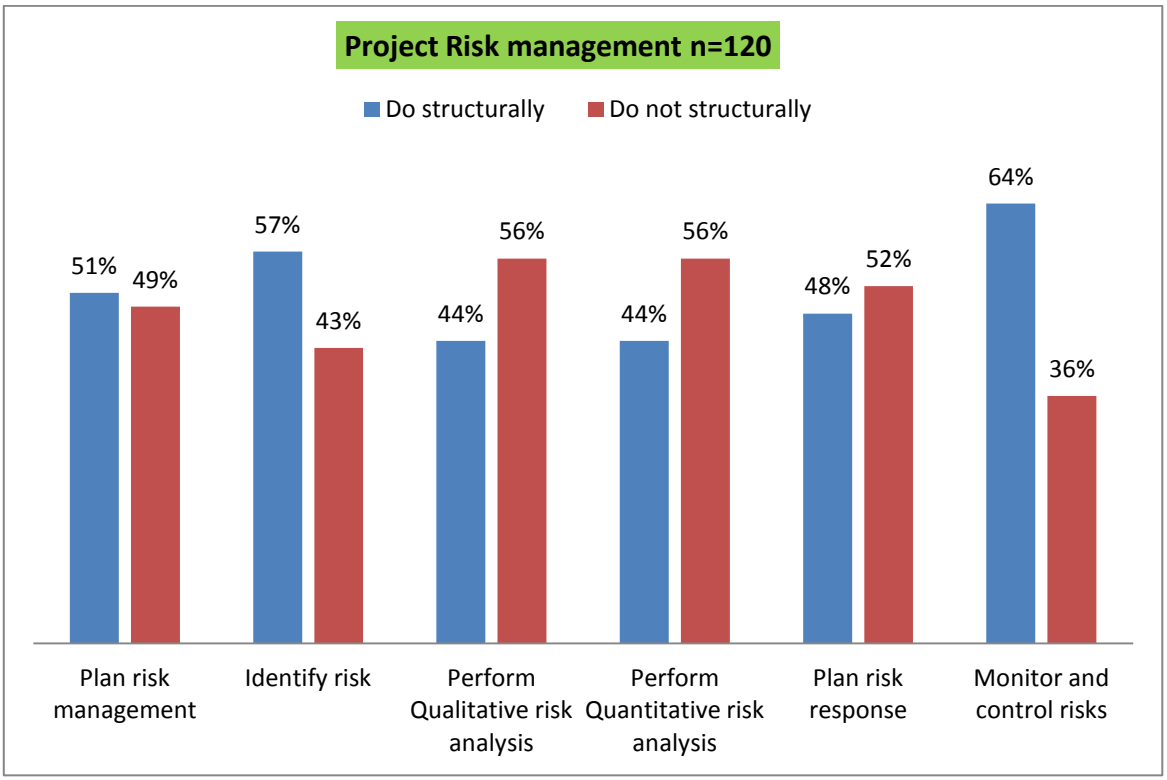


Fig 4.21 CPM's application of project risk management processes

Figure 4.21 indicates that 49% of CPMs do not structurally plan risk management and 43% do not structurally identify risks. The result presents a very worrisome view for the next three processes, including 56% of CPMs who indicate that they do not perform qualitative risk analysis, 56% do not perform quantitative risk analysis and 52% do not plan risk response. Up to 64% believe that they monitor and control risks, which some did not identify, did not analyse and did not have a response plan, but are nonetheless monitoring.

According to the PMBOK® Guide, risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objective. Effective risk management helps to increase the probability and / or impact of positive risks or opportunities while decreasing the probability and impact of threats to the project (Mulcahy et al., 2013). Though there is positive risk, this study looks mostly at the negative risk that could negatively affect the project, particularly in relation to time and cost.

For multiple reasons, most often projects are undertaken within uncertain environments. Uncertain events include changes in leadership in the client's organisation, which can affect the project priority or scope changes; rate exchange and inflation, which can affect the cost of material and / or labour;

unknown stakeholders, which can have an impact on the project; political interference and others (Akinsiku and Akinsulire, 2012). These problems are real and CPMs often have to contend with them. However, when given the project to lead, the project manager's work should not ignore them or focus on dealing with them but on preventing those (Mulcahy *et al.*, 2013).

The PMBOK® Guide has developed processes, tools and techniques to assist project managers to manage risks, particularly negative ones, to reduce the impact of uncertain events that may occur during project implementation. Mulcahy *et al.* (2013) suggest that in well-managed projects where risk management is an integral part of the planning stage, the following occurs:

- There are no longer huge fires to put out every day as they were eliminated with response plans.
- Risks are brought up and addressed before they happen.
- If a risk event does occur, there is a plan in place to deal with it.

Unfortunately, the result presented in Figure 4.21 reveals that, of the six processes within the risk knowledge area, most CPMs do not structurally apply all of them. Even worse, the result suggests that more than half of the CPMs do not structurally apply three of the six risk management processes: perform qualitative risk, which 56% indicated do not structurally apply; perform quantitative risk analysis, which 59% indicated they do not structurally apply; and plan risk response, which 52% indicated they do not structurally apply. This is a concern and questions the basis of the 64% of CPMs claiming to control and monitor risk, if some of them do not perform quantitative risk, let alone plan risk response. Following is an analysis of the implications of not performing each of these three risk processes:

1. Qualitative risk analysis

Just as for all the PMBOK® Guide knowledge areas, risk knowledge areas also start with planning. In the risk management plan, the project manager and the team define how risk management will be structured and performed for the project. Amongst other things, the team members determine the methodology, roles and responsibilities; determine risk categories; define probability and impact; and determine reporting and tracking. Once the plan is completed, the team identifies all possible risks known at that time and, if possible, analyses each one to establish a response plan.

Nonetheless, sometimes it is not possible to do something about all the risks that are identified because it might just be too expensive and / or too time-consuming. Thus, the PMBOK® Guide recommends that by perform qualitative risk analysis, these identified risks are analysed considering their probability and potential impact on the project. Therefore, a short list of risks that could have high impact on the project to warrant future analysis can be determined. The short-listed risks may then be further analysed in performing the quantitative risk analysis process.

In case a CPM decides not to perform the qualitative analysis process, the ideal situation would be that the team members undergo quantitative analysis of each risk and plan responses for each risk.

From Figure 4.21 this eventuality cannot be supported, because the result also indicates that the majority of CPMs (52%) do not plan risk response, though 64% believed they monitor risks that they did not analyse, or plan for, nor did they plan for any form of response.

2. Performing qualitative risk analysis

According to the PMBOK® Guide, quantitative risk analysis is the process of numerically analysing (in terms of time and cost) the effect of these high risks determined in perform qualitative risk analysis on the overall project objectives. Through that analysis and calculation, the project manager can then derive the contingency amount necessary to cover possible identified risks if they happen to occur. It is with that understanding that Mulcahy *et al.* (2013) advocate that performing quantitative risk analysis involves:

- Determine which risks warrant a response.
- Determine the quantified probability of meeting project objectives.
- Determine cost and schedule reserves (i.e., contingencies).
- Identify risks requiring the most attention.
- Create realistic and achievable cost, schedule, or scope targets.

Unfortunately, analysing the study result, not only the 50/50 split of CPMs who structurally plan risk and those who do not is a concern; more than 40% do not structurally identify risks. Furthermore, although 57% do identify risks, 56% do not perform qualitative risk analysis and 55% do not perform quantitative risk analysis. Again, this result supports Zwikael (2009) finding that CPMs still select tasks that they find easy to perform or find important according to their own measurements.

When calculating the project estimate, a contingency reserve is added to each work package to form the project baselines, both for time and for cost (Mulcahy *et al.*, 2013; PMI, 2013). However, such contingency reserves are determined by proper analysis and calculation using tools and techniques such as sensitivity analysis, Monte Carlo analysis and expected monetary value (EMV) analysis, as explained in the PMBOK® Guide. All these analyses are based on the project quantitative risks analysis. In the PM environment, any contingency reserve determined by guessing is called padding and is not advised (Mulcahy *et al.*, 2013). Contingency reserves determined using a padding approach might be unnecessarily high or very low, which might not cover even the uncertainty planned for.

This study's results suggest that up to 56% of CPMs do not structurally perform quantitative risk analysis, which is a concern. Consequently, it can be concluded that the contingency reserve that these CPMs are determining in their cost and schedule estimate are pure padding.

Without structurally performing quantitative risk analysis, there is no way to derive a plausible contingency reserve to cover uncertainty and to form the basis of risk responses in a given project (Mulcahy *et al.*, 2013). Considering this result, the indication of poor project performance as indicated

in previous studies (Apolot *et al.,* 2010; Baloyi and Bekker, 2011; Mokoena, 2012; Olatunji, 2010; Ramabodu and Verster, 2013) and as confirmed in this study in section 4.2 it is not surprise.

3. Perform risk response

Mulcahy *et al.* (2013) explain that the risk responses planning process involves figuring out what to do about each top-ranked risk. In this process, the project manager finds a way to reduce or eliminate threats (negative risks), and to make opportunities (positive risks) more likely to happen or increase their impact when they happen. The PMBOK® Guide provides four strategies that typically can assist to deal with threats or negative impact on project objectives if they occur. These strategies are: avoid, transfer, mitigate and accept. All of them can be used appropriately as and when specific risk occurs. In the same way, the PMBOK® Guide also provides four strategies for positive risks (i.e. opportunities): exploit, enhance, share and accept.

This study has revealed that only 48% of CMPs structurally undertake planned risk response. For the remaining 52%, it appears that project risk management is left to chance. Knowing that there will always be uncertainty or risk in a construction project, it is no surprise that most projects experience delays and cost overruns because there is no response plan to protect the project from any risk in the first instance.

4.4.9. Respondents' application of project procurement management processes

Figure 4.22 presents CPMs' performance in all processes contained in the project procurement management knowledge area.

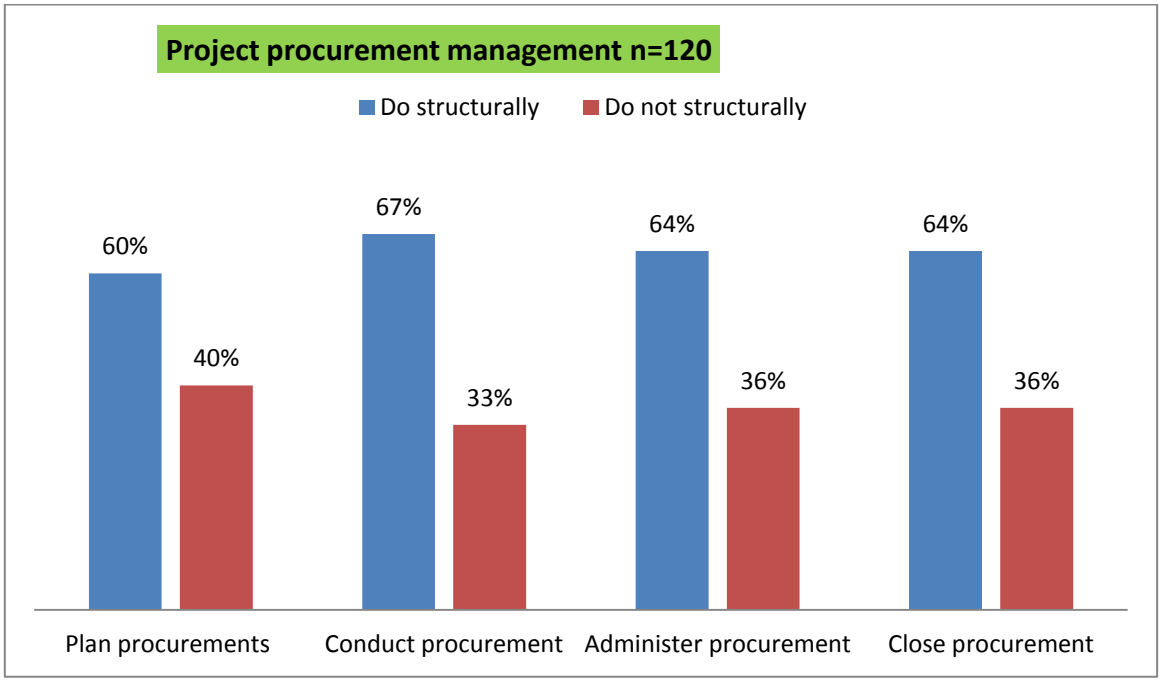


Fig 4.22 Respondents' application of project procurement management processes

Figure 4.22 indicates that on average 30% to 40% of CPMs do not structurally apply one or another procurement process. Of the respondents, 40% do not structurally plan procurement and 33% do not structurally conduct procurement; 36% do not administer procurement and 36% also do not structurally close procurement. The indication that a large number of CPMs do not have full control of project procurement management is a concern.

According to the PMBOK® Guide, procurement management processes involve agreements, including contracts, which are legal documents between a buyer and a seller. Although due to the legal implications, procurement documents may be subject to some form of review and approval, PM teams may seek support in early phases from specialists in the disciplines of contracting, purchasing, law and technical aspects, which might be mandated by an organisation's policies (PMI, 2013). However, throughout all these processes, the CPM must be the central person and should take full responsibility.

CHAPTER 5: CONCLUSION

5.0. Introduction

In recent years, the built environment industry in South Africa has been in the headlines for all the wrong reasons, particularly for project delay and / or cost overruns (SA Construction, 2013; Ramabodu and Verster, 2013). Despite a number of studies to identify the causes and suggest solutions to this acute problem, a definitive solution is not yet forthcoming (Baloyi and Verster, 2011; Ramabodu and Verster, 2013; Olatunji, 2010). The most notable problem still in the mind of the public would be the delay and cost overruns of the Gautrain project and Eskom's power plant projects (Fombad, 2013; Graumann, 2010; Linda, 2014). This continual trend of project delays and cost overruns is cause for concern and has a far-reaching negative implication for the country's affairs (Graumann, 2010; Linda, 2014).

As stated in the first chapter of this research, the aim of this study was to evaluate the extent of application of the PMBOK® Guide by CPMs within the built environment industry in South Africa. In that regard the primary question for this study was formulated as follow: To what extent CPMs performing CPM work structurally apply the PMBOK® Guide's when managing their construction project? To answer to this primary question this study answered nine secondary questions as detailed in chapter 4 and presents here below findings summary.

5.1. Response to the research Primary question

The result of this study confirm conclusions of previous studies which affirmed that the prevalence of construction project delays and cost overrun within South Africa's built environment is still high (Graham and Englund, 2004; Ramabodu and Verster, 2013; Rwelamila and Purushottam, 2011). The results show that some CPMs do apply the PMBOK® Guide partially, but that, in general, CPMs do not apply the PMBOK® Guide structurally. The findings indicate that this limited structural application of the PMBOK® Guide is one of the major reasons for the prevalence of project delays and cost overruns within South Africa's built environment.

5.2. Responses to the research secondary questions

To respond to the research primary question, this study evaluated the extent of application for each process within all nine knowledge areas contained in the PMBOK® Guide by CPMs when managing construction projects. This study reveals that the extent of CPMs' PMBOK® Guide application is not the same for all processes within each of the nine knowledge areas. The findings indicate that there is no one process within all the nine knowledge areas where all CPMs are structurally adhering to as recommended by PMI. In some processes, more than half of CPMs indicated not applying them. The implication and consequence of not structurally applying PMBOK® Guide processes, particularly where more than half of CPMs are not structurally applying were discussed in chapter 4 of this study. The findings of the extent of application of each PMBOK® Guide knowledge areas by CPMs as tabulated in Table 4.2 are as follows:

5.2.1. To what extent do CPMs structurally apply integration management processes?

Within the integration management knowledge area, this study reveals that more than half of CPMs, precisely 59%, do not structurally develop project charter. 42% do not structurally develop PM plan. 22% do not direct and mange project execution. 18% of CPMs do not monitor and control project work. 40% of CPMs do not structurally perform integrated change control. 32% do not structurally close the project.

5.2.2. To what extent do CPMs structurally apply scope management processes?

Within the scope management knowledge area, the result shows that 33% of respondents do not structurally collect requirement. 28% of respondents do not structurally define scope. A large majority 56% of respondents do not create a WBS. 24% of respondents do not structurally verify scope and 20% do not structurally control scope.

5.2.3. To what extent do CPMs structurally apply time management processes?

Within the project time management knowledge, the result shows that 38% of respondents do not structurally define activities of their work. 38% of respondents do not structurally sequence activities of their work. 50% of respondents do not estimate the resource required for each activity. 42% of respondent do not structurally develop activity duration. 37% of respondents do not develop schedule and 21% do not control schedule.

5.2.4. To what extent do CPMs structurally apply cost management processes?

Within project cost management knowledge area, the result indicates that 28% of the respondents do not structurally estimate cost. 27% of the respondents do not determine budget and 17% of the respondents do not control cost.

5.2.5. To what extent do CPMs structurally apply quality management processes?

Within the project quality management knowledge area, the result indicates that 33% of CPMs do not structurally plan quality. 34% do not structurally perform quality assurance and 27% do not structurally perform quality control.

5.2.6. To what extent do CPMs structurally apply human resource management processes?

Within the project human resource management knowledge area, the result indicates that a majority of CPMs 54% in total do not structurally develop human resource plan. 43% of them do not structurally acquire their project team. Almost half, exactly 49%, do not develop their project team and 25% of them do not structurally manage project team.

5.2.7. To what extent do CPMs structurally apply communication management processes?

Within the project communication management area, the results of shows that a considerable number of CPMs, 39% exactly do not structurally identify project stakeholders. 43% of CPMs do not structurally plan communication. 21% do no structurally distribute information, 30% do not manage stakeholder expectation and 20% do not report performance.

5.2.8. To what extent do CPMs structurally apply risks management processes?

Within the project risk management area, the result indicates that 49% of CPMs do not structurally plan risk management. 43% of CPMs do not structurally identify risks. 56% of CPMs do not structurally perform qualitative risk analysis, 56% do not perform quantitative risk analysis and 52% indicate that they do not plan risk response and 36% do not structurally monitor and control risk.

5.2.9. To what extent do CPMs structurally apply procurement management processes?

Within the project requirement management area, the result indicates that 40% of respondents do not structurally plan procurement. 33% do not structurally conduct procurement. 36% do not administer procurement and 36% also do not structurally close procurement.

5.2. Conclusion

The findings of this study show a pattern whereby CPMs often overlook certain processes within the nine knowledge areas indicated in the PMBOK® Guide. There is a similar trend of neglecting certain processes and focusing only on some. This could be due to convenience or even lack of competence in conducting some of the processes (Zwikael, 2009). In some cases, the bottleneck might be the result of the culture of the organisation and a lack of PM maturity or excellence (Bieg, 2014). Irrespective of the reasons why CPMs do not ensure that the standards set by the PMBOK® Guide are adhered to and followed strictly justify amongst others the prevalence of project delays and cost overruns in the built environment and this is detrimental to South Africa's infrastructure development.

The use of standards, knowledge, tools and techniques guarantee the excellence of projects and their success (Grau, 2012), but these standards, knowledge, tools and techniques must be used appropriately (Zwikael, 2012). CPMs cannot be seen to perform only easy and comfortable tasks and task that suit them, as opposed to ensuring that they follow the laid-down standards and processes of the PMBOK® Guide. This study demonstrates that CPMs within the built environment in South Africa do not structurally apply all the processes required of them. As a consequence, the poor performance that the industry is experiencing is not a surprise. Therefore, amongst other things, stakeholders in the built environment in general and the SACPCMP in particular should take measures to overcome this challenge of project delays and cost overruns.

5.3. Implication

Limited application of the PMBOK® Guide by CPMs when managing their construction projects is one of the major reasons why there is a prevalence of project delays and cost overruns within the built environment in South Africa. Therefore, mechanisms must be put in place to force CPMs to abide by the PMBOK® processes, tools and techniques as prescribed by PMI and upheld by the SACPCMP. Without such enforcement, the industry will continue to experience project poor performance.

5.4. Limitations

This study was limited to the PMI's knowledge areas and processes as contained in the PMBOK® Guide fourth edition. However, the PMI published the fifth edition of the PMBOK® Guide in 2013, therefore the result of this study cannot be readily generalised for the fifth edition. And since construction extension has not been considered, neither can the results be generalised as being representative of the application of the full PMI processes, because it is possible that if the PMBOK® Guide is used in conjunction with the construction extension, the results might be different.

5.5. Recommendations

Studies have demonstrated that structural application of PMBOK® Guide's knowledge, processes, tools and techniques increases the chance of project success (Grau, 2012; Zwikael, 2009). However, the prevalence of project delays and cost overruns within the built environment in South Africa is not yet solved (Ramabodu and Verster, 2013). Considering that this study confirms that CPMs do not structurally apply the PMBOK® Guide's knowledge, processes, tools and techniques when managing their construction projects, this study recommends the following:

1. Introduce the PMBOK® Guide as a compulsory component of Construction management courses for all built environment fields of study; degrees in these fields, particularly at the Master's level, should be subject to PMP or CAPM exam certification and therefore automatic registration as Pr. CPM.

2. Following from the first recommendation and considering the SACPCMP's stand to ensure that the PMBOK® is used as basis of Pr. CPM registration, to ensure compliance it is recommended that passing the PMI's PMP exam be a requirement of Pr. CPM registration.

3. To regulate the construction and project management profession in South Africa, it is recommended that the no-prohibition Clause 26(4) be either eliminated or reviewed, and the Act 48 of 2000 establishing the SACPCMP be amended accordingly.

4. As most CPMs and their project teams do not create WBSs, and considering that the structure of the BOQ in the built environment is not tailored to the WBS, this study recommends considering the possibility of reviewing the structure of the built environment tender document and aligning it with the WBS structure.

5.6. Proposed future research

Based to the findings of this research, its limitations and recommendations, the following areas are suggested for future study.

1. The viability of CPM professional registration in the built environment in South Africa: The proposed study will shed light on the position of CPM professional registration to understand whether or not Pr. CPMs are performing better than their counterparts who are not registered with the SACPCMP but only with other built environment councils.

2. The necessity to adjust the structure of the BOQ used within the built environment in South Africa: This will help discover whether or not the actual structure of the BOQ does to a certain extent inhibit the CPMs and their teams from to create a WBS, which is supposed to assist in determining reliable schedule and cost estimate.

3. Assessment of the built environment working setting in relation to introducing best-practice change: The study will aim to determine whether or not CPMs are given a chance to introduce

new knowledge in their workplace. It might be found that as employees, CPMs are not allowed to introduce best-practice changes in their organisations due to the organisations' established culture.

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