Key project role-players' influence on project success or failure- A South African built environment sector project management perspective

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DECLARATION

I declare that this research report is my own unaided work. It is being submitted in partial fulfilment of the requirements for the degree, Master of Science in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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28th day of September, 2021

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ABSTRACT

The concept of project success within the built environment sector has many facets. The study explores the literature on project success and associated factors, and determines the degree of influence that key project role-players have on critical success and failure factors. The Project Management Institute (PMI) Guide to the Project Management Body of Knowledge (PMBOK® Guide) is a benchmark for the research.

A five-round Delphi survey was undertaken to firstly agree on success or failure criteria, critical factors and groups for typical built environment projects. The critical factors were subsequently allocated to typical project life cycle phases and each of the critical factors rated to determine the degree of influence of each key role-player. Consensus was achieved among the 8 expert participants. The 17 critical factors distributed over the project life cycle resulted in 48 critical factors rated. The project manager was ranked as most influential on 29 occasions, contractor on 11 occasions and the client on 10 occasions.

The results of this research provide a better understanding of the key project role-players' degree of influence on project critical success and failure factors. In this way responsibility can be apportioned to the appropriate role-players.

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LIST OF ACRONYMS AND ABBREVIATIONS

APM	Association for Project Management
APMBOK	Association for Project Management Body of Knowledge
CBE	Council for the Built Environment
CIDB	Construction Industry Development Board
Covid-19	COrona VIrus Disease- 2019
C-PMBOK	Chinese Project Management Body of Knowledge
Delphi	A Survey Technique
ECSA	Engineering Council of South Africa
GDP	Gross Domestic Product
IPMA	International Project Management Association
ISO	The International Organisation for Standardisation
KPIs	Key Performance Indicators
KPMG	'Klynveld Peat Marwick Goerdeler' firms providing Audit, Tax and Advisory services.
KZN	KwaZulu-Natal
Logframe	Logical Framework
P2M	Project and Programme Management for Enterprise Innovation
Pareto principle	The 80/20 rule
PMBOK® Guide	Project Management Body of Knowledge
PMI	Project management Institute
PMP	Project Management Professional
Pr.CPM	Professional Construction Project Manager (Designation by SACPCMP)
PRINCE2	PRojects IN Controlled Environments
PROCSA	PROfessional Consultants Services Agreement
RACI	Responsible, Accountable, Consulted, Informed. (A Matrix)
ROI	Return on Investment
S&P	Standard and Poor's
SACAP	South African Council for the Architectural Profession
SACPCMP	South African Council for the Project and Construction Management Professions
SAFCEC	South African Forum of Civil Engineering Contractors
SANRAL	South African National Roads Agency Limited
Viz.	'Videlicet' or 'Namely'

1. INTRODUCTION

Over the past few decades, researchers in many countries have explored project critical success factors and critical failure factors in a range of industries and categorised these factors into groups, as well as generated rankings of the relative importance. Examples of such studies include Shokri-Ghasabeh et al. (2010); Garbharran et al. (2012); Tsiga et al. (2016); Thote et al. (2017); Shahid and Ramakrishnaiah (2019). However limited research into this field has been conducted specifically to the project role-players' influence in the South African built environment sector. These factors may vary in terms of importance per industry and project throughout the world, however the influence of key project parties to these critical success factors and critical failure factors remain imperative. Key role-players have an influence on critical success factors which may determine project success or failure.

The key project role-players considered for the research are: the client; project manager or lead consultant; and contractor. The project manager is often the project personnel's and key stakeholders first point of contact. The client or sponsor looks no further when apportioning accountability considering the nature of professional services contract obligations. However, there is indication that certain criteria are not part of the project manager's responsibility, and can be a reason for project failure or success. This is the case in certain circumstances at project inception which typically include activities such as choosing the correct project manager, securing funding in order to ensure timely payments, upfront community engagement by the client organisation to limit or avoid interruption by the so-called 'construction mafia' (Donnelly, 2019), and later in the project such as poor quality of construction. All of the above, if not addressed diligently, could have disastrous effects on the project resulting in delays, disputes, claims, financial loss, unhappy end user, and so on. Each role-players' degree of influence varies throughout the project life cycle.

1.1. Research aim

The study aims to explore the relevant literature on project success and associated factors, and to determine the degree of influence that key project role-players have on critical success and failure factors within the South African built environment.

1.2. Outline of the study

The current state of the South African built environment sector and the economy as a whole, suggests a need for a successful roll out of infrastructure projects. In order to determine the key project role-players' degree of influence on project critical success factors and critical failure factors, firstly, literature review will be carried out which explores the origin and extent of critical success and failure factors in project management. The broad range of factors and criteria will be assorted in a manageable list of critical success or failure factors and its supporting factors or criteria. These will be classified into the typical project life cycle stages or phases. The research methodology implemented for reaching consensus is the Delphi technique also known as the Delphi method. The participants are regarded as experts in the field as either built environment practitioners or academics. The research is conducted using mixed

methods. The design adopted is exploratory sequential (George, 2021). In an exploratory sequential design, qualitative data collection and analysis occurs first, as carried out during literature review, rounds 1 and 2 of the Delphi survey. This is followed by quantitative data collection and analysis, as carried out during rounds 3, 4 and 5 of the Delphi survey.

The order of the Delphi survey proceedings is intended as follows: During round 1, all participants are required to validate the assorted list from literature review or to add, move, remove critical success or failure factors or criteria which they feel necessary and add comments or suggestions, if any. The selected critical factors are distributed into an initial conceptual framework model of the typical project life cycle as the degree of influence of key role-players may vary for common factors at different stages or phases of the project life cycle. In round 2, all participants will be provided with comments and/or suggested changes (if any) and an updated model based on input received from round 1. The outcome after round 2 is a validation and acceptance of the list and conceptual framework model. In the next phase (round 3), the participants are required to rate each key role-player's degree of influence for every critical success or failure factor listed (as agreed in the previous rounds). Ratings will be from a Likert scale. During round 4, mean scores and standard deviation to mean ratio will be provided for each rating. Each participant will be provided with their previous rating and an opportunity to input a new rating for specific items out of the average tolerance range, with insight on the previous round's average and standard deviation of the survey group. Rounds will continue until there is no significant variation in results based on mean scores. A greater than or equal to 80% agreement in rating, or a deviation of no greater than 1.5 rating (greater or less) from the group average will be considered as essential for consensus. The output of the research will be in the form of a conceptual framework displaying the critical success or failure factors at different project life cycle stages or phases and the consolidated average influential ratings resulting from the Delphi survey. There may be a combination of factors which eventually lead to project success or failure. The research does not attempt to classify critical success factors or critical failure factors in order of importance. It instead categorises a selection of critical factors into groups, and distributes the factors into project life cycle stages or phases in order to determine the key project role-players' degree of influence on project success and failure factors. The research paper will contribute knowledge to this subject in a South African context by exploring success criteria and supporting factors, and the key role-players' degree of influencing the related critical success or failure factors. This influence is pertinent as a means of determining project accountability during the project life cycle phases.

1.3. Background and current state

The South African economy is in need of recovery. The country has consistently high unemployment rates in recent years (StatsSA, 2020a), ailing state owned enterprises in need of repeated financial bailouts (National Treasury, 2020), aging infrastructure partly due to inadequate maintenance (National Treasury, 2020), a national energy crisis culminating in rolling blackouts, and growing urbanisation (StatsSA, 2016) resulting in a burden to existing infrastructure, to name a few challenges.

A prevalent trend is the disruption to the projects by the 'construction mafia'. According to Donnelly (2019), the South African Forum of Civil Engineering Contractors (SAFCEC) reports that approximately 183 infrastructure and construction projects as at April 2019, valued more than R63 billion, have been disrupted or halted by such acts. This includes more than 60 South African National Roads Agency Limited (SANRAL) projects including termination by the Aveng and European-based Strabag International joint venture of the R1.6 billion SANRAL Mtentu Bridge Project in the Eastern Cape due to site disruptions by armed gangs demanding to be part of the project. Private sector projects were also impacted.

A risk to this prolonged situation is that many investors and clients will withdraw from big construction projects or will not be willing to spend in an uncertain environment, and many consultants, contractors and other skilled role-players are considering taking their skills abroad or are forced to leave the industry altogether. The loss of these key skills would create a serious capacity and skills shortage problem for the South African built environment sector. This can drive many construction companies to the brink of bankruptcy, with some already in business rescue and are shedding more jobs, exacerbating the country's economic challenge.

A robust plan is needed for economic recovery by way of enabling employment and rolling out quality and essential infrastructure programmes and projects related to the built environment in order to contribute to a stimulus boost and improvement in the country's gross domestic product (GDP) on a large scale. Such project examples are in the form of creating smart cities, residential and non-residential buildings, water supply, energy networks, transport systems such as roads, streets and bridges, and so on. Capital expenditure by public-sector institutions on new construction work for the financial years ended in 2018 and 2019 is R160,705,000,000 and R157,642,000,000 respectively. Capital expenditure on new construction works consists of expenditure on fees payable to architects, engineers and other professional firms, and expenditure on works under construction but excludes capital expenditure on plant, machinery and equipment (StatsSA, 2020b). The South African government projected budget on all public works and infrastructure programmes for the 2020/21 fiscal year totals R8,070,796,000 (South African National Treasury and Imali Yethu, 2020). It is questionable whether the budget will be spent as two considerable events have transpired in South Africa since the budget publications, viz.: the Covid-19 pandemic; and the downgrading of credit ratings by credit ratings agencies which resulted in the country falling to "non-investment grade speculative". Budget spending is likely to be centred on changing priorities favouring health care of citizens and activities that lessen the debt burden.

1.4. Credit ratings

Credit ratings are a measure of the creditworthiness of a country's government, meaning that they show how likely the government is to pay back borrowed money. These ratings are important because they influence the cost of borrowing. If a country is more likely to default, lenders will charge a higher interest rate to compensate for the greater risk, as they would if the borrower were an individual. The three major

credit rating agencies – Standard and Poor's (S&P), Moody's, and Fitch assess the government's ability to honour debt commitments. These measurements take certain economic indicators into account and viewed as indications of a country's economic prospects (Old Mutual, 2019).

Table 1 shows the recent credit ratings for South Africa. All 3 credit ratings agencies have graded South Africa as "Non-investment grade speculative" which is also referred to as "junk status".

Agency	Rating	Outlook	Date	Description
S&P	BB-	stable	30 Apr 2020	Non-investment grade speculative
Fitch	BB-	negative	20 Nov 2020	Non-investment grade speculative
Moody's	Ba2	negative	20 Nov 2020	Non-investment grade speculative

Table 1: Ratings and outlook status by agencies (Trading Economics, 2020)

"Junk status" rating signals to potential investors that the risk of South Africa's debt has increased because the government might not have enough money to pay back what it borrows. Some investors may be deterred from investing in the country. In general, a credit rating is used by sovereign wealth funds, pension funds and other investors to gauge the credit worthiness of South Africa thus having a big impact on the country's borrowing costs. With the downgrade to "Junk status", the government will need to pay more in debt servicing costs, meaning that it will have less to spend on social initiatives and infrastructure. In order to plug the funding gap, government may have to increase revenue through higher taxes (Old Mutual, 2019). South Africa is many levels below the "high grade" and "prime" ratings achieved by many other countries, however none of which are from the African continent.

1.5. The built environment sector

The term, 'construction', has been used in a number of ways in different definitional studies. de Valence (2018) describes that the construction industry using the standard industrial classification of industries is only one part of the creation and maintenance of the built environment and the range of industries that it encompasses. Construction economics makes an important contribution to researching the macroeconomic role of the built environment sector.

The term that encompasses the extraordinarily large number and range of participants in the creation and maintenance of the built environment, from suppliers to end users, is the built environment sector. As elaborated by de Valence (2018), measuring the built environment sector helps public policy and macroeconomic management for two reasons. Firstly, the macroeconomic contribution of the built environment sector to aggregate demand and employment is large, and possibly the largest component in many countries. It is one of the most volatile components of a country's economy, with annual rates of growth or contraction often greater than changes in GDP, which makes the built environment sector a key driver of the business cycle. Importantly, changes in the composition of output of the built environment sector would be a leading indicator of future demand as current work is completed. Secondly, measuring the built

environment sector provides a way to measure the effectiveness of discretionary fiscal policy, when that involves changes in expenditures on building and construction.

In South Africa, the Council for the Built Environment (CBE) is an overarching body that coordinates six councils for the built environment professions - architecture, landscape architects, engineering, property valuation, project and construction management, and quantity surveying (CBE, 2019). The South African project and construction management professions within the built environment are regulated by the South African Council for the Project and Construction Management Professions (SACPCMP). As defined by SACPCMP (2019a:3), “the built environment includes all structures that are planned and/or erected above or underground, as well as the land utilised for the purpose and supporting infrastructure”. Persons practicing in a professional capacity within the built environment as construction managers, construction project managers, as well as mentors and health and safety specialists are required to register with the SACPCMP. As reported by CBE (2019) in March 2019 there are 533 candidate construction managers and 1812 candidate construction project managers registered with the SACPCMP. As reported by SACPCMP (2019b) in March 2019 there are 894 professional construction managers and 1709 professional construction project managers (Pr.CPM) registered with the SACPCMP. The SACPCMP as well as the other Built Environment Professional Councils named above has noted the need to develop the scope of work, known as the Identity of Work (IDOW). The purpose is to explain the regulation of the built environment professions, with reference to certain regulatory mechanisms and to place the identification of the scope of work for each category of registration in perspective (Deacon and Smallwood, 2016).

1.6. Research problem and question

In an environment with a history of wasteful expenditure, corruption and skills shortages, rolling out much needed built environment sector projects without due diligence and process can result in project failure; a failed project results in many stakeholders left worse off. The identification and understanding of the influence by the project’s key role-players on critical success factors apportions responsibility to that party and can thereby be held accountable for its success or failure.

What is the degree of influence of key project role-players on the success of projects within the South African built environment particularly from a project management perspective?

1.7. Research objectives

Acquire an understanding of project management literature especially the PMBOK® Guide and its knowledge areas. Explore the South African built environment sector. Discuss project role-players and identify the key role-players. Explore the origin and extent of success and failure factors from literature and determine critical factors and supporting criteria impacting the typical South African built environment project life cycle phases. Gauge the degree of influence of key role-players on project success particularly from a project management perspective.

1.8. Relevance and importance

The need for economic recovery in the form of the built environment infrastructure development is crucial in South Africa. The stimulus requires the willingness of public and private funders to make available and release funding at the appropriate stages of the programmes or projects, which enables employment and skills development. In an ideal scenario an essential project is planned well, executed well and the product of the project is used as intended, resulting in a successful project which benefits all stakeholders. This ideal scenario can be achieved by implementing good practices related to project selection and project management, from project initiation through to close-out and thereafter operation and maintenance (outside the scope of project management).

1.9. Overview of the research structure

Chapter one provides a generic overview of the research relative to the background and current state of the South African economy. The chapter presents the research aim, research problem and question, research objectives and the relevance and importance of the research in light of the built environment sector.

An extensive review of the related literature to this study area is presented in chapter two. A gap in the literature review studies is identified. The relevant findings from previous studies that have a bearing on this study area are discussed; the success factors and criteria are presented in the form of a table.

Chapter three discusses the research methodology. The different research approach options are presented and the most suitable approach and methodology is selected and implemented to fulfil the research objectives.

The detail of the Delphi survey is presented. A summary of the findings and analyses as derived from the mixed method approach is revealed in chapter four.

Chapter five presents the conclusion and recommendations for future research. Thereafter, all the references are listed and essential information on Annexures A, B and C are attached.

2. LITERATURE REVIEW

In order to explore the relevant literature on project success and associated factors, and to determine the degree of influence that key project role-players have on critical success and failure factors within the South African built environment, firstly, literature review will be carried out.

The literature review presents an overview of project management in the built environment providing definitions and concepts. The project team and various project stakeholders are summarised which enable the identification of key role-players. The review goes on to explore the origin and extent of success and failure factors and criteria in projects with the intent of identifying the critical success or failure factors during a typical built environment project life cycle. The review further explores the various project factors and criteria from previous studies which have an influence on project success or failure.

As part of the review of literature, various project management frameworks and standards are listed. The PMI PMBOK® Guide is explored further as a widely accepted standard for project management in South Africa. The review of literature gauges how organisations apply project management practices through the various organisational structures.

Project management success is distinguished from project success. Central to project management success is the project manager's competences. Project selection in alignment with investments and the organisation's strategy contributed to organisational success. The literature review is summarised in line with the research objectives.

2.1. Project management frameworks

Bayona et al. (2018) and Sanjuan and Froese (2013) describe various frameworks for project management which exist in countries around the world. Each standard and method contains its own structure, level of granularity and complexity. Among these are PMBOK® Guide, PRINCE 2, P2M, C-PMBOK, APMBOK, IPMA and ISO 21500. Brief descriptions of the acronyms above are as follows:

a) PRINCE2 (PRojects IN Controlled Environments) by the Office of Government Commerce UK is a method that focuses on the business and on an organisational structure aimed at the project management team. In addition, it is oriented towards the final product and emphasises the division of the project into phases (Bayona et al., 2018).
b) P2M (Project and Programme Management for Enterprise Innovation) by the Engineering Advancement Association of Japan (Sanjuan and Froese, 2013).
c) C-PMBOK (Chinese Project Management Body of Knowledge). A guide by the Chinese project management conference (Sanjuan and Froese, 2013).
d) APMBOK (Association for Project Management Body of Knowledge) is United Kingdom based. It covers stakeholder interaction and personal skills. In essence, it is a collection of knowledge related to project management,

programmes and project portfolios, focusing on the core competencies that a project manager must possess (Bayona et al., 2018).

e) IPMA (International Project Management Association) is a federation of about 70 member associations. The Individual Competence Baseline (ICB) version 4 was developed by the IPMA and is based on the professional competences that a project manager must have. It is divided into 46 competencies that are grouped into textual competences related to projects, programmes and portfolios, technical competences and behavioural competences (Bayona et al., 2018).
f) ISO 21500. The International Organisation for Standardisation guidelines for project management and management emerged as a response to market and industry demand to harmonise internationally recognised best practices, rules, models and standards. It establishes common principles, concepts and terms in project management at international level (Bayona et al., 2018).
g) The PMBOK® guide by the Project Management Institute is a set of foundations for project management, recognised as “good practices”, which can be applied to most projects. The knowledge, skills, tools and techniques can be applied according to the type of project and the skills of the project manager (Bayona et al., 2018).

Although various standards and bodies of knowledge exist, the g) PMBOK® Guide is the standard of preference in this research. The SACPCMP requires that certain professional registration reports must be aligned with project management knowledge areas prescribed by the Project Management Body of Knowledge (PMBOK® Guide). Understanding of the PMBOK® Guide is listed as an area that may be covered during the SACPCMP professional construction project manager interview, even though other standards are not omitted as possible areas of competency. The PMBOK® Guide provides and promotes common vocabulary which is used among project professionals in the South African built environment sector and its contents are widely referenced in project management related research papers. The PMBOK® Guide is the standard that is explored further as a benchmark for the research.

2.1.1. PMBOK® Guide

Project management is accepted as a profession in its own right. A new edition of the PMBOK® Guide is issued approximately every four to five years and has increased from the original 176 pages of the (first) edition (PMI, 1996) to 978 pages of the latest (sixth) edition of the PMBOK® Guide (PMI, 2017) inclusive of the Agile Practice Guide. A white paper published in 1987 (PMI, 1987) can be considered the predecessor of the first edition which defines the processes today known as knowledge areas, as necessary to achieve the required [function] output (Muller and Jugdev, 2012).

The PMBOK® Guide (PMI, 2017) consists of ten knowledge areas and five process groups. The ten knowledge areas of projects are: 1) integration management; 2) scope management; 3) schedule management; 4) cost management; 5) quality management; 6) resource management; 7) communications management; 8) risk management; 9) procurement management; and 10) stakeholder management. Of the original set of core management disciplines identified, seven have survived and appear in PMBOK®

Guide (PMI, 2017) with considerably extended content and understanding. As published in 1987, these consisted of scope; quality; time; cost; risk; human resources; contract/procurement. Project stakeholder management is the newest knowledge area. It is still in its infancy according to Wideman (2018) because one cannot really manage (external) stakeholders, but only try to influence stakeholders. Project integration management is a crucial knowledge area as it involves the coordination of all other management activities. Sanjuan and Froese (2013) summarise that project integration management includes the authorisation of the project via the project charter, the project management plan consisting of construction schedule, human resource plan, quality plan, risk plan, communication plan, and procurement plan, as well as the execution, monitoring, controlling, closing of the project, and the change control process.

The construction extension to the PMBOK® Guide was first published in 2003 and has been updated with each subsequent release of the PMBOK® Guide. The construction extension describes supplemental knowledge and practices that are generally accepted as good practices on construction projects. The document includes two knowledge areas specific to the construction industry, which do not appear in the PMBOK® Guide viz.: project health, safety, security, and environmental management; and project financial management (PMI, 2016).

The PMBOK® Guide (PMI, 2017) states that each phase, stage [or other division of time] is characterised by five project management process groups. These as a whole are applicable to each and every phase of a project. The process groups are: 1) initiating; 2) planning; 3) executing; 4) monitoring and controlling; and 5) closing. Each of the process groups consists of sets of specific processes that should be closely examined and adhered to when appropriate. There are 49 such processes. “Monitoring and controlling consists of those processes required to track, review and regulate the progress and performance of the project” (PMI, 2017: 554). As described by Gyadu-Asiedu (2014), the main activities in monitoring and control, according to the guide, include monitoring the ongoing project activities against the project management plan and the project performance baseline and influencing the factors that could circumvent integrated change control so that only approved changes are implemented. The closing process group is performed to conclude all activities across the project management process groups and formally completes a phase, contractual obligations, premature closure of the project, or completion of the project. The titles of the five process groups should not be confused with the steps named in the project life cycle, which can lead to misunderstanding. The PMI (2017) lists the generic project life cycle structure as: 1) starting the project; 2) organising and preparing; 3) carrying out the work; and 4) closing the project. A different and widely accepted four phases of the project life cycle by Burke (2017) are: 1) feasibility; 2) design and development; 3) execution; and 4) commissioning and handover. Each of the 49 processes described in PMI (2017) are defined within the 10 knowledge areas and process groups’ matrix. The 49 processes are described in terms of their inputs, tools and techniques, and outputs.

The PMI (2017) encompasses what constitutes managing a project without encroaching on the territories of general management, established professional

engineering associations, or competing specialists like the American Association of Cost Engineers, which is a major strategic achievement. It stood the PMI in good stead and together with four other institutes provided the foundation for the highly successful Project Management Professional (PMP) certification programme. It put the PMI on the international map with a clear path for its members to a recognised certification and a solid financial foundation (Wideman, 2018).

There is a linkage between the success factors identified by Pinto and Slevin (1988b) and their consideration within the bodies of knowledge of professional organisations like the United States-based PMI or the United Kingdom-based Association for Project Management (APM). The first edition of PMI's PMBOK® Guide was published in 1996, eight years after Pinto and Slevin's seminal work. The first edition referred to project success as: ….meeting or exceeding stakeholder needs and expectation invariably [by] balancing competing demands among: 1) Scope, time, costs, quality, 2) Stakeholders with different needs and expectations, 3) Identified requirements (needs) and unidentified requirements (expectations). No reference is made in the later version of PMBOK® Guide (PMI, 2008) to Pinto and Slevin's success factors. Conversely, the Body of Knowledge of the APM (2000) refers directly to the work of Pinto and Slevin (1988a;b) as critical success factors, which APM defines as "those measurable factors that when present in the project's environment, are most conducive to the achievement of a successful project". Pinto and Slevin seem to have influenced thinking among academics and practitioners, but not penetrated all the profession's bodies of knowledge (Muller and Jugdev, 2012).

2.2. Definition of a project

A pioneering definition of a project by Davis (1951:5) is: "Any undertaking that has definite, final objectives representing specific values to be used in the satisfaction of some need or desire." The definition of a project in the 1985 version by the PMI as described by Wideman (1987) is: "Any undertaking with a defined starting point and defined objectives which, when achieved identifies completion". The definition in a 1991 annual report by the PMI defines a project as: "A temporary process undertaken to create one or a few units of a unique product or service whose attributes are progressively elaborated." This is currently described in the PMBOK® Guide (PMI, 2017:13) as: "A temporary endeavour undertaken to create a unique product, service, or result." Some writers consider the PMI definition to be adequate while some including Wideman (2018), state that it does not speak to the considerable challenge of dealing with limitations of resources such as manpower, materials and money. In practice most projects depend on finite or limited resources with which the objectives are to be accomplished. These inclusions are stated in the (PMI, 2017) but not specifically mentioned as part of the above definition.

Errihani et al. (2015) summarise that projects require a good command of resources and attract great interest by project practitioners and academics, due to the limitations and the scarcity of resources. Berkun (2008) documents that project management history shows that most projects have several items in common. They have requirements, designs and constraints. Their success depends on communication, good decision making and the combination of creative and logical thinking. Projects

usually involve a schedule, a budget and a customer. The main task of the project is to combine the work of different people in a single coherent whole that will be useful to people or customers.

2.3. Definition of project management

Management of projects is typically defined as the process of planning, organising, directing and controlling a company's resources for a relatively short-term target that has been established to meet specific goals and objectives (Kerzner, 1989). Project management is a special management technique designed to manage projects. It is the application of knowledge (ten knowledge areas), skills (talent, ability, aptitude), tools (templates or checklists), and techniques (how to accomplish a specific activity or task) to project activities to meet the project requirements (PMI, 2017; Burke, 2017).

Errihani et al. (2015) explain that project management provides a permanent advantage in the dynamic context of current organisations. It has evolved into a key role for the success of any project and has always been practiced informally, but began to emerge as a distinct profession in the mid-20th century. The PMBOK® Guide is fast becoming an indispensable tool for practitioners in all organisations and sectors. It identifies its recurring elements of the project management five process groups and draws on ten project management knowledge areas. Project management brings a unique focus shaped by the goals, resources and schedule of each project (Burke, 2017).

2.4. Requirements for effective project management

Burke (2017) states that the project manager requires accurate and timely information. One of the ways to supply this information is through a fully integrated project management planning and control system which outlines the work and measures performance against the original plan. Even though this control system will incur additional management costs, it should be appreciated that lack of information could be more expensive if it leads to poor management decisions, costly mistakes, rework and time delays.

Dutta (2017) describes that in the United States of America, the Boston University Corporate Education Centre have an online project management skills evaluation tool that is intended to measure project management technical competencies, personal competencies, and leadership and business competencies. After implementation of the assessment tool, the individual identifies their strengths, weaknesses and training requirements. This skills evaluation tool is oriented toward measuring a person's understanding, knowledge and skills. Alongside the same lines are the project management skills evaluation tools by the Atlantic Management Center Inc. and the Business Improvement Architects. They are intended to identify an individual's existing project management skill profile and areas for enhancement in basic related knowledge. The Business Improvement Architects assessment tool consists of one hundred questions based on the PMBOK® Guide (PMI, 2008). Other forms of assessment are project management maturity evaluation, project management competency and project management skills assessment tool.

Project management tools, techniques, and theories account for the rational components of project management, but these overlook the emotional components. Emotional factors account for a large part of a project's success. Project delivery requires quality control, scheduling, and budgeting. Yet controlling for these factors does not prevent project delays or failure. Hardy-Vallee (2012) further postulates that when projects fail, it usually can be traced to one or more of the following causes: 1) Technical (technology developed, project management techniques); 2) Individual (project leadership, scope management, and communication); 3) Stakeholder (user involvement, executive buy-in, goal specificity). Typical project management techniques such as quality control, budgeting, scheduling, and critical path analysis are good at solving the first type of problem (technical). Their record is less impressive for solving the second (individual) and third (stakeholder) type of problem, primarily because these techniques are less effective at managing the human, emotional, and social factors at play in individual and stakeholder problems.

Project management performance refers to the practices used in managing a project. Since project management serves mainly as an essential task, consequently it is also vital to measure its performance (Qureshi et al., 2009). Many studies have provided different measures to improve project management performance such as key performance indicators (KPIs) and to benchmark assessment models embedding project management practices and project management methodologies (Alkhlaifat et al., 2019). A study by Ehsan et al. (2010) concludes that the project manager's knowledge areas (which excluded stakeholder management at the time) play a vital role in the successes or failure of projects and an experienced project manager will possess particular uniqueness that will enhance the team performance. All these project manager's knowledge areas contribute positively and significantly in project success (Ehsan et al., 2010).

2.5. Project organisation structures

The project organisational structure describes how the performing organisation manages the way projects human resources are staffed, managed and executed. Burke (2017) describes three key types of organisational structures known as: functional organisation structure; matrix organisation structures; and team structures, also called projectised or project-oriented organisation structures (PMI, 2017).

The functional organisation structure is the most commonly used and is based on the subdivision of disciplines such as marketing, accounting or civil engineering into separate departments with a vertical hierarchy reporting to top management. Each department does project work independently from the other departments. The projectised organisation structure is described as the opposite to the functional organisation structure. The project manager has authority over the project resources. Projectised organisations often have organisational departments that report to the project manager or provide project support services to various projects. The matrix organisation structure represents a mathematical matrix which reflects a blend of a functional and projectised structure. The vertical direction represents the functional department's responsibility while the horizontal direction represents the project's responsibility. People to people contact is represented where lines of responsibility

intersect, providing formal lines of communication, however these project to functional department interfaces increase the potential for conflict (Burke, 2017). A strong, a balanced and a weak matrix structure can exist depending on the magnitude of control and authority of the functional and the project manager. In a strong matrix organisational structure, the project manager is usually promoted from within the organisation, whereas in a weak matrix structure the project manager is often appointed from outside the organisation (Kerzner, 2006). The matrix structure is considered by many practitioners as a natural project organisation structure. Many organisations involve the above structures at various levels, often described in PMI (2017) as a composite or hybrid organisation. Project success can be influenced by the implemented project organisational structure.

Burke (2017) documents that up until the 1950's projects were predominantly run by companies using the traditional functional hierarchical organisation structure, where the project work would be passed from one department to another. In the 1950's a project management organisational structure was adopted by the company 'Bechtel', to manage an oil pipeline project in Canada. This was one of the first instances where a project management organisational structure was applied. Responsibility was assigned to an individual operating in a remote location with an autonomous team assembled to perform the project. This is an organisational structure with the project manager as a single point of responsibility with autonomous authority over a pool of resources. The project management approach is to assign responsibility to one person who works on a project full time through the entire project life cycle. This person came to be known as the project manager.

2.6. Role-players

Projects within the built environment are impacted by many role-players. The section identifies and summarises a few of these roles with the intent of selecting the key role-players.

2.6.1. Role of the project manager

The SACPCMP (2019a) defines construction project management as the management of projects within the built environment from conception to completion which includes the management of related professional services. As stated in the PMBOK® Guide (PMI, 2017), it is presumed that the project manager is the person assigned by the performing organisation. The project manager leads the team that is responsible for achieving the project objectives. The project manager can be an external project management consultant to the client, or from within the client organisation when in-house capacity exists in the form of a directive type project management office (PMI, 2017). The role of a construction project manager is different to the role of a construction manager which represents the contractor tasked with the physical construction process mainly active in the execution phase of the project. The contractor role is discussed in section 2.6.6.

Burke (2017) emphasises that the selection of the project manager is a key appointment which can influence the success or failure of the project. As a single point

of responsibility, it is the project manager who integrates and coordinates all the contributions from the stakeholders, and guides them to successfully complete the project. In addition, project sponsors, when selecting project managers to manage their projects, want assurance that the manager will focus on the relevant success criteria of the project, and will be skilled in implementing the appropriate success factors (Muller and Turner, 2007).

The role of a project manager is different to the role of functional manager or operations manager. Typically the functional manager is focused on providing management oversight for a functional or a business unit. An operations manager is responsible for ensuring that business operations are efficient. Depending on the organisational structure, a project manager may report to a functional manager. In some cases, a project manager may be one of many who report to a programme or portfolio manager who is ultimately responsible for enterprise-wide projects. In this type of structure, the project manager works closely with the programme or portfolio manager to achieve the project objectives and to ensure the project management plan aligns with the overarching programme plan. The project manager also works closely and in collaboration with other role-players such as a business analyst, quality assurance manager, and subject matter experts. The project manager is the owner of the project management plan and responsible for delivering the project on time, within budget and agreed quality. The role of the project manager should be outlined in the project charter which includes details of how the project should be managed (Burke, 2017).

According to research by Jha et al. (2013), activities performed by a project manager have been examined based on their importance and the time consumed in performing them. On average, a project manager spends working approximately 10 hours per day (approximately 60 hours per week consisting of six work days). This quantity had increased in the last five years leading up to the publication of their research. A quarter of time is spent supervising, planning and in review meetings which are considered to be the most important activities perceived by project managers. The time consumption for different activities is different for the two groups of project managers (i.e. the owner's 'project manager' and 'contractor's project manager') with the contractor organisation in majority of approximately 68% of the activities. This may be the reason behind the notion that a working pattern of one construction project manager is expected to differ from another which might be the reason for non-standardisation of a working pattern of a project manager.

2.6.2. Project team

Teamwork effectiveness is considered as a component of project success in many studies (Bryde, 2007; Lim and Mohamed, 1999; Muller and Jugdev, 2012; Müller and Turner, 2007; Westerveld, 2003; Mir and Pinnington, 2014). The PMI (2017) differentiates between the project team, which is a set of individuals who support the project manager in performing the project work to achieve its objectives, and the project management team, consisting of members of the project team who are directly involved in project management activities.

The PMBOK® Guide chapter on project human resources management shows how to develop an organisation chart and responsibility assignment matrix to define team members' roles and an illustrative resource histogram to manage time. It indicates the importance of recognition and performance evaluations and puts forward the use of interpersonal skills to resolve conflicts in the form of diagrams. As highlighted by Hardy-Vallee (2012), these techniques primarily address rational factors such as planning and controlling which is not adequately emotionally engaging for the project team members or project managers. “The problem with a single-minded focus on processes and methodologies is that once people are given procedures to follow, compliance replaces results. People become concerned about how to do the job, not about the outcome if the job is done well” (Hardy-Vallee, 2012:1). When reliance on only managing the rational factors is at the forefront, organisations fail to encompass the power of human nature by engaging employees' emotions.

Project managers with greater experience emphasise the importance of one of the most influential success criteria, recognised as team satisfaction. This criterion according to Muller and Turner (2007) should be taken into account by the responsible party when allocating project managers to critical projects. In allocating resources the parent organisation will have an interest in the efficient use of the resources during planning and execution phases. The project team will be responsible for the effective use of these resources, and the parent organisation will be interested in the success of the project management process. The team will be accountable for their use of these provided resources, and failure to meet objectives should result in the team and leader accounting for their actions. Another concern by the parent organisation is whether it will receive a return on their allocation of resources to the project i.e. there will be an interest in the success of the project as a whole, along with the project management aspects (Munns and Bjeirmi, 1996).

Kerzner (1989) and Munns and Bjeirmi (1996) share the view that it may be inappropriate to place all the responsibility for integration on the project team because the involvement of the project team is concerned with only a small subset of the total project. It would seem more appropriate to make an individual who has a wider orientation the responsible person for the project. The client fulfils these requirements hence there is a logical argument for making the client responsible for the end project.

2.6.3. Client

The completion of a project requires input from a variety of groups including the client, parent organisation, project team, producer [manufacturer] and end user. Each party has a role in defining and determining success. They all have specific tasks and responsibilities that must be respectively fulfilled in order to achieve success (Kumar 1989; Munns and Bjeirmi, 1996).

The parent organisation will be involved in the project by providing resources. They may also exercise a controlling influence over the project in determining factors such as profitability, market share, quality and scope of service. The responsibility, commitment and support of a parent organisation are vital requirements to project success. The parent organisation must be willing to commit company resources and

provide necessary administrative support, in order to aid project management. The client is expected to be the main role-player concerned with the success of the project in the long term. Munns and Bjeirmi, (1996) elucidates that in most cases, the project will be instigated at the discretion of the client, and the financial and other rewards for the client hinge on its successful implementation. The client should not relinquish responsibility by passing all duties to the project team. Facilitating the team is important for the client, but not the purpose of the project, as the project originates from a requirement to meet a need that exists for the client and that initial need must be kept in focus by all those involved on the project.

2.6.4. Project sponsor

It is imperative that the roles and responsibilities of project sponsor and project manager are clearly delineated. The project sponsor can be described as an individual, person, body or a group. The Association for Project Management (APM, 2000) define a project sponsor as the individual or body, who is the primary risk taker, on whose behalf the project is undertaken. The Project Management Institute (PMI, 2017) describe the sponsor as the person or group that provides the resources (in cash or in kind) for the project, programme or portfolio and is accountable for enabling success. The trend in the literature is to conceptualise a project sponsor from the perspective of an individual. As described in research by Bryde (2007), this individual represents the client body and acts in the interests of the commissioning (client) organisation in the day-to-day management of the project. Typically the sponsor is a senior management representative, either from within the client organisation or, if the project is being undertaken by another organisation on behalf of the client, from within the project organisation.

This person is responsible for activities that span across the whole of the project life cycle, including activities such as: 1) defining the business benefits or requirements; 2) establishing a project strategy with priorities; 3) agreeing the project definition including objectives; 4) importantly, defining the project success criteria; 5) ongoing monitoring of the project's business environment and of benefit realisation; 6) taking delivery of a project at completion; and 7) taking the decision to cancel a project (if required). An effective relationship must be developed between project sponsor and project manager in order to successfully undertake these life cycle activities. The project sponsor is the interface between project ownership (client) and project delivery organisation, acting as the point of contact with the project manager for the day-to-day management of the client's interests (Office of Government Commerce UK, 2007).

The project manager is responsible for meeting the success criteria that are defined by the project sponsor (Field and Keller, 1998) and the project sponsor may cancel the project on the recommendation of the project manager (Morris, 1994). One cause of ineffective sponsorship is situations in which these lines of responsibility are not clear, with the project sponsor carrying out project manager roles, and vice versa. This relationship is so important that Tighe (1998) emphasises that project managers must ensure that they have mobilised the support from the most appropriate person to act as sponsor for the project. Bryde (2007) further articulates that being the focal point between the client and the project manager, the role of the sponsor can be viewed

from two broad perspectives. The first is an external focus, concentrating on the project from the viewpoint of the client. Examples of responsibilities for a sponsor role from this external perspective include defining the business benefits, monitoring the business environment and benefit realisation. A second is more inward-looking ‘‘internal sponsor” role focused on giving the project manager and the project team the necessary support they need to fulfil their role. Examples include ensuring that adequate resources, in the form of staff, are made available to the project manager, ensuring the staff is provided with necessary training to enable the project objectives to be achieved, which contributes to an enabling environment in which projects can succeed. This notion of general support and commitment to project management is the foundation of the concept of project championing.

2.6.5. Project champion

A project champion is an individual who identifies with the project and will use all the weapons at their disposal to break down any existing resistance and do all in their power to see the project succeed. Common types of project champions include an engineer or scientist, an entrepreneur, or sponsor (Pinto and Slevin, 1989a). According to research by Bryde (2007), the project sponsor role is generally accepted as being a senior management role, however the project champion role does not necessarily require any level of seniority and is not usually a well-defined position in an organisational hierarchy. The exception is Six Sigma (a widely known set of techniques and tools for process improvement) projects, where the project champion role is clearly defined and specific training is provided for carrying out the role. One of the key functions of a project champion is to ensure appropriate and ongoing commitment of resource.

2.6.6. Contractor

“Contractor” is defined in the SACPCMP (2019a) as any person or legal entity entering into contract with the client for the execution of the works or part thereof. It is usually at the execution phase of the project that most of the project budget is spent and the product is realised, except in certain scenarios where expensive equipment is purchased by the client prior to the execution phase and is a ‘free issue’ to the contractor. Subcontractors fall under the main or principal contractor and are represented in many types viz.: nominated; selected; domestic; and direct, depending on the condition of contract used. The different subcontractor types have its own set of conditions with varying risk to the employer, contractor and subcontractor themselves. “Construction Management” is the management of the physical construction process within the built environment and includes the co-ordination, administration, and management of resources.

No contractor is capable of managing all the possible major risks on a project. The employer will be required to accept the risks that the contractor does not have control over, such as changing corporate policies in the employer organisation, changing regulatory requirements, and other risks from outside the project (PMI, 2017).

2.6.7. User

As per Munns and Bjeirmi (1996), the user is the group or individual who makes use of the completed project or product. In some circumstances this might be the client, but for goods sold on the open market the end user and client can be two distinct groups. Project success will be considered by the users as the ability to satisfy their needs, as defined by Oakland (1989). Satisfying end users' needs is one facet of quality assurance. Success for the user will be concerned with long-term utilisation of the project outcome rather than project management techniques. Hence the project team concerned with the development, may have little or no direct contact with the user, and in many cases the user remains unaware of the management processes and whether these were successful or not (Munns and Bjeirmi, 1996).

2.7. Critical success or failure factors

This section explores the origin and extent of critical success factors. Some researchers identify failure factors which can be just as important. The intent is to identify critical success or failure factors applicable to a typical built environment project's life cycle.

Success of a project means different things for different people (Kothandath, 2018). Over the past several decades, numerous research studies have been performed in the area of project management to identify critical success. Although numerous authors, as listed in (Alkhlaifat et al., 2019), have conducted research on project success, the concept still remains ambiguously defined (Gomes and Romão, 2015; Muller and Jugdev, 2012). Over the last few decades academics and practitioners in the discipline of project management have sought to answer the question: "What are the influences on project success?" Seeking the answer resulted in research into project critical success factors. The concept of ''success factors" was introduced by Daniel (1961) as the usual factors that determine success. The concept of critical success factors was then further expanded on and popularised a decade later by John F. Rockart, an organisational theorist and senior lecturer at Massachusetts Institute of Technology's Sloan School of Management (Thote et al., 2017; Cooke-Davies, 2002). Although the concept has been applied to project environments, Bryde (2007) points out that reviews of 13 prior studies of project critical success factors found that most had focused on deriving factors that are applicable to a particular industry, such as construction or information technology.

2.7.1. Why are critical success factors important?

As conveyed by Gyadu-Asiedu (2014), research conducted identified progressive emphasis on issues such as: top management support, organisational, stakeholder management, coordination and human relations. It established from a case study, evidence that there is a relationship between critical success factors and potential pitfalls in the projects; that lack of critical success factors are considered potential drawbacks and vice versa. The above is in line with de Wit (1988) who states that the presence of critical success factors do not guarantee success but an absence of such factors is likely to lead to failure.

Academics and practitioners now have a more thorough insight into the most appropriate success criteria for approving and evaluating projects, thereby managing the expectations of all stakeholders in a more realistic manner (Gomes and Romão, 2015). As explained by Chipulu et al. (2012), project environments are characterised by levels of complexity and uncertainty that create difficulties in identifying project success or failure factors. Ideally, project success or failure could be measured by assessing how closely the project achieved intended outcomes once it had been decommissioned. The responsible role-players must define these factors early on to evaluate projects for selection and thereafter to monitor progress and evaluate performance. The selection of factors and the evaluation thereof are crucial.

2.7.2. Project failures and critical failure factors

Pinto and Mantel (1990) state that it is difficult to define why projects fail and that the concept of project failure is nebulous. There are many factors outside the control of management which could determine the success or failure of a project. Most of the early studies focused on the reasons for project failure rather than project success. In these studies summarised by Belassi and Tukel (1996), it was assumed that if a project's completion time exceeded its due date, or expenses overran the budget, or outcomes did not satisfy a company's predetermined performance criteria, the project was assumed to be a failure.

Several studies were found, which identify the factors responsible for infrastructure project failures. One such study by Maity (2017) shows that the causes for project failure in an Indian city are shortage of skilled people and professionals at all the management levels and field operations amongst contractors, clients and consultants. Similar shortages have been reported by Belassi and Tukel (1996) in the supply of surveyors, engineers, equipment operators and the skilled workers which hinder the stakeholders' ability to handle the higher volumes of work with expected quality workmanship which can contribute to project failure. Further, the success of a project can be defined as the extent to which the objectives and the goals of a project are satisfied. Whenever the objectives and goals of a project have not been met, then it is considered as project failure. According to the PMBOK® Guide (PMI, 2017), a project's success or failure is measured at the end of the project using the content of the business case including project objectives. This can be done by comparing the difference in the expectation on a project before and after its completion and also based on the actual performance observed when the project is put into place. The project is considered as a failure when the client and other stakeholders' expectation in terms of schedule, cost and quality is not met by the actual schedule, cost and quality of construction by the contractors and other project teams. Subsequent studies have identified other reasons such as stakeholder management, risk management and communication (Maity, 2017).

According to Avots (1969) as listed by Maity (2017) and Belassi and Tukel (1996), the major causes for project failure are wrong selection of project manager, unsupportive top management and unplanned termination of projects. Other causes include: inadequate basis for project; inadequately defined tasks; lack of project management techniques; management techniques misused; project closedown not planned; and

lack of commitment to project. However, the researchers have recognised project failures in construction at the project level, rather than at the level of company. Oyedele (2016) lists examples of critical failure factors of public private partnership projects in Nigeria, which include lack of sound legal framework, policy instability, individual approach of stakeholders to development, poor institutional framework to manage public private partnership contracts and deficiency in project costing leading to high cost projects. Some projects require a huge amount of money which only banks' syndication can provide. Other factors which have made specifically public private partnership practices difficult in Nigeria are systemic corruption, uncooperative attitude of members of the public to government projects and paucity of funds. A common dilemma management faces in managing projects, programmes and portfolios are the continued rates of project and programme failures within those portfolios (Stratton, 2011).

2.7.3. Project success criteria, success factors and groups

As documented by Dutta (2017); Ika (2009), research in the area of critical success factors and success criteria has demonstrated that it is simply impossible to develop an exhaustive list that will meet the needs of all projects. Research on project success generally falls into one of the following categories, depending on the subject of study: either they deal with project success criteria (or dimensions); or they examine critical success factors.

Project success criteria may refer to a group of principles or standards used to determine or judge project success, and critical success factors refer more specifically to conditions, events, and circumstances that contribute to project results (Ika, 2009). It is more productive to take into account both project success factors and success criteria. On occasion, there exists a hybrid or fusion category that acts as a bridge between critical success factors and success criteria. It is important to clarify these two concepts, because it is not unusual to come across a dialogue that blurs the distinction between them or regards them as synonymous (Lim and Mohamed, 1999). Conversely Dutta (2017) states that articles should not be categorised as either work on project success criteria or work on success factors exclusively, as there is a common idea that features in the articles connecting success factors with success criteria. If project achievement criteria are known, there are a certain number of conditions that must be met in order for a project to be successful (Ika, 2009). Belassi and Tukel (1996) comment that success or failure factors vary in various studies in the literature. Although several lists of factors are generated, they seem to tabulate individual factors rather than grouping them according to some criteria, to help analyse the interaction between them and the possible consequences. Belassi and Tukel (1996) state that sound research on critical success factors has to distinguish between success factors and success criteria; and distinguish success factors within the control of the project manager and factors outside the control of the project manager. They construct a framework for critical success factors for projects. The framework does not provide a single list of success factors but defines groups of success factors (Westerveld, 2003).

Wateridge (1995) suggests that in choosing a project management methodology, the project sponsor or project manager should identify the success criteria, from which to determine appropriate success factors to increase the chance of achieving those success criteria and then select a project management methodology that delivers those success factors. Bryde (2007) highlights the suggestions of Iyer and Jha (2005) which identify two groupings of criteria. The first group can be measured objectively, such as meeting budget, schedule and specification targets. The second group are measured subjectively, such as the overall satisfaction of the customer and other key stakeholders.

Kothandath (2018) considers the following success criteria in his research: a) completion on-time or ahead of time (time); b) completion within budget (cost); c) execution as originally planned (scope); d) customer satisfaction; e) meeting the expected benefit; f) profitability; g) innovation; h) environmental and social safeguards; i) uniqueness; j) use of new or improved technology; k) minimal variations; and l) stakeholder integration. The result of 84 usable responses to the survey from cities in India and the Middle East conclude that there is preference to the time and budget criteria with completion on time chosen as the most important criteria. Pinto and Mantel (1990) identify three distinct aspects of project performance, also listed by Gomes and Romão (2015), as benchmarks against which the success or failure of a project can be assessed viz.: 1) the implementation process itself; 2) the perceived value of the project; and 3) client satisfaction with the delivered project output.

As listed by Dutta (2017) and Ika (2009), Slevin and Pinto (1986) propose a scientific basis for success that consists of ten key success factors: 1) project mission; 2) top management support; 3) client consultation; 4) personnel; 5) technical tasks; 6) project schedules/plan; 7) client acceptance; 8) monitoring and feedback; 9) troubleshooting; and 10) communication. These ten factors are more or less “manageable” by the project team. Pinto and Slevin (1988b;1989b) further extended this list with four additional factors which were considered outside the project implementation process, hence outside the project team’s control. Also related to research and development projects, these factors are: 11) characteristics of the project manager/head/team leader; 12) power and politics; 13) environmental events; and 14) urgency. The achievement of the project success criteria might be impacted throughout the life cycle of the project by success factors (Muller and Turner, 2007).

Some researchers including Belassi and Tukel (1996); Cooke-Davies (2002); Pinto and Slevin (1987) among others, have focused on identifying critical success factors that positively influence project success. Thote et al. (2017) tabulates research by Pakseresht and Asgari (2012), and Abdelnaser Omran and Gebril (2012). The latter evaluate critical success factors pertaining to the construction industry in Libya. The critical success factors were divided into ten groups as follows: 1) project management related factors; 2) procurement related factors; 3) client related factors; 4) contractor related factors; 5) design team related factors; 6) project manager; 7) work Environment; 8) material; 9) labour and productivity; 10) external factor. Pakseresht and Asgari (2012) attempted to identify and rank critical success factors of an Iranian company’s construction projects as well as assign different priorities and weights to

the critical success factors. Of the twenty six factors provided for survey, the highest weighted critical factor is technical and economic assessment of the project required resources. This is followed by experience and executive records of the project manager; project strategic planning; and executive experience of the contractor team about the project subject. The top four factors accounted for 40% of the total weighting. They conclude that by concentration on the factors, its effectiveness can be maximised.

Viewpoints about performance vary across industries (Chan and Chan, 2004). Owners make several important project delivery decisions in the early phases of a project that impact project performance. Ideally, these decisions should be based on objective consideration and empirical evidence, but are frequently based on the owner's level of comfort or prior experience. Due to the importance of making informed decisions, researchers including Muller and Turner (2007) and Muller and Jugdev (2012) have investigated the relationship between project performance and potential predictive variables including delivery method, contract type and procurement. As acknowledged by Esmaeili et al. (2013), this need led researchers to construct empirical databases of construction projects to find meaningful relationships between these project variables and project outcomes. However, many studies have lost or are losing their relevancy due to the introduction of new concepts such as integrated project delivery, the importance of knowledge transfer, and adopting new processes and technologies such as building information modelling.

2.7.4. Interpersonal skills of a project manager

Interpersonal skills are an important tool for managing project teams. In construction projects, the project team may be diverse in terms of culture, education, knowledge, and other aspects, which make interpersonal skills important for the project manager and the entire team (PMI, 2016). The interpersonal skills as described in the PMBOK® Guide (PMI, 2017) include communicating, which falls under project communications management as a knowledge area, and various other skills which include leadership (Crosby, 2012; Hardy-Vallee, 2012; Thote et al., 2017; Gewanlal and Bekker, 2015; Chipulu et al., 2012), team building (Maity, 2017; Belassi and Tukel, 1996), motivation, influencing, decision making, political and cultural awareness (Maity, 2017; Chipulu et al., 2012; Muller and Turner, 2007; Pinto and Slevin, 1989b; Belassi and Tukel, 1996), negotiation, trust building, conflict management and coaching.

These project manager skills as well as attributes and competencies may not carry the same degree of importance from one project to another due to the unique nature of projects, but are necessary for a refined project manager to possess. According to a research paper Gewanlal and Bekker (2015), even though the "perfect" project manager remains an elusive goal, guidance on selecting the best candidate should help improve the likelihood of project success. The top ranked attributes across the categories by Gewanlal and Bekker (2015) are communication skills; leadership style; and planning (integrative).

Belassi and Tukel (1996) created a group which includes factors related to the project manager. Pinto and Slevin (1988b) explored the factor "characteristics of the project

team leader" summarised as the administrative, interpersonal and technical competence of the project leader as well as the amount of authority available to perform the required duties. Shokri-Ghasabeh (2010) tabulates the "project manager" as one of the success criteria/ factors.

2.7.5. Communication

Studies have been done on the specific relationship between a particular critical success factor and project success. An example of such a study is the association between the project manager's competency in communication and project success by Henderson (2004) as cited by (Dutta, 2017; Ika, 2009). Data was collected using the core communication processes of encoding and decoding. Results of the research show a significant communication–performance relationship where project managers' competency in decoding and encoding are significantly associated with team member satisfaction, while project managers' encoding is significantly associated with project team productivity (Henderson, 2004).

2.7.6. Leadership

Clear leadership and careful planning and implementation by the client are referred to as a factor in success of a project (Deacon and Smallwood, 2016). Novo et al. (2017) describes leadership as a factor of project success. Research by Geoghegan and Dulewicz (2008) and Jiang (2014) indicate a primary focus on behavioural, emotional, and managerial competencies (as factors of leadership). In this collection of work, evidence shows that not only are leadership traits correlated with successful project managers but leadership traits are a contributing factor towards success in projects. Managerial and emotional competencies have important contributing effects in determining the success of a project. However, this success can be impeded if the wrong leadership style is chosen and/or if the project manager is inexperienced with the project type.

In a comparable study by Gewanlal and Bekker (2015), factors ranking highly are associated with the project manager's managerial and personal behaviour which include leadership; strategic direction; communication; problem-solving; and supervision.

2.7.7. Contracts

In terms of managing the importance of project success factors, under-utilising the capabilities of project managers may lead to negative project results. According to Muller and Turner (2007), higher complexity in projects and fixed price contracts increase awareness and importance of success factors. Project managers should not be assigned to projects that are below their management capabilities which appear to be a major factor for regulating importance of success criteria and associated results. Muller and Turner (2007) state that fixed price projects, even though possessing inherent risks, are managed more successfully than remeasurement types and advise that sponsors should be conscious of the pricing strategy when deciding on the contracting strategy.

In a South African context according to Garbharran et al. (2012), the simplification of contracts should be one of the key priorities of the Construction Industry Development Board (CIDB), as this issue results in the increase of lawsuits. The lawsuits have created an atmosphere of mistrust, mainly between project managers and contractors, as in many contract frameworks, contractors do not deal directly with the client. The importance assigned to stakeholder and supplier satisfaction differ by nationality and project complexity; end-user satisfaction differs by nationality; and recurring business and customer satisfaction differ by contract type (Muller and Jugdev, 2012).

2.7.8. Culture

The importance assigned to the team impact on project success should not be under-estimated in the South African context, where various cultures exist. This is also relevant in other parts of the world due to globalisation. In keeping with Chipulu et al. (2012), understanding the impact of cultural influences is critical in projects involving diverse organisations and locations around the world. Organisations may choose to recruit from a wider talent pool resulting in multi-cultural project teams. The participants in multicultural projects should understand cultural differences and what the differences imply in order to improve project success. Chipulu et al. (2012) identify significant culture-dependent causes of project failure, such as use of inappropriate team structures, volatility in project team dynamics, poor team integration, cultural readiness and ineffective communication.

Muller and Jugdev (2012) concur and summarise the importance of previous research assigned to related success criteria: team satisfaction differed by nationality, project importance and age of project manager. Differences were noted by Muller and Turner (2007) in both the rating of success criteria and performance against them by nationality. These differences in rating of criteria seemed to be cultural in origin. In terms of equal opportunities and diversity, male and female project managers are found to be equally proficient. They recommend that, if faced with a choice between two equally qualified project managers, the project sponsor may prefer the local person rather than a person from a foreign country as project managers working in their own culture are likely to be more successful than their expatriate counterparts. Soft criteria do make a difference. Project managers must understand the various organisational styles and cultures that may affect a project. The project manager needs to know who are the decision makers or influencers in the organisation and collaborate with them to increase the probability of project success.

Culture is a critical factor in defining project success. Multicultural competence becomes crucial for the project manager (PMI, 2013). Chipulu et al. (2012) and Muller and Turner, (2007) advise that to mitigate the above and to maintain equal opportunities and diversity, there should be a requirement by industry for project manager training and competence in multicultural interactions.

2.7.9. Risk

Dutta (2017) agrees that project management is an important and integral part of the organisation to govern the project. As well as understanding the life cycle of the

project, the team leader should also understand the risks and risk management in order to create the strategies for successful project performance. The particular objective of a paper by Alkhlaifat et al. (2019) was to examine the moderating impact of organisational culture and mediating impact of project risk management on the relationship between project management performance and project success. The integration of health and safety in all aspects of the project is cited as a success factor in projects by Deacon and Smallwood (2016).

It can be argued that a risk category grouping can account for most or all success and failure factors as these factors could be identified by exemplary risk management methods and techniques. Identify goals which may fail due to uncertain risk or any other factors, and work accordingly to mitigate before these cause project failure. Failure factors can be lessened to a certain extent by the appropriate party at the appropriate stage of the project via prudent quality assurance and risk management processes.

2.7.10. The problems with the success or failure definition

Ambiguity exists in determining whether a project is a success or a failure. Various authors have expressed concern about the definition of success and failure of projects. Gyadu-Asiedu (2014) states that limiting the final report of a project only on the basis of whether or not it was a success or failure poses great challenges to uncovering the true state of affairs. A major difficulty with this idea is the lack of consensus on what constitutes success or failure of the project in the first place. Pinto and Slevin (1989b) state that it is not clear how to measure project success because the stakeholders involved in projects perceive project success or failure differently. Lim and Mohamed (1999) agree that stakeholders often interpret project success and failure in different ways. A project which is considered to be a success by the client might be considered a failure by top management, if the project outcome does not meet top management specifications, although it might satisfy the client. In this case, both of these parties are evaluating project success differently and consequently value the result differently (Belassi and Tukel, 1996).

One of the results of this discrepancy is the inherent assumption that the two are dichotomous; a project either ends up successfully or it failed. Klakegg et al. (2005) agree with the lack of consensus on what success is and how to measure successful projects as a fundamental and unresolved issue in investment projects. They discuss that “success is to apply the right amount of resources to do the right things at the right time”. The responsible role-players should agree on these “right things”, and must reflect relevant needs in society. Success for the investor (the Government in the case of their research) is to make the right decision, which can be difficult. Implementation of an analysis technique such as Logframe to achieve goals and objectives can prove beneficial, as its primary objective is to reach stakeholder consensus before the project begins.

As opined by Dutta (2017), there are two major issues associated with success of projects, viz.: the criteria used to define and measure project success and factors; and criteria influencing the critical success factor of a project. Usually a combination of

many factors at different stages of the project life cycle results in project success or failure (Belassi and Tukel, 1996). Projects differ in uniqueness, size and complexity, therefore the criteria for measuring success varies from one project to another (Müller and Turner, 2007; Wateridge, 1998) making it unlikely that a universal set of project success criteria will be agreed upon (Westerveld, 2003). Most of the factors in any list might not be applicable for a particular project, or a factor which is the main determinant of success for a project might not be listed. Muller and Jugdev (2012) conclude that project success continues to be “in the eyes of the beholder”.

Murray et al. (2002) indicate from research that the definition of success or failure of a project is not always an easy one. Project management research and concepts have not always agreed on a universal definition of the success of a project meaning (Pinto and Slevin, 1988a; Shenhar et al., 2002). Belassi and Tukel (1996) write that determining whether a project is a success or a failure is complex, and multifaceted. Delays in project completion dates are common. Because of the delays, project managers occasionally pay penalties which results in an increase to the project costs. Yet these projects can still be considered successful. Conversely, a project that is perceived as a success by a project manager and team members might be perceived as a failure by the client.

Project critical success factors and criteria should be created per project due to every project’s unique nature and at an early stage. Modern project management concept and project specific conditions must be considered when reviewing success criteria and creating the project specific factors. Although factors and criteria are sometimes used interchangeably, it is important for the interpreter to understand what the related success parameters are so that the project is given its best chance of achieving success. Certain factors are regarded as more important than others as identified in the review of literature, however this can be subjective and dependant on the impacted party’s own interests. For certain factors, success is dependent on subjective opinions as the success criteria are not easily quantifiable. In order to create a better understanding of the factors and its supporting criteria, there can be grouping introduced which help categorise the factors into common themes. Further to common themes, factors and its supporting criteria are impacted at various phases of the project life cycle.

2.8. Triangle

Many authors including (Westerveld, 2003; Chipulu et al., 2012; Howsawi et al., 2014; Dutta, 2017) have written about the work of (Rubin and Seeling, 1967; de Wit, 1988) listing the triple constraints of time, cost and quality which have been regarded as the most important link to project success. This is commonly termed the “iron triangle”, “triangle of virtue” (Ika, 2009) “Holy Trinity” (Alkhlaifat et al., 2019) or “golden triangle” (Westerveld, 2003). The project management iron triangle is used to measure success of the project but has been singled out for criticism due to the limited scope of the trilogy (Dutta, 2017).

The triangle refers to “hard factors” [criteria] which are easy to measure (Kothandath, 2018) however quality can be an ambiguous, multidimensional, and subjective conception that lends itself to different interpretations by various project stakeholders. The quality criterion involves gathering functional and technical specifications (Ika, 2009). Sanjuan and Froese, (2013) generalise that project success criteria are subjective, and most of the time are determined by the stakeholders. Studies on perceived success are subjective, which frequently consists of practitioners’ experience and understanding (Hazebroucq, 1993). “Soft factors” such as happiness, job satisfaction, and enhanced reputation are subtle and difficult to measure (Kothandath, 2018; Baccarini, 1999). The triangle is very operational and cannot assess the strategic dimensions of projects. It lacks the ability to assess the soft dimensions of projects such as customer communication (Howsawi et al., 2014).

Ika (2009) further makes mention of the “virtuous square of criteria” which includes client satisfaction. Project success becomes a hexagon, when in addition to the dimensions of time, cost, and quality, included is the realisation of the strategic objectives of the client organisation that initiated the project, the satisfaction of end users, and the satisfaction of other stakeholders. Factors extend to include risk and sustainability factors.

Sanjuan and Froese, (2013) state that projects are considered successful when they meet stakeholders’ needs and expectations. Most of the time, the stakeholder’s needs and expectations are met when the project is on time, on budget and within the scope and quality planned. Chipulu et al. (2012) point out that time, cost and quality are found to be combined into one project success or failure indicator.

2.9. Importance of the project life cycle

Knowing the individuality of projects and their temporary nature, studies on critical success factors should also take the project life cycle into account (Dutta, 2017). Chipulu et al. (2012) concur with the view that project success could previously be measured using easily quantifiable metrics based on cost, time and quality yet is now generally accepted that measures of success or failure should go beyond this triangle and additionally, vary over the life-cycle of the project. Pinto and Prescott (1988) claimed that not only does the relative importance of success dimensions vary with the project’s progress, but the critical success factors are different for each phase of the project, which was reiterated in a subsequent paper by Pinto and Covin (1989). This knowledge is supported by Belassi and Tukel (1996). When external success measures are employed, planning factors dominate tactical factors throughout the project life cycle. Muller and Jugdev (2012) expand on the above and note that critical success factors can vary by project types, life cycle phases, industries, nationalities, individuals, and organisations.

Pinto and Slevin (1988a;b) identify the factors which support success, followed by an assessment of the different weights of these factors over the project life cycle or in different industries. They developed a tool enabling project managers to assess the status of their projects and compare them with a database of over 400 projects (Pinto

and Slevin, 1988a). The combination of these studies and the associated publications provide for a solid basis and toolset to manage projects towards success (Muller and Jugdev, 2012).

Table 2 displays key factors at the four project life cycle phases according to researchers Pinto and Slevin (1988a;b), noted by Dutta, (2017); Belassi and Tukel (1996) and Ika (2009). In the project conceptual phase the following appear to be the most important and significant factors: project mission [goal]; and client consultation. In the project planning phase, the critical success factors are: project mission; support from top management; acceptance from client; and urgency. Throughout project execution, the key factors are: project mission; characteristics of the project leader; troubleshooting; project schedules/ plans; technical tasks; and consultation with client. Finally, at project closing phase, the key success factors are: technical tasks; project mission; and client consultation.

1. Conceptualisation	2. Planning	3. Execution	4. Close out
• project mission, • client consultation.	• project mission, • support from top management, • acceptance from client, • urgency.	• project mission, • characteristics of the project leader, • troubleshooting, • project schedules/plans, • technical tasks, • consultation with client.	• technical tasks, • project mission, • client consultation.

Table 2: Critical success factors at project management phases in order of importance (Pinto and Slevin, 1988b)

Project managers responsible for the wider project life cycle, not only planning, execution and close-out, tend to be more successful. Project managers should therefore be assigned at the earliest stages and lead their project up to the commissioning stage. Project success was only a subject of the implementation phase in the 1980s. Thereafter, literature on project success gradually extended into the concept phase and close-out phase. Currently, the success literature spans the entire product life cycle and extends from product success to business success (Muller and Jugdev, 2012).

Bonnal et al. (2002) state that the skills sets required to manage the pre-project phase and project phase are quite different. The pre-project phase requires creativity, while a project phase needs to be managed with rigor. They derive that the two phases should be carried out by different people with complementary skills. The pre-project phase requires design input, and creativity is an attribute of the designer or architect whereas rigor and order are synonymous attributes of a project manager suited for the project phase. No consideration by management for the respective skills requirement leads to incorrect personnel selection for the pre-project and project phases, which can result in project failure.

The following are the project work stages set out in the IDOW (SACPCMP, 2006) for construction project managers: Stage 1) Project Initiation and Briefing; Stage 2) Concept and Feasibility; Stage 3) Design Development; Stage 4) Tender Documentation and Procurement; Stage 5) Construction Documentation and Management; and Stage 6) Project Close-out. The amended guideline scope of services and recommended guideline tariff of fees (SACPCMP, 2019a) name the project stages slightly differently as 1) Inception; 2) Concept and Viability; 3) Design and Development; 4) Documentation and Procurement; 5) Construction; and 6) Close-out. The project stage naming varies slightly among the Built Environment Professional Councils.

2.10. Project success and project management success

Many authors including Sanjuan and Froese (2013), Cooke-Davies (2002) and Gyadu-Asiedu (2014) support the work of de Wit (1988) and other writers; there is a clear difference between project (meaning the product) success and project management (meaning the managerial processes) success. Pinto and Slevin (1988a) suggest concepts in project management and that project success is ambiguous and an illusory construct. It is a multidimensional concept whose definition is bound to a specific context (Ika, 2009). Despite the fact that project success is recognised by practitioners including project managers as being connected to the fulfilment of the traditional “iron triangle” criteria (Bryde, 2007; Müller and Turner, 2007; Wateridge, 1995), it is more a multidimensional variable. The project management success would be neither a necessary nor a satisfactory condition for project success (Gomes and Romão, 2015).

Gomes and Romão (2015); de Wit (1988); Munns and Bjeirmi (1996) and Cooke-Davies (2002) clarify that project success is measured against the overall objectives of the project while project management success is measured mostly against completion to budget, satisfying the project schedule and to adequate quality standards. Project success has long been considered the ability to fall within time, cost, and quality constraints, however, the idea of considering a successful or a failed project when it meets or fails the time, cost and quality criteria, is outdated. Many projects have been delivered within time, cost, and quality parameters, only to be considered failures and other projects that have exceeded time or cost constraints are generally considered successful (Shenhar et al., 2001) as discussed below. This idea is supported by Kothandath (2018) and Alkhlaifat et al. (2019). Murray et al. (2002) record from their study that projects can be termed a technical success despite being behind schedule and over budget. Conversely, projects may be ahead of schedule and within budget but termed as a technical failure. Gyadu-Asiedu (2014) referred in his research to construction as a business issue and not an engineering technical issue stating that a layman can identify whether the contractor finished on time, on-budget, and whether the owner’s expectations were met and suggested that solving a business issue with technical specification will not lead to performance. Performance specification should include the owner’s requirement, and the method of identifying what would be the best performance. Kerzner (2006) defines project management success as the achievement of the following project objectives: within time and cost; at the desired

performance or technology level; while utilising the assigned resources effectively and efficiently; when accepted by the customer.

Gyadu-Asiedu (2014) tabulates work by Willard (2005) showing different ways of declaring success and failure. The Sydney Opera House project, also mentioned in (Ika 2009), has a project management evaluation to be approximately 10 year time overrun (opened in 1973). It also has $93 million cost overrun resulting in a project management failure assessment, but a success according to the use assessment due to its iconic position. It also describes the 2002 Olympic winter games project, in which a $100 million deficit was turned into a $400 million surplus by securing additional funds. This project is regarded as a project management success, and a success according to the use assessment due to the profitability. The Thames Barrier, the Fulmar North Sea Oil project and the Concorde are examples of projects which turned out to be relative successes, even though the project control aspect of them failed (Morris and Hough, 1987; Munns and Bjeirmi, 1996). The percussion effect, described by Hazebroucq (1993), is when projects that were perceived as failures at their launch (after project execution and handover phases) would later become models of success, while others considered successes at their launch turned into catastrophes. Which implores the question, how long must one wait to determine success? Various timeframes are suggested to review project success. A yardstick of project success as described by Abdullah et al. (2010) shows that project success can be viewed and classified from different perspectives in terms of its measurement or dimension, citing Shenhar et al. (1997). Works can describe measurement of project success through four dimensions: 1) the period of execution; 2) upon completion of project; 3) after project is delivered to the client; and 4) assessment 1-5 years after the completion of the project. Although, extensive research has been developed to examine the relationship of project management with project success, there is a lack of appropriate studies on project management performance impact on project success (Alkhlaifat et al., 2019). A project may be successful despite the failings of project management because it meets the higher and long-term objectives. When the project management is completed, the short-term positioning could be one of failure but the long-term result could be one of success (Munns and Bjeirmi, 1996).

Despite several measures tested to improve project management performance towards enhancing the success of projects, the number of successful projects is relatively small. According to a paper by Alkhlaifat et al. (2019), many projects fail to achieve their objectives as projects outcomes are below stakeholders' expectations (Cooke-Davies, 2000, 2002; KPMG, 2013; Standish Group, 2012). The Standish Group (2012) report states that 18% of projects failed, while 43% face challenges. KPMG (2013) states in a survey that project activity is on the increase, and so are failure rates.

Many authors discuss project success with the conviction that they are talking about project management success. Cooke-Davies (2002) clarifies the necessary distinction between project success and project management success. Firstly, one needs to distinguish between project success (measured against the overall objectives of the project) and project management success (measured against the widespread and

traditional measures of performance against cost, time and quality). The second distinction is the difference between success criteria (the measures by which success or failure of a project or business will be judged) and success factors (those inputs to the management system that lead directly or indirectly to the success of the project or business).

There is an overlap between project management and projects. Project management is purely a subset of the project as a whole yet confusion exists between the two in practice. According to Munns and Bjeirmi (1996), this confusion could have arisen because of three factors:

1. Time frame. Project success is often commented on at the end of the project management phase. At this stage the project management success can be known primarily because the budget, schedule and quality criteria can be measured. The long-term indicators will not have been realised yet and consequently those cannot be measured. Project management success therefore becomes synonymous with project success.
2. Confusion of objective. Lack of distinction between the two sets of objectives is seen to be linked. The suggested example is 'completion to budget' may be alongside 'profitability' as objectives. Budget is predominantly a project management issue, but profitability is a project objective. To suggest that a client instigates a project so that it can be completed to budget diminishes the importance of the project objectives.
3. Ease of measurement. Compliance with budget and schedule are objectives within project management that are common across projects and are easy to measure quantitatively. Many of the project objectives will tend to be either qualitative and difficult to measure in any objective manner, or longer-term in the form of benefit tracking and periodic review hence not measurable immediately. Therefore it becomes convenient to use measures of project management success as a means of determining overall project success.

Figure 1 adapted from Munns and Bjeirmi (1996) describe a six stage model of the life of a project as follows:

1. Conception phase. The idea for the project by the client organisation and its feasibility determined.
2. Planning phase. The method to achieve the idea is planned and designed.
3. Production. The plans are converted into physical reality. This includes construction works by the contractor.
4. Handover. The finished project is handed over to the client for use.
5. Utilisation. The client makes use of the finished project.
6. Closedown. The project is disposed of at the end of its useful life.

The role of project management is to use the resources available effectively to accomplish a set goal within certain criteria. This role of project management needs to be placed within the context of a wider project.

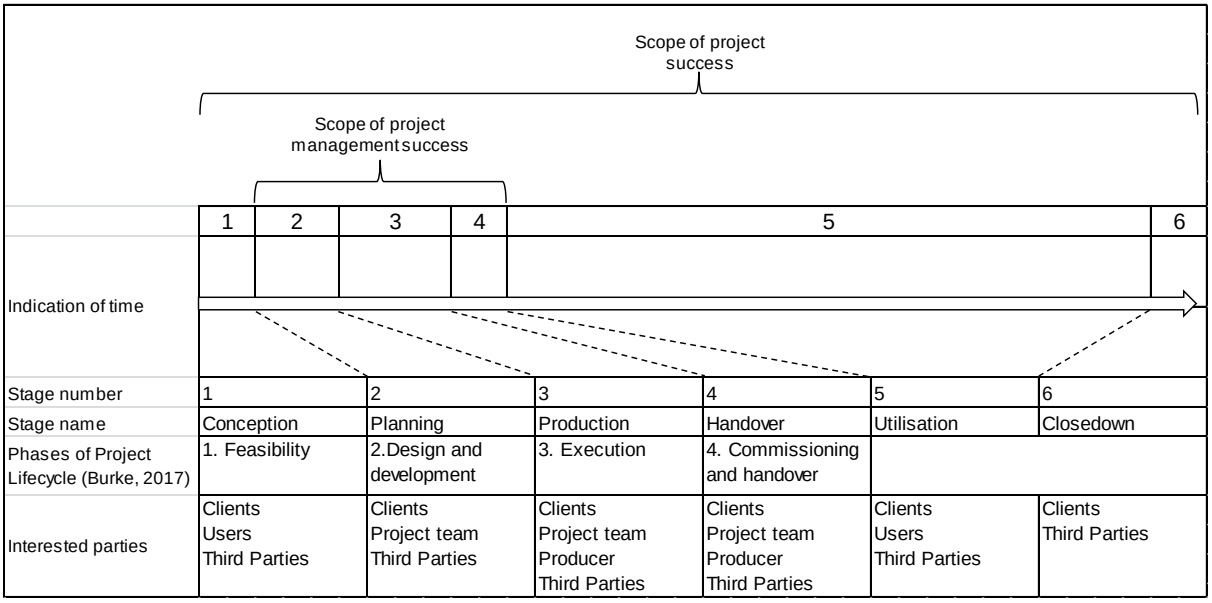

Figure 1: Adapted from Munns and Bjeirmi (1996). The stages in a project life cycle, the parties interested in each stage and the scope of success within the project life cycle

The interested parties interact with the project during its life cycle. The third parties could influence the development and use of a project. These include statutory authorities, both local and national, the media, environmental groups and the general public. According to Munns and Bjeirmi (1996), the project team will be involved with stages 2 to 4, whereas the client is involved in stages 1 to 6. The team will end their involvement after successfully reaching the end of stage 4, and progress to another project. The client must effectively utilise the product of the project until it reaches stage 6. Throughout this process the project performance can be assessed in one of three ways. Firstly is the implementation which is completed in planning, production, handover (stages 2-4) and is concerned with project management techniques and their implementation. Secondly are perceived values, which speak of the view of users who will interact with the project during the utilisation phase (stage 5). Third and finally is client satisfaction, in which the client can examine all influences on the project at project closedown (stage 6) and assess to the fulfilment of the original goals. The variance with the above is that various sources name the phases or stages differently including the SACPCMP (2006 and 2019a) with the construction project manager and consultants being involved from the “inception” stage named as stage 1 (SACPCMP, 2019a). It must be noted that the number of stages/phases or need for stages/phases depend on size, complexity and potential impact of the project (PMI, 2013). Stage or phase activities may also overlap.

The above demonstrates the view that project management techniques are not solely important for project success. The project management team will concentrate on completing stage 4 within the set criteria. There is less significance placed on satisfying stage 5 and 6 targets because the team will probably have little or no direct involvement with the project at this time. Therefore parameters of return on investment, profitability, competition and marketability are likely to become secondary to the project management team (Munns and Bjeirmi, 1996).

A set of metrics was developed to determine the link between project management practices and project success (Papke-Shields et al., 2010). The outcome of a study discussed by Sanjuan and Froese (2013) was that the better the project management practices, the better the project results. The results of the study suggest that the project management practices that make a difference may not necessarily be the most frequently used. The following list derives variables and factors which affect the ability to achieve goals: objectives (Burke, 2017; Maity, 2017; Morris and Hough, 1987; Garbharran et al., 2012); third parties which comprise of statutory authorities, the media, environmental groups and the public (Crosby, 2012; Doloi et al., 2012); relations with client (Chan et al., 2004); contracting and legal agreements (Morris and Hough, 1987; Azeez ahamed and Asadi, 2017; Doloi et al., 2012; Garbharran et al., 2012; Shokri-Ghasabeh et al., 2010); politics (Nallathiga et al., 2017; Morris and Hough, 1987; Pinto and Slevin, 1988b); efficiency and effectiveness of a project management process (Meenakshi, 2015); conflicts (Nallathiga et al., 2017); and profit and tangible benefits (Munns and Bjeirmi, 1996; Howsawi et al., 2014; Bryde, 2007). Further research by Munns and Bjeirmi (1996) implies that the success of a project is dependent on having: a realistic goal; competition; client satisfaction; a definite goal; profitability; third parties; market availability; the implementation process; and the perceived value of the project. Only two of the items above viz.: “a definite goal” and “the implementation process”, lie directly within the scope of project management.

In summary, project success should not be confused with project management success. Although the two terms are found to be interchangeable, these represent success at different points of a project undertaking. Project management success can be determined after the project is commissioned and handed over to the client for its purpose and function. At this point the operational management activities commence and the benefit of the product begins to bear reward for the client and/ or end user. The contractor and project manager have no interest in operational activities unless the contract specifically states so such as in the case of build and operate contracts. However the contractor must ensure that the defects identified are rectified after handover of the product to the client. Depending on the conditions of contract, the latent defects period does not completely absolve the contractor from the operational phase. It is only after the project management phases are complete and the product is in use can the project success be determined by the client and/ or end user. Project success is usually reviewed periodically as agreed in the approved project or programme business case or cost benefit analysis completed during the first stage of a project when project viability is determined. The client remains interested in all phases of the project management phases as well as the operational phase until the product is sold or disposed of.

2.11. Project selection

The roots of many project success criteria and factors are very similar to project selection criteria. In a study by Shokri-Ghasabeh et al. (2009), a direct relationship is described between all of the project selection criteria and one or more project success criteria and factors. Fourteen common categories are listed and incorporated into the critical success factor list for the purpose of their research.

2.11.1. Alignment of investments with the organisation's strategy

The need to align investments in projects with the organisation's strategy and combining practices that are commonly used separately was emphasised by Gomes and Romão (2015). They recognise the need to look for the satisfaction of the parties associated with, and affected by the project. This is in line with a seminal study of over 400 project managers where Pinto and Slevin (1988b) conclude that successful project implementation is very complex. It is the satisfaction of different stakeholders with the project deliverable that has a great deal to do with the perceived success or failure of projects. It is crucial to consider the downstream effect of the end project product or service, evaluating other dimensions of success such as the stakeholder's satisfaction and the project impact on the organisation and business objectives.

Cooke-Davies (2002) indicates that large organisations show three areas of practice in which it is difficult to make significant progress, and which appear to be critical to consistent organisation success. Firstly, portfolio and programme management practices that allow the enterprise to fully resource a suite of projects should be matched to the corporate strategy and business objectives. Secondly, a suite of project, programme and portfolio metrics should provide direct ''line of sight'' feedback on current project performance, and anticipated future success. This will assist in project, portfolio and organisation decisions being aligned. For the project management community, it is important to make the distinction between project success (which cannot be measured until after the project is completed) and project performance (which can be measured during the life of the project). No system of project metrics is complete without both sets of measures (performance and success) and a means of linking them so as to assess the accuracy with which performance predicts success. Lastly, there needs to be an effective means of learning from experience on projects, which combines explicit with tacit knowledge in a way that encourages people to learn and to entrench that learning into continuous improvement of project management processes and practices. Continuous improvement represents the fifth and highest stage of project management maturity in an organisation according to Kerzner (2001). The first four stages being common language; common processes; singular methodology; and benchmarking. As well as distinguishing between the relationship between project management success and project success to organisation's success, a set of processes and practices are presented by Cooke-Davies (2002) as being determinate of consistently successful projects.

Cooke-Davies (2004) suggests three levels of success relating to projects, which reflect upon the organisation's success. Stratton (2011) expands upon these three levels from a project or programme management perspective. Firstly "project management success" i.e. was the project done right? Is reliant on the project or programme manager and their use of project or programme management processes. Secondly "project success" i.e. was the right project done? Is categorised in a field of study that has risen out of the project management discipline viz. portfolio management. Third and finally is "consistent project success" i.e. were the right projects done right, time and time again? Is as with project management success, reliant on the project or programme manager and their use of project or programme

management processes. The project or programme manager plays a key role in each of the three disciplines (project management, programme management, portfolio management) and in many cases, contributes in the development and maintenance of the key tools used by the three disciplines.

2.12. Frameworks and models

Frameworks and models may be necessary to display findings of research in a coherent manner. Numerous critical success factor lists and frameworks have been proposed in various academic studies. Project success and deliverable acceptance criteria are an example of one of the many elements of a project governance framework. Project governance is a critical element of any project and provides the project manager and team with structure, processes, decision-making models and tools for managing the project (PMI, 2017).

In a paper by Crosby (2012), Shenhar and Wideman (1996) are shown to have listed 13 success dimensions including several client/user aspects such as: the extent of customer use; customer satisfaction; market share creation; and new technologies/product lines. Shenhar et al. (1997) introduces business as a distinct dimension of project success in addition to the previous work of de Wit (1988). Four success dimensions were listed, viz.: project efficiency (equivalent to PM activities); impact on the customer (equivalent to the product); business and direct success; and preparing for the future (Shenhar et al., 1997) which is similar to Baccarini (1999) as pointed out by Howsawi et al., (2014). Even though they consider these as four distinct dimensions, “direct success” and “preparing for the future” are business dimensions with short term and long term implications, respectively. In 2001, these four dimensions, containing 13 measures, formed a project success multidimensional strategic framework (Shenhar et al., 2001). For example, assessing an aircraft project according to the framework shows that the project failed at the business dimension when it could not attract sales (Mir and Pinnington, 2014; Howsawi et al., 2014).

Baccarini (1999) presented the logical framework method to define project success. He argues that four levels of project objectives should be used to define success. These levels are: goals; purpose; output; and input. These four levels are known as objectively verifiable indicators when analysed as part of the Logical Framework (Logframe) matrix. Logframe is a planning and monitoring technique used predominantly on development projects and endorsed by the World Bank. Logframe analysis creates clear objectives and builds commitment and ownership among stakeholders. It has evolved as a core technique for managing the complete project cycle from design, to implementation, monitoring, and evaluation. The technique takes into account assumptions which may impact the objectively verifiable indicators and success criteria are established upfront for effective monitoring and evaluation of the project (World Bank, 2020).

Three common ways of measuring the value of project management as listed by Dutta (2017) and Sanjuan and Froese (2013) are: 1) Maturity-based Return on Investment (ROI) metric; 2) A balance scorecard ROI and 3) A resource-based view. An assessment tool can be used to diagnose the strengths and weaknesses, training

needs as well as the value of project management implementation in organisations. Companies with mature project management practice have better project performance resulting in low direct costs. A balanced scorecard establishes goals and measures in the form of financial, internal business, innovation and learning and customer perspectives. The resource based view is based on subjective opinions. Even though no currency value or cost saving percentage is calculated as a consequence of implementing project management knowledge and practices, project management implementation brings value to the organisation. Competencies are tacit, knowledge-related and difficult to trade and the idea of measuring the value of project management implementation is yet to be explored in quantitative depth.

Mir and Pinnington (2014) state that many of the critical success factors which are identified in studies are actually the project management practices applied during project execution. However, the limitations of using critical success factors for modelling hinder the applications of these models. Mir and Pinnington (2014) concisely summarise Muller and Jugdev's (2012) research that focused on the evolution of various project success works in the literature and determine it as a multi-dimensional and networked construct.

Some research studies have focused on project management maturity models based on the Organizational Project Management Maturity Model (PMI, 2013a). The PMI has developed industry specific versions to its PMBOK® Guide and industry specific versions of its project management maturity assessment tool since 2003. These models were criticised for being limited to short-run gains and excluded intangible benefits (Mir and Pinnington, 2014). The Project Management Institute's Standard for Program Management (PMI, 2013b) offers clear definitions of success measurement in projects, as well as mentioning the benefits of lessons learned. PMBOK® Guide (PMI, 2017) mentions the use of 'lessons learned knowledge repositories' for collecting historical information.

Based on the findings by Gomes and Romão (2015) and on the importance of the balanced scorecard as a classical instrument for monitoring organisational performance, they have explained and characterised how to integrate and combine project management and benefits management approaches with the balanced scorecard strategic map perspectives. Furthermore, in this developed version of the strategic map, they represented the less traditional project success factors, framing their use in a more clear alignment with the organisation's strategy, however this integration is difficult to achieve and practice.

Given the difficulty in defining project success, the four COMs model has been advocated as being a useful tool in assessing project success, especially in developing countries such as those on the African continent. The four COMs model consists of success factors that are grouped into four categories beginning with "com" viz.: comfort; competence; commitment; and communication. The comfort component includes the involvement of both primary and secondary stakeholders. Competence relate to utilisation of up-to-date technology; past experience; comprehensive skills; and the awarding of bids. Commitment relates to support of top management;

commitment to the project; clear objectives and scope; and political support. Finally, communication plays a role in leading; integrating people; and taking decisions. The article by Garbharran et al. (2012) sought to assess the perceptions of project managers and contractors regarding the critical success factors that lead to project success. The findings suggest that project managers and contractors strongly support the critical success factors identified in the four COMs model as being significant in achieving project success. It emerged that there were no significant differences between project managers and contractors regarding the critical success factors listed.

Research by Bonnal et al. (2002) speak of a risk-oriented model, often implemented on technical projects and especially on large-scale industrial projects, which can promote better understanding and communication within the projects. The model enforces that planning and scheduling on the one side, and risk estimating and monitoring on the other side are deeply interlocked all along the project.

2.13. Overview of literature review

The South African economy is currently in need of recovery. A stimulus boost in the form of infrastructure related programmes and projects will contribute to job creation, sustainable employment and prosperity within the built environment sector. The benefits of quality and essential infrastructure development are wide-ranging.

Project management within the built environment sector has evolved into a profession and is regulated in South Africa by the SACPCMP. There are several standards for project management practice worldwide, including the PMBOK® Guide which is found to be reputable among South African project management practitioners.

Programmes and projects need to be carefully considered and implemented effectively in order to reap the benefits for all stakeholders in the short, medium and long term. Investment in projects should be in line with organisation strategy. Many client organisations may not possess in-house project management capacity, neither have a conducive project organisational structure or adequate knowledge of project management. A project manager, whether internal to the client organisation or externally sourced as a consultant, is a crucial appointment which can influence project management success.

Key project role-players considered as part of the study include the client, project manager or lead consultant, and contractor. Each of these role-players has individual or organisational responsibilities which impact the project differently during the various project life cycle phases. Although other roles are important, the key role-players have a direct impact on project and project management success. Other roles discussed are the project sponsor, project champion and end user as well as the project team as a whole. The project sponsor funds the project and is generally represented by an individual within or behalf of the client organisation. A project champion, also an individual, believes in the project and removed obstacles in order to ensure that the project is completed. The end user makes use of the completed project or product.

Clients have a responsibility of appointing a ‘best fit’ project manager to the project. Along with project management related knowledge and personal competencies, selection criteria can incorporate a cultural fit to the project team members and mitigates the challenges posed by globalisation. Interpersonal skills of a project manager contribute to the overall synergy within the project team. Leadership styles and communication skills are among the project manager’s most important attributes.

The concept of project success is multifaceted and can often be subjective, depending on what aspect of the project is assessed, who makes the assessment and when it is assessed. Project success is dependent on many variables, some of which are outside the control of the project management team. In order to give a project an increased probability of success, critical success factors should be identified early on by the client organisation with assistance of the project manager and communicated to the project team. Known critical success factors are important for project management to understand, which may increase a project's odds of success. The presence of critical success factors does not guarantee success but an absence of such factors is likely to lead to failure. These factors usually vary among built environment projects and extend beyond the traditional triangle of cost, time and quality constraints.

2.13.1. Summary of selected criteria and factors

The literature review supports the identification of critical success and failure factors in projects. Many studies rank the importance of critical factors relative to each other on specific projects or projects in general. The gap in research identified during literature review is the influence of key project role-players on project success within the South African built environment; a manner in which to determine this influence is through the project’s critical success and failure factors.

From a total of 361 success criteria, sub factors, factors and categories identified during literature review, a selection of 126 is listed. The reason for this selection is that these criteria, sub factors and factors identified encompass the critical success or failure factors during a typical built environment project life cycle. See Annexure A for table 3, which lists the 126 success criteria and factors. The literature review continues into the survey phase of the research where a select few critical factors were agreed from the list of 126.

The critical factors may not apply to all stages of a project and the role-players have a varying degree of influence on factors at the different project stages. Therefore, for a holistic view, the project critical success or failure factors will need to be separated into the various project stages before attempting to gauge the degrees of influence on these critical factors via survey and achieve the research objectives. The degree of key role-players’ influence on the critical success or failure factors is a means to apportion responsibility and determine accountability.

3. RESEARCH METHODOLOGY

In order to explore the relevant literature on project success and associated factors, and to determine the degree of influence that key project role-players have on critical success and failure factors within the South African built environment, a selection of research approaches are identified. Inductive or deductive reasoning will not suffice. A qualitative or quantitative approach on its own will not achieve the required objectives. Hence a mixed method approach needs to be adopted.

Literature review provides the knowledge and information required for constructing a template to work from. This qualitative analysis of the information allows for a selection of the common and critical factors for a typical built environment sector project to be presented to an expert panel for comment and validation. The critical factors must be assorted into the most appropriate project stages or phases. The key role-players are involved with the project at different phases. An agreed conceptual framework concludes the qualitative portion of the mixed method approach and lays the platform for determining the influence on these critical success or failure factors. Conducting the comment and validation process among the general public in the form of a survey or questionnaire will not yield satisfactory results. Achieving consensus will be difficult and some participants may not have the adequate experience and knowledge of projects within the built environment, and therefore be deemed an unreliable outcome.

The same expert panel will be best suited to commence with the quantitative analysis portion of the mixed method approach, where level of influence ratings are required. Quantitative research is generally empirical in nature. The convergence to a norm of readings and resulting rankings means that the level of influence ratings may need to be revised by an expert participant based on group averages until consensus is reached. After literature review, the Delphi technique is a suitable method which can be applied in order to achieve the research objectives.

3.1. Delphi technique

Delphi is an established technique used by academic researchers in the field of construction engineering and management since the early 1990s. The technique keeps experts free to make judgements (Hallowell and Gambatese, 2010). The Delphi technique is a way of obtaining a collective view from experts where there is little definite evidence and expert opinion is important. It is an iterative questionnaire exercise with controlled feedback to a group of expert panellists who are anonymous. This method avoids the often counterproductive group dynamics that can occur where individuals are swayed or intimidated by others. The technique is about harnessing and organising judgement and is used as an alternative to conventional meetings, avoiding problems arising from powerful personalities, group pressure and the effects of status. The Delphi technique allows the expert participants to reappraise their views in light of the responses of the group as a whole. It is an ideal approach to questions that are complex and require intuitive interpretation of the evidence (Thangaratinam and Redman, 2005).

As per research by Gunduz and Elsherbeny (2020), there is no agreed minimum number of experts that should participate in Delphi studies, however based on several previous research papers, Hallowell and Gambatese (2010) recommend that a minimum of 8 experts is required. The success of the study is based on their unbiased judgement. All Delphi survey participants were willing persons purposively identified by the researcher. Giel and Issa (2014) state that two to six rounds of Delphi survey is sufficient to attain the required consensus from the expert panel, and have used three rounds successfully in the past. Hallowell and Gambatese (2010) suggested three rounds as sufficient.

3.2. Model for testing and analytical technique

It was intended that a cross-section of experts participate in the survey in order to explore divergent views. The experts invited comprised industry professionals in engineering, architecture, project management, quantity surveying, researchers (academics in the built environment field) and clients (senior management employees of public or private organisations of any size that require project management services related to the built environment). It was preferred, but not essential, that the participant be professionally registered with a suitable Built Environment Council such as Engineering Council of South Africa (ECSA), SACPCMP, South African Council for the Architectural Profession (SACAP) or similar.

The selected Delphi survey experts each had a minimum of 10 years project experience within the South African built environment sector. The selected experts were briefed on the background and objectives of the study and order of proceedings prior to their consent to participate being received. The initial assessment survey was then sent to consenting expert participants targeting a minimum of 8 responses. The expert participants classified their current organisation as employer, consultant or contractor. It was noted that a project manager (consultant) may have different titles depending on the conditions of contract used.

Round 1. The initial survey was distributed to the experts. The survey comprised a list of critical success and failure factors (based on literature review) which were categorised into similar groups and supported by criteria and supporting factors. The panel of experts comprehensively reviewed project critical success and failure factors provided from research. The experts reviewed the groups, which are related to the PMBOK® Guide knowledge areas and any additional group when factors did not align to any knowledge area.

The experts were invited to review and modify the factors by adding, moving or removing criteria, factors or groups. The experts were also encouraged to comment on the survey. The experts at this stage had view of the initial conceptual framework model which was a distribution of the listed factors and criteria into the project life cycle phases. Comments were returned to the researcher.

Round 2. The researcher collated all comments and informed the experts of all changes and redistributed the final list to the experts. The initial conceptual framework model was edited to reflect the final list. The experts then reviewed the adequacy of

distribution of the critical factors, criteria and supporting factors into the project phases as presented in the conceptual framework model. Comments were returned to the researcher.

Round 3. The researcher collated any additional changes which were required and redistributed the final conceptual framework model to the experts. At this stage the experts were required to rate the degree of influence of each key role-player for every critical success or failure factor listed, in their opinion, using the following representation on a Likert scale: 0= not applicable, 1= not influential, 2= slightly influential, 3= moderately influential, 4= very influential, 5= extremely influential. The ratings were returned to the researcher.

Round 4. The researcher calculated mean scores and standard deviation to mean ratio of the survey population for each rating. A greater than or equal to 80% agreement in rating, or a tolerance limit of no more than 1.5 rating (greater or less) from the group average was considered as essential for consensus. Each participant was provided with their previous rating and an opportunity to input a new rating for specific items out of the average tolerance, with insight on the previous round's average and standard deviation. The standard deviation measures the spread of the data distribution. Values closer to zero indicate that the data input are closer to the average value. The formula used for standard deviation based on the survey population is as follows.

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

∑ = sum, x = rating value, μ = mean of rating values, N = total number of ratings.

Rounds continued until the range of ratings were reduced and results arrive closer to experts' consensus. A further round (round 5) was necessary for 3 expert participants in order to achieve the tolerance limit. The research is conducted using mixed methods. The design adopted is exploratory sequential (George, 2021). In an exploratory sequential design, qualitative data collection and analysis occurs first, as carried out during literature review, rounds 1 and 2 of the Delphi survey. This is followed by quantitative data collection and analysis, as carried out during rounds 3, 4 and 5 of the Delphi survey.

4. DELPHI SURVEY RESULTS

This chapter provides the relevant information about the experts who participated in the survey and reveals the outcome of each round of the Delphi survey process. The comment and discussion section relates to the written interaction during the Delphi survey. The findings conclude the chapter which highlight the significant results from the ranking of each key-role-player's influence on critical success or failure factors.

4.1. Participants

10 experts were invited to take part in the survey, 9 agreed to participate in good time, of which 8 participants started and completed the survey process which comprised a total of 5 rounds of assessment. The survey participant demographic is presented in table 4. The 8 expert participants average 21 years of working experience in the built environment. The vast majority (75%) of experts work in the private sector and the same percentage are professionally registered. Unfortunately, one out of the two clients did not complete the survey process although 2 participants provide client representative services and are registered with the SACPCMP in the designation of Pr.CPM. No current academic researchers completed the survey.

Expert	Province, and Country of residence	Sector (operating in)	Type of service provided by organisation	Position at current company	Experience related to the built environment	Highest tertiary qualification	Professional registration/s
1	Gauteng; South Africa	Private	Construction Project Management. Client representative services.	Director.	15	Bachelors Degree: Architectural Studies	Pr.CPM
2	Gauteng; South Africa	Private	Client Property Owner, Facilities Management, Project Services	Associate.	10	PhD: Mech Engineering	None
3	Gauteng; South Africa	Private	Consulting (Architects and Project Management)	Architect.	40	MBA	Pr.Arch
4	Gauteng; South Africa	Private	Consulting (Architects and Project Management)	Director.	15	BTech: Architectural Technology	Pr.SArchT & Pr.CPM
5	Gauteng; South Africa	Public	Client Property Owner, Facilities Management, Project Services	Executive. Telecommunications	27	MBA	None
6	Gauteng; South Africa	Private	Consulting (Electrical Engineering)	Director. Electrical Engineer	27	National Higher Diploma: Electrical	Pr.Tech Eng
7	KZN; South Africa	Public	Construction (Building and Civils)	Contracts / Construction Manager.	18	BSc: Civil Engineering	Pr.Eng
8	Gauteng; South Africa	Private	Consulting (Cost Engineering)	Senior Quantity Surveyor.	16	Hons: Quantity Surveying	Pr.QS

Table 4: Demographic of expert participants

4.2. Information classification

Drawing from the numerous success and failure factors, criteria or supporting factors that were identified during literature review (see Annexure A for table 3), the items listed in table 5 form a consolidated selection which is applicable to a typical project within the South African built environment sector. The supporting factors or criteria are not meant to be exhaustive but provide a description or breakdown of the critical success or failure factor. There are 17 such critical success or failure factors categorised into 14 analogous groups. Many of the groups listed bear a similarity to all 10 of the project management knowledge areas defined in the PMBOK® Guide (PMI, 2017). The groups serve as a high-level and concise naming relating to the corresponding critical factor or factors.

Table 5 displays the final list of groups, critical success or failure factors, and criteria or supporting factors as agreed upon at the beginning of round 2 via the Delphi technique.

Ref no.	Group (14 groups in total)	Critical Success or Failure Factor (17 factors in total)	Supporting Factors or Criteria (not intended to be exhaustive)
317	Client related Factor	**Project mission [Goal]**	
154			Business opportunity and market impact
294			Clear project definition; sound business case
295			Client/ sponsor brief- achievement of intended outcomes
320			A realistic goal [and timeline]
322			Clearly identified tangible benefits carried out.
316			Tangible benefits for the organisation
28			Clear objectives
306			Economic benefits to the owner
299	Organisation related Factor	**Top management support**	
80			Continuous improvement of business, project and support processes
301			Top management (or sponsor) support and commitment, appropriately engaged.
302		**Project organisational structure**	
6			Employ an effective project management process
7			Project management control and execution systems in place
23			Project size and value
323			Project management organisational understanding and competence in project management
3	Integration and Risk related Factor	**Monitoring and feedback**	
8			Effective planning and control
9			Effective control & monitoring
125			Risk management and mitigation of risk
126			Project risk management
130			Health, safety and zero accidents
109	Communication related Factor	**Communication**	
113			Effective coordination & communication
117			Frequent project meetings
118			Response time
119			Client consultation & acceptance
309			Poor site coordination- Slow decision from owner
178	Stakeholder related Factor	**Stakeholder [Except end user]**	
180			Effective stakeholder engagement [includes identification]
179			Stakeholder satisfaction
184			Client's emphasis, ability and contribution
185			Client satisfaction
188			Competitors
190			Sub-contractors
193			Intervention of Government agencies
195			Government and professional bodies' regulations
198		**End-users expectations**	
199			Users of the project are satisfied
202			Acceptance of the project by the community
203			Community involvement
49	Cost related Factor	**Cost [budget]**	
51			Preliminary estimates
312			Financial strength
313			Adequate funding
52			Estimating
58			Control of cash flow
62			Slow payment of completed works
63			Price fluctuation
64			Project completed within budget
324	Procurement related Factor	**Supply chain**	
165			Procurement method
166			Shortage of material

299			Top management support
325			customer-supplier relationship
326			schedule reliability
327			budget reliability
328			logistics integration
329			E-commerce system quality
151	Governance related Factor	**Contract and legal agreements**	
104			Qualified consultant
147			Comprehensive contract documentation
161			Fraud
163			Influence of corruption
171			Bidding process (awarding a project)
172			Tendering method
173			Land acquisition
174			Approvals and clearances
175			Awarding bids to the right project manager/ contractor
152			Dispute resolution
220	Project manager related Factor	**Competence [of the project manager]**	
35			Planning (time)
93			Ethical and cultural issues
213			Project manager's performance on the job
223			Commitment to the project
233			Effective use of managerial skills
239			Emotional intelligence
242			Leadership
246			Team building
247			Motivation
248			Communication
249			Influencing
251			Decision-making and problem-solving skills
252			Political and cultural awareness
253			Negotiation
254			Trust building
255			Conflict management
256			Coaching
257			Experience [relevant to project]
88	Human resources related Factor	**Project team [Human Resources]**	
85			Resource availability
93			Ethical and cultural issues
96			Cooperation among the project participants
99			Teamwork
102			Inefficient site management. Poor labour productivity
104			Qualified consultant
106			Good subcontractor
17	Scope related Factor	**Scope**	
19			Well defined project scope
21			Management of variations and change orders
72			Effective change management
132	Exogenous related Factor	**External environment [Outside Project Manager's control]**	
135			Environment impacts
138			Natural phenomenon
143			Political environment
156			Economical environment
158			Social environment
160			Technological environment
197			Unpredictable government policies and priorities
43	Time related Factors	**Urgency [Time imposed by Client]**	
32			Schedule (time)
33		**Schedule/ plans**	
32			Schedule (time)
39			Project completed on time
268	Quality and Design related Factor	**Technical tasks [Technology and Design]**	
264			Uniqueness (high technical knowledge)
271			Utilising up-to-date technology
272			Effective use of technology
275			Quality of construction project design

276			Efficiency of drainage system
278			Poor design capacity and frequent design changes
281			Meeting the specifications
286			Use of good quality material
287			Functionality or fitness for purpose
288			An excellent product to specification
76			Quality control

Table 5: Groups, critical success or failure factors, criteria or supporting factors

4.3. Final conceptual framework model

See Annexure B for figure 2.

The conceptual framework displays the scope of project management success which is contained within the scope of the project success as a whole. The 17 critical success or failure factors are now shown to be distributed into four project life cycle phases predominantly concerned with project management. Two further phases are shown which fall outside the concern of project management, viz.:'utilisation' and 'closedown'. The final conceptual framework is agreed upon at the beginning of round 3 via the Delphi technique. It is necessary for the visualisation of the 17 critical success or failure factors spread across the project life cycle spectrum, which aid in the key role-player rating of influence rounds to follow.

A summarised version of the conceptual framework is provided in figure 3.

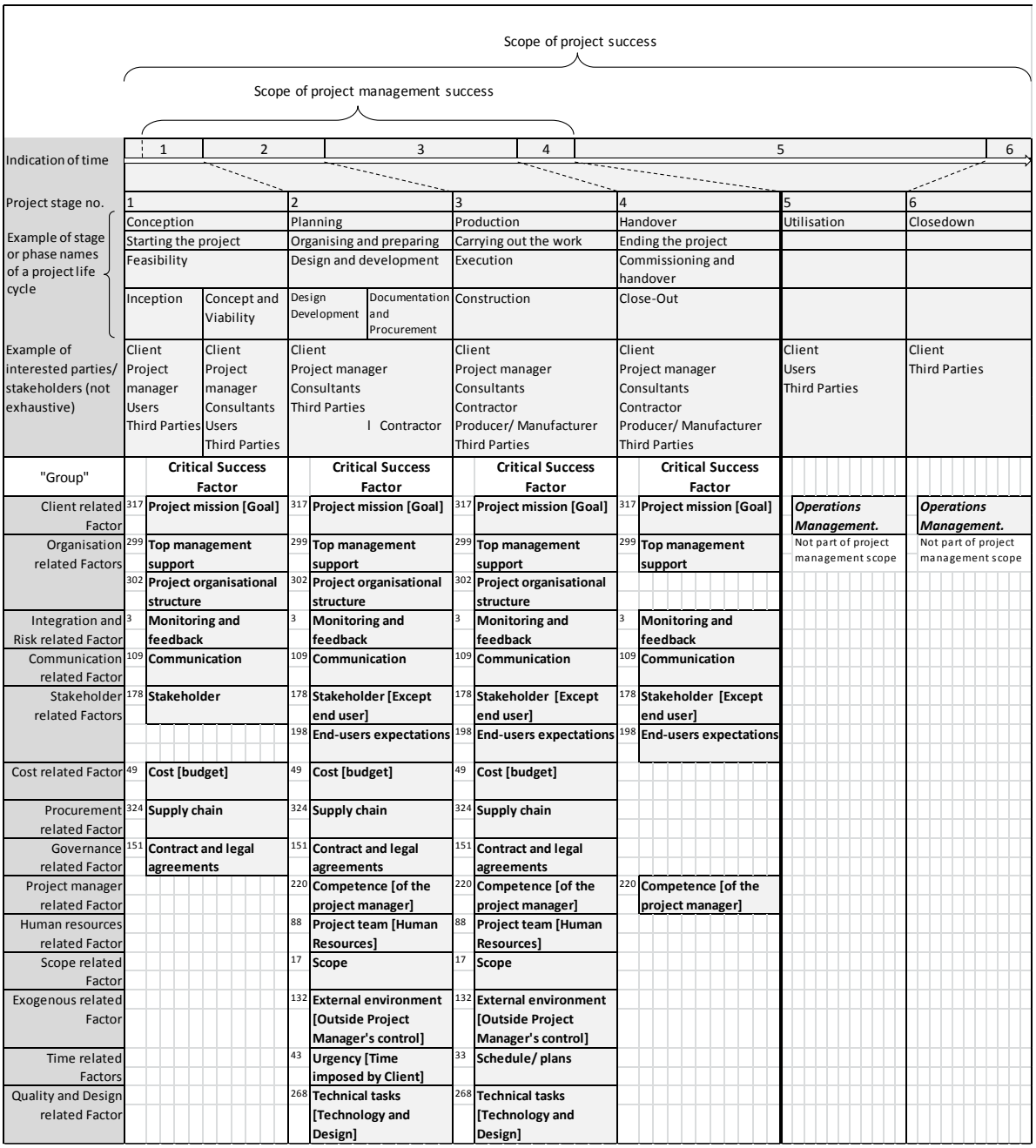

Figure 3: A summarised version of the conceptual framework

4.4. Comment and discussion

The initial list and conceptual framework required changes during rounds 1 and 2 of the survey. The following comment and discussion during the survey process shaped the final conceptual framework shown in Annexure B figure 2.

‘Clear objectives’ is a criterion in stage 2 and is replicated in stage 1 for the ‘project mission [goal]’ critical success factor. The ‘project mission [goal]’ critical factor could be included in a ‘stage 0’ which is recognised as pre-project management investigation works. ECSA term this as ‘planning, studies, investigations and assessments’.

Professional Consultants Services Agreement (PROCSA) term this as ‘project initiation and briefing’ for property development projects. The model includes the latest names of the project life cycle phases or stages as defined by Burke (2017), PMBOK® Guide (PMI, 2017) and SACPCMP (2019a) as well as older referenced stage names by Munns and Bjeirmi (1996); Pinto and Slevin, (1988b); SACPCMP (2006). The number of phases or need for phases depends on size, complexity and potential impact of the project (PMI, 2013). Stages activities may overlap. The conceptual framework is split into 4 general project management phases when rating the critical success or failure factors in the future round/s to not obfuscate the conceptual framework and to avoid repeated ratings of the same critical factor spanning various phases.

The management of the supply chain is an area of increasing emphasis by the contractor’s project team. The supply chain link to managing projects within the built environment may be considered under the procurement category or factor group. Project procurement management is classified as a knowledge area in the PMBOK® Guide (PMI, 2017). For this research, the ‘supply chain’ is a critical success factor with a sample of the supporting factors or criteria being ‘top management support’; ‘customer-supplier relationship’; ‘schedule reliability’; ‘budget reliability’; ‘logistics integration’; and ‘E-commerce system quality’ (Talib and Hamid, 2014).

‘Planning’ is classified as a project management process group (PMI, 2017) as well as a stage of the project life cycle (Munns and Bjeirmi, 1996); (Pinto and Slevin, 1988b). The planning process group is part of the project integration management knowledge area and coordinates and unifies a total of 24 of the 49 processes applicable to all 10 knowledge areas (PMI, 2017). For this research, planning is considered as a process group and as a life cycle stage in the model after ‘conception’ and before ‘execution or production’ (Munns and Bjeirmi, 1996; Pinto and Slevin, 1988b). ‘Effective planning and control’ is included as a supporting factor in all phases of the project life cycle under the ‘Monitoring and feedback’ critical success factor. Planning is included as a criterion for the critical factor ‘Competence [of the project manager]’. ‘Urgency’ imposed by the client is a critical factor defined as the need to implement the project as soon as possible, which impacts the project schedule with knock-on effects on time, cost, and quality criteria.

‘Design’ is crucial to the success of a project; these aspects are covered under the ‘Technical tasks [Technology and Design]’ critical success factor. ‘Approvals and clearances’ including those from the local authority, is a supporting factor that falls under the umbrella of ‘contracts and legal agreements’ as the critical success factor. Clear and informative tender documents, including the bill of quantities and contract conditions are considered as supporting criteria under the critical factor of ‘Contract and legal agreements’. ‘Tendering method’ (Chan et al., 2004) is a criterion in stage 2 and is replicated in stage 1. ‘Procurement method’ is listed as a criterion in stage 1 under ‘Procurement related Factor’. ‘Warrantees and Guarantees in place’ is listed under ‘Operations management’ stage 5. Warrantees and Guarantees may form part of the project procurement strategy and specified in the supplier/contractor tender documentation. ‘Use of good quality material’ during construction is stated under the

‘Technical Tasks [Technology and Design]’ critical factor which is classified as ‘Quality and Design related’.

‘Scope [change] management’ is included as a supporting factor under the ‘Scope’ critical success factor. Scope related items i.e. client brief, clear objectives and clear project definition are stated under ‘Client related factor’ during stage 1. A ‘well defined project scope’ is deemed critical for project success during the design and tendering phases of the project.

Site or ground conditions are to be assessed during the geotechnical survey as part of the ‘Technical tasks [Technology and Design]’ critical factor. ‘Poor design capacity and frequent design changes’ must be avoided. Unforeseen ground conditions may impact the project schedule which has an impact on the time and cost criteria. The management of water and drainage systems during the construction phase contribute to favourable ground conditions. Certain environmental impacts and natural phenomenon, as part of the ‘External environment’ critical factor, are listed as outside the control of the project manager and other key project stakeholders.

The ‘economic benefit’ to the client is realised after the project is used for its intended purpose which materialises during or after commissioning and handover.

The project manager’s experience that is ‘relevant to project’ is regarded as a criterion under ‘Competence [of the project manager]’ critical success factor. A detailed communication plan is necessary for the effective dissemination of information. ‘Frequent project meetings’ can be effective as a form of communication. Effective project meetings are part of ‘effective coordination & communication’ which is a supporting factor to the ‘Communication’ critical success factor.

Use of the RACI (Responsible, Accountable, Consulted, Informed) matrix may be beneficial on projects: Similarly, the benefit of this research survey will contribute to identification and understanding by the project’s key role-players of the project critical success factors applicable to the project life cycle phases. The degree of influence to each critical factor is pertinent as a means of apportioning responsibility and determining accountability to that party, which may contribute to project success or failure.

As part of the rating of influence assessments during rounds 3 and 4, comment and discussion include the following.

It was noted that the client hasn’t much influence on the competence of the project manager except on the choice of the project manager. The contractor is not critical to the competence of the project manager. For the ‘External Environment [Outside project manager's control]’ critical factor, government clients may have influence on social, political and economic climate and some private clients have economic influence. The project manager and contractor also received slightly influential ratings for the ‘External Environment [Outside project manager's control]’ critical success factor even though it is generally out of their control.

The contractor does not have much or any influence on the critical factors in stage 2 however their influence in phase 2 is debateable. For the 'Contracts and Legal Agreements' critical factor, influence is extremely minimal and could be construed as reviewing the tender, filling it out correctly and submitting on time. The same may be said for contract documentation after appointments however, those tasks may fall in the next phase. For the 'Urgency [Time imposed by Client]' critical factor, the contractor may raise concern or negotiate or may not bid for whatever reason if they feel that they can't achieve the time frame of the project. For the 'Technical tasks [Technology and Design]' critical factor, the contractor has minimal involvement, perhaps only in planning for highly skilled labour/artisans or specialised equipment. Subsequently, the phase 2 contractor related queries above resulted in the ratings being very low, but not 0, when compared to the other key role-players for the related critical factor assessment in the phase.

No comment or discussion took place during round 5 of the survey.

4.5. Findings

The conceptual framework displays the critical success or failure factors and groupings for typical built environment projects distributed over the project life cycle stages or phases. As per Mir and Pinnington (2014), many of the critical success factors which are identified in studies are actually the project management practices applied during project execution. In the case of this research the critical success or failure factors and related groups are similar to the PMBOK® Guide knowledge areas and span different phases. Gauging the influence of key role-players on these critical factors may lead to project success in line with Sanjuan and Froese (2013) as their research positions that the better the project management practices, the better the project results. Although the project management techniques are not solely important for project success, in line with Munns and Bjeirmi (1996), other critical success or failure factors and stages are outside the project manager and contractor areas of influence, where the client is best placed to impact project success.

After the distribution of the critical factors into the project phases was finalised as per the conceptual framework shown in Annexure B figure 2, the key role-players' degree of influence was determined by analysis of the data received after the final round of survey. See Annexure C for table 6. 48 ratings per key role-player were assessed. This is a total of 144 ratings for the influence of the 3 key role-players on critical factors. The representation on a Likert scale is as follows: 0= not applicable, 1= not influential, 2= slightly influential, 3= moderately influential, 4= very influential, 5= extremely influential.

After analysis of the results from round 5, it was revealed that all ratings were within the predefined tolerance limit, which implied consensus among the expert participants. Based on the average rating scores received from all experts on each key role-player influence, overall the project manager ratings were the highest (195) with the client in second place (158) and the contractor third (104). From the final results of the survey as shown in Annexure C table 6, the critical success or failure factors upon which the client was found to be most influential are displayed in table 7.

Rank	Stage or Phase Number	Stage or Phase Name	Critical Factor	Average Rating
1	1	Feasibility	Project Mission [Goal]	4.8
1	2	Design and development	Urgency [Time imposed by Client]	4.8
3	1	Feasibility	Top management support	4.6
3	1	Feasibility	Cost [budget]	4.6
5	1	Feasibility	Stakeholder	4.5
5	2	Design and development	End-users expectations	4.5
5	2	Design and development	Scope	4.5
8	1	Feasibility	Communication	4.3
9	1	Feasibility	Contract and legal agreements	4.1
10	2	Design and development	Top management support	4.0
10	1	Feasibility	Monitoring and feedback	4.0
10	2	Design and development	Monitoring and feedback	4.0
10	2	Design and development	Cost [budget]	4.0
10	2	Design and development	Contract and legal agreements	4.0

Table 7: Highly ranked client influence on critical factors

The critical success or failure factors upon which the project manager was found to be most influential are displayed in table 8.

Rank	Stage or Phase Number	Stage or Phase Name	Critical Factor	Average Rating
1	3	Execution	Project mission [Goal]	4.8
1	3	Execution	Competence [of the project manager]	4.8
3	3	Execution	Monitoring and feedback	4.6
3	3	Execution	Communication	4.6
3	3	Execution	Contract and legal agreements	4.6
3	3	Execution	Schedule/ plans	4.6
7	2	Design and development	Project organisational structure	4.5
7	4	Commissioning and handover	Monitoring and feedback	4.5
7	2	Design and development	Communication	4.5
7	4	Commissioning and handover	Communication	4.5
7	2	Design and development	Contract and legal agreements	4.5
7	2	Design and development	Competence [of the project manager]	4.5
13	3	Execution	Project organisational structure	4.4
13	2	Design and development	Monitoring and feedback	4.4
13	3	Execution	Project team [Human Resources]	4.4
13	2	Design and development	Scope	4.4
13	3	Execution	Scope	4.4
13	2	Design and development	Urgency [Time imposed by Client]	4.4
19	3	Execution	Cost [budget]	4.3
19	2	Design and development	Supply chain	4.3
19	1	Feasibility	Contract and legal agreements	4.3
19	4	Commissioning and handover	Competence [of the project manager]	4.3
19	2	Design and development	Project team [Human Resources]	4.3

Table 8: Highly ranked project manager influence on critical factors

The critical success or failure factors upon which the contractor was found to be most influential are displayed in table 9.

Rank	Stage or Phase Number	Stage or Phase Name	Critical Factor	Average Rating
1	3	Execution	Schedule/ plans	4.8
1	4	Commissioning and handover	Monitoring and feedback	4.8
3	3	Execution	Communication	4.6
3	4	Commissioning and handover	Communication	4.6
5	3	Execution	Monitoring and feedback	4.3
5	3	Execution	Cost [budget]	4.3
5	3	Execution	Supply chain	4.3
5	3	Execution	Technical tasks [Technology and Design]	4.3
9	3	Execution	Stakeholder [except end user]	4.1
9	3	Execution	Contract and legal agreements	4.1
9	3	Execution	Project team [Human Resources]	4.1

Table 9: Highly ranked contractor influence on critical factors

The data from tables 7, 8 and 9 indicate that the client is extremely influential on the project mission [goal]; top management support; and cost [budget] critical success factors during the feasibility phase. The client is also extremely influential on the urgency [time imposed by client] critical success factor during the design and development phase.

The project manager is extremely influential on the project mission [goal]; competence [of the project manager]; monitoring and feedback; communication; contract and legal agreements; and schedule/ plans critical success factors during the execution phase.

The contractor is extremely influential on the schedule/ plans; and monitoring and feedback critical success factors during the execution; and commissioning and handover phases respectively. The contractor is also extremely influential on the communication critical success factor during the execution; and commissioning and handover phases.

The summary of average ratings of influence by key role-players on critical success or failure factors per project life cycle phase, as well as standard deviation of the survey population and ranking of influence per critical factor are displayed in table 10.

Project Phase Feasibility (Burke, 2017)				Critical Factor	Client/ Employer			Project Manager or Lead Consultant			Contractor		
					Average Rating of Survey Population	Standard Deviation of Survey Population	Rank of influence (within stage)	Average Rating of Survey Population	Standard Deviation of Survey Population	Rank of influence (within stage)	Average Rating of Survey Population	Standard Deviation of Survey Population	Rank of influence (within stage)
1				Project mission [Goal]	4.8	0.4	1	3.3	0.4	2	0.3	0.4	3
1				Top management support	4.6	0.5	1	3.3	0.8	2	0.6	0.9	3
1				Project organisational structure	3.8	0.8	2	3.9	0.8	1	0.5	0.5	3
1				Monitoring and feedback	4.0	0.9	2	4.1	0.8	1	0.6	0.7	3
1				Communication	4.3	0.8	1	4.0	0.9	2	0.5	0.7	3
1				Stakeholder	4.5	0.7	1	3.4	0.5	2	0.4	0.5	3
1				Cost [budget]	4.6	0.5	1	3.9	0.8	2	1.0	0.9	3
1				Supply chain	2.9	0.6	2	3.9	0.8	1	0.8	0.8	3
1				Contract and legal agreements	4.1	0.8	2	4.3	0.8	1	0.9	0.9	3
				Average	**4.2**			**3.8**			**0.6**		
Design and development				Critical Factor									
	2			Project mission [Goal]	3.9	0.8	2	4.0	0.9	1	0.5	0.5	3
	2			Top management support	4.0	0.9	1	3.5	0.9	2	0.4	0.5	3
	2			Project organisational structure	3.5	0.9	2	4.5	0.7	1	0.5	0.5	3
	2			Monitoring and feedback	4.0	0.9	2	4.4	0.7	1	0.6	0.7	3
	2			Communication	3.9	0.8	2	4.5	0.7	1	0.6	0.7	3
	2			Stakeholder [except end user]	3.3	0.8	2	3.4	0.7	1	0.8	0.8	3
	2			End-users expectations	4.5	0.7	1	3.9	0.8	2	0.5	0.7	3
	2			Cost [budget]	4.0	0.7	2	4.1	0.8	1	0.6	0.7	3
	2			Supply chain	2.9	0.3	2	4.3	0.8	1	0.9	0.8	3
	2			Contract and legal agreements	4.0	0.9	2	4.5	0.7	1	1.5	0.7	3
	2			Competence [of the project manager]	3.1	0.8	2	4.5	0.7	1	0.3	0.4	3
	2			Project team [Human Resources]	3.9	0.9	2	4.3	0.8	1	0.6	0.7	3
	2			Scope	4.5	0.7	1	4.4	0.7	2	0.5	0.7	3
	2			External environment [Outside project mar	2.9	0.6	1	2.1	0.9	2	0.8	1.0	3
	2			Urgency [Time imposed by Client]	4.8	0.4	1	4.4	0.9	2	1.3	0.7	3
	2			Technical tasks [Technology and Design]	1.9	0.6	2	3.8	0.8	1	1.4	0.7	3
				Average	**3.7**			**4.0**			**0.7**		
Execution				Critical Factor									
		3		Project mission [Goal]	2.9	0.6	3	4.8	0.4	1	3.5	0.5	2
		3		Top management support	2.8	0.7	2	3.9	0.8	1	2.4	0.7	3
		3		Project organisational structure	2.9	0.8	3	4.4	0.7	1	3.5	0.5	2
		3		Monitoring and feedback	3.4	0.5	3	4.6	0.5	1	4.3	0.7	2
		3		Communication	3.0	0.5	3	4.6	0.5	1	4.6	0.5	1
		3		Stakeholder [except end user]	2.5	0.9	3	4.0	0.7	2	4.1	0.8	1
		3		End-users expectations	3.1	0.8	3	4.0	0.7	1	3.9	0.8	2
		3		Cost [budget]	3.4	0.7	3	4.3	0.8	1	4.3	0.7	1
		3		Supply chain	2.3	0.8	3	4.1	0.8	2	4.3	0.7	1
		3		Contract and legal agreements	2.9	0.8	3	4.6	0.5	1	4.1	0.9	2
		3		Competence [of the project manager]	2.0	0.9	3	4.8	0.4	1	2.0	0.5	3
		3		Project team [Human Resources]	2.8	0.7	3	4.4	0.9	1	4.1	0.8	2
		3		Scope	2.5	1.2	3	4.4	0.9	1	4.0	0.7	2
		3		External environment [Outside project mar	2.8	0.4	3	2.8	0.7	3	3.0	0.7	1
		3		Schedule/ plans	2.8	0.8	3	4.6	0.5	2	4.8	0.4	1
		3		Technical tasks [Technology and Design]	1.5	0.9	3	4.0	0.9	2	4.3	0.8	1
				Average	**2.7**			**4.3**			**3.8**		
Commissioning and handover				Critical Factor									
			4	Project mission [Goal]	3.0	0.9	3	4.1	0.6	1	3.9	0.8	2
			4	Top management support	3.0	0.9	2	3.5	0.9	1	2.3	0.7	3
			4	Monitoring and feedback	3.3	0.7	3	4.5	0.5	2	4.8	0.4	1
			4	Communication	3.1	0.6	3	4.5	0.5	2	4.6	0.5	1
			4	Stakeholder [except end user]	2.4	0.7	3	3.9	0.8	2	4.0	0.9	1
			4	End-users expectations	2.5	1.2	3	3.9	0.8	2	4.0	0.9	1
			4	Competence [of the project manager]	1.0	0.7	3	4.3	0.7	1	2.0	0.7	2
				Average	**2.6**			**4.1**			**3.6**		

Table 10: Average ratings of influence per project phase and rank per critical factor

The data from table 10 indicates that during the first phase (feasibility) of the project, the client is the most influential with an average influence rating of 4.2 followed closely by the project manager with 3.8. The contractor is ranked a distant third with 0.6 with very little or no involvement during the feasibility phase. During phase two (design and development), the project manager (4.0) is slightly ahead of the client (3.7), with the contractor again a distant third (0.7) due to very little or no involvement during the design and development phase. For the third phase (execution) the project manager is the most influential (4.3), followed closely by the contractor (3.8) and the client with an average influence rating of 2.7. At the final phase (commissioning and handover) the project manager is again the most influential with an average influence rating of 4.1 followed by the contractor at 3.6 and the client with 2.6.

The data on standard deviation of the survey population demonstrates the spread of the data distribution. Values closer to zero indicate that the data input by all survey participants are closer to the average value. The vast majority of readings (141) are under 1.0, and only 3 readings are between 1.0 and 1.2. This demonstrates confidence in the data input.

The influence of key role-players in the different phases demonstrates the importance of the client role throughout the project but especially in the early phases. The project manager's crucial influence is prevalent throughout all phases and is the most influential from the second phase (design and development) of the project and onward. The contractor is very influential during the execution, and commissioning and handover phases only, with very little or no involvement during the first two phases of a typical built environment project.

5. CONCLUSION

This research paper aims to explore the relevant literature on project success and associated factors, and to determine the degree of influence that key role-players have on critical success and failure factors within the South African built environment. It firstly provides an overview of project management in the South African built environment sector which is in need of infrastructure development to maintain and create employment, revive the sector and boost the fiscus. The research benchmarks the PMI PMBOK® Guide and its extensions which is recognised and accepted as good practices in project management.

In order to give projects the best chance of success, due diligence must be performed during project selection with realistic goals and strict organisational governance adherence. Stakeholder identification and engagement must be carried out from the onset; there is a requirement for understanding all stakeholders' power and influence and the roles and responsibilities of each person or party as the actions of these role-players during the various project stages inevitably influences the project outcome. The differentiation between project management success and project success is discussed. The selection and support of the project management team is the responsibility of the client who receives the tangible benefit after successful commissioning and handover for use by the end user. Competent consultants for the required disciplines, including the project manager, enable the project to be planned and executed effectively with important dependencies on the contractor and suppliers of material. At this stage skills development is an important criterion in the effectiveness of a contracting organisation's project team.

The research is conducted using mixed methods. A few examples from literature are provided in the conceptual framework as project lifecycle stage or phase names, as the number of phases or need for phases depend on size, complexity and potential impact of the project. Critical success and failure factors, and supporting criteria are selected from a comprehensive review of past repositories which resulted in an initial list. As part of a Delphi survey, the list is reviewed by 8 expert participants who are highly experienced in projects within the South African built environment sector. The input received during the survey adopting the Delphi technique was concluded after 5 rounds of qualitative and quantitative assessment culminating in a conceptual framework model and accompanying table. The table indicates the degree of influence of each of the key role-players (client, project manager or lead consultant, and contractor) on every critical success or failure factor displayed in the conceptual framework model.

17 critical factors were agreed as most applicable to typical South African built environment projects. These 17 critical factors were distributed over the project life cycle resulted in 48 critical factors rated. On average, the project manager has the most influence on the critical factors identified. The project manager was ranked as most influential on 29 occasions, contractor on 11 occasions and the client on 10 occasions. The project manager and contractor shared the most influential ranking for both 'communication' and 'cost [budget]' critical factors during the execution phase.

Results of the survey reveal that the key role-players have varying levels of influence throughout the project life cycle, from being not influential to extremely influential. Even though project success is not entirely dependent on project management success, a positive influence by the correct role-player on the relevant critical factors will positively impact project management success. Project management success is purely a subset of the project success. Certain factor groups in the conceptual framework such as integration and risk; communication; stakeholder; cost; procurement; human resources; scope; time; and quality and design related bear a similarity to all 10 of the project management knowledge areas defined in the PMBOK® Guide. The integration and risk; stakeholder; and cost factor groups encapsulate some of the factors which impact the health, safety, security, and environmental management; and financial management knowledge areas defined in the construction extension to the PMBOK® Guide.

The product of the Delphi survey is a conceptual framework and accompanying table displaying the degree of influence of the client, project manager or lead consultant, and contractor, on each of the selected critical success or failure factors at the various project life cycle phases. The results of this research provide a better understanding of the key project role-players' degree of influence on project critical success factors and critical failure factors. In this way responsibility can be apportioned appropriately to the relevant role-players in order to positively impact on project management success and improve the probability of project success.

The study does not attempt to classify project critical success or failure factors in order of importance, nor does it intend on linking supporting factors or criteria comprehensively to support the critical factors. The supporting factors or criteria are not meant to be exhaustive but provide a description or breakdown of the critical factor. The study does not attempt to recreate the scopes of services of South African built environment council registered professionals during the project stages as documented in the various built environment council documents.

To a certain extent the ranking of influence and consequent responsibility is a validation of the critical factor distribution into the project life cycle phases as per the conceptual framework, as not all role-players are involved equally throughout the project life cycle. The research offers an alternative means of planning for and interpreting project management and project success by assessing the degrees of influence on project critical success or failure factors.

5.1. Recommendation for future research

Suggested further work based on the research is to apply the conceptual framework to individual built environment sector projects. Projects differ in uniqueness, size and complexity, therefore the criteria for measuring success varies from one project to another. The success criteria that impact the critical success factors throughout the project's life cycle must be identified and measurable. For certain factors, success is dependent on subjective opinions as the success criteria are not easily quantifiable.

After finalising the criteria, KPIs for the project manager and contractor may be drawn up based on the Pareto principle, focusing on the project critical success factors that the role-player influences greatly based on rankings. These rankings are provided in section 4.5 of the research in tables 7, 8, and 9. The client organisation may adopt similar KPIs for the sponsor or client's project management office. However, the risk of considering only highly ranked critical factors in terms of influence rating is that lower ranked critical factors, which are not considered, could eventually lead to lower efficiency and effectiveness of the project management process or result in project failure. Annexure C table 6 displays the full view of each key project role-player's degree of influence average ratings, and rankings.

The KPIs can be reviewed and assessed in order to gauge the performance of the influential role-player or players. This assessment should take place at frequent and predetermined timelines but not longer than at the completion of each project stage or phase.

Project management success can be determined by assessment of the agreed KPIs from the perspective of all key role-players' influence, not long after the project is commissioned and handed over to the client for its intended purpose. Based upon the assessment, areas that need improvement can be identified including training and development, lessons can be learned and targeted improvements can be implemented for future projects.

Beyond the remit of the scope of project management and when the project or product is in use, the business case benefit tracking criteria must be assessed at previously specified frequency by the client organisation to determine project success. Similar to the project management success assessment, areas that need improvement can be identified including training and development, lessons can be learned and targeted improvements can be implemented for future projects.

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ANNEXURE A

Selection of criteria and factors from literature review

Ref no.	Selection of Criteria and Factors from literature review	Source/ citation
317	Project mission	Pinto and Slevin, 1988b
154	Business opportunity and market impact	Shokri-Ghasabeh et al., 2010
294	Clear project definition; sound business case	Crosby, 2012
295	Client/ sponsor brief- achievement of intended outcomes	Chipulu et al., 2012
320	A realistic goal [and timeline]	Munns and Bjeirmi, 1996
322	Clearly identified tangible benefits carried out	Bryde, 2007
316	Tangible benefits for the organisation	Bryde, 2007
28	Clear objectives	Garbharran et al., 2012
306	Economic benefits to the owner	Howsawi et al., 2014
299	Top management support	Pinto and Slevin, 1988b
80	Continuous improvement of business, project and support processes	Cooke-Davies, 2004
301	Top management (or sponsor) support and commitment, appropriately engaged	Crosby, 2012
302	Project organisational structure	Belassi and Tukel, 1996
6	Employ an effective project management process	Bryde, 2007
7	Project management control and execution systems in place	Crosby, 2012
23	Project size and value	Belassi and Tukel, 1996
323	Project management organisational understanding and competence in project	Crosby, 2012
3	Monitoring and feedback	Pinto and Slevin, 1988b
8	Effective planning and control	Cooke-Davies, 2004
9	Effective control & monitoring	Belassi and Tukel, 1996
125	Risk management and mitigation of risk	Meenakshi, 2015
126	Project risk management	Alkhlaifat et al., 2019
130	Health, safety and zero accidents	Meenakshi, 2015
109	Communication	Pinto and Slevin, 1988b
113	Effective coordination & communication	Belassi and Tukel, 1996
117	Frequent project meetings	Garbharran et al., 2012
118	Response time	Burke, 2017
119	Client consultation & acceptance	Belassi and Tukel, 1996
309	Poor site coordination- Slow decision from owner	Doloi et al., 2012
178	Stakeholder	Hardy-Vallee, 2012
180	Effective stakeholder engagement [includes identification]	Crosby, 2012
179	Stakeholder satisfaction	Shokri-Ghasabeh et al., 2010
184	Client's emphasis, ability and contribution	Chan et al., 2004
185	Client satisfaction	Thote et al., 2017
188	Competitors	Belassi and Tukel, 1996
190	Sub-contractors	Belassi and Tukel, 1996
193	Intervention of Government agencies	Maity, 2017
195	Government and professional bodies'	Ononuju et al., 2016
198	End-users expectations	Maity, 2017
199	Users of the project are satisfied	Meenakshi, 2015
202	Acceptance of the project by the community	Meenakshi, 2015
203	Community involvement	Morris and Hough, 1987
49	Cost [budget]	Shokri-Ghasabeh et al., 2010
51	Preliminary estimates	Belassi and Tukel, 1996
312	Financial strength	Thote et al., 2017
313	Adequate funding	Garbharran et al., 2012
52	Estimating	Burke, 2017
58	Control of cash flow	Thote et al., 2017
62	Slow payment of completed works	Azeez ahamed and Asadi, 2017
63	Price fluctuation	Thote et al., 2017
64	Project completed within budget	Meenakshi, 2015
324	Supply chain	Talib and Hamid, 2014
165	Procurement method	Chan et al., 2004
166	Shortage of material	Thote et al., 2017
299	Top management support	Pinto and Slevin, 1988b
325	Customer-supplier relationship	Talib and Hamid, 2014
326	Schedule reliability	Talib and Hamid, 2014
327	Budget reliability	Talib and Hamid, 2014
328	Logistics integration	Talib and Hamid, 2014
329	E-commerce system quality	Talib and Hamid, 2014
151	Contract and legal agreements	Morris and Hough, 1987
104	Qualified consultant	Thote et al., 2017
147	Comprehensive contract documentation	Garbharran et al., 2012
161	Fraud	Maity, 2017
163	Influence of corruption	Azeez ahamed and Asadi, 2017
171	Bidding process (awarding a project)	Nallathiga et al., 2017
172	Tendering method	Chan et al., 2004
173	Land acquisition	Nallathiga et al., 2017
174	Approvals and clearances	Nallathiga et al., 2017
175	Awarding bids to the right project manager/ contractor	Garbharran et al., 2012
152	Dispute resolution	Nallathiga et al., 2017
220	Competence [of the project manager]	Belassi and Tukel, 1996
35	Planning (time)	Gewanlal and Bekker, 2015
93	Ethical and cultural issues	Maity, 2017
213	Project manager's performance on the job	Belassi and Tukel, 1996
223	Commitment to the project	Garbharran et al., 2012
233	Effective use of managerial skills	Belassi and Tukel, 1996
239	Emotional intelligence	Gewanlal and Bekker, 2015
242	Leadership	PMI, 2013
246	Team building	PMI, 2013
247	Motivation	PMI, 2013
248	Communication	PMI, 2013
249	Influencing	PMI, 2013
251	Decision-making and problem-solving skills	Gewanlal and Bekker, 2015
252	Political and cultural awareness	PMI, 2013
253	Negotiation	PMI, 2013
254	Trust building	PMI, 2013
255	Conflict management	PMI, 2013
256	Coaching	PMI, 2013
257	Experience [relevant to project]	Thote et al., 2017
88	Project team	Shokri-Ghasabeh et al., 2010
85	Resource availability	Shokri-Ghasabeh et al., 2010
93	Ethical and cultural issues	Maity, 2017
96	Cooperation among the project participants	Meenakshi, 2015
99	Teamwork	Thote et al., 2017
102	Inefficient site management. Poor labour productivity	Doloi et al., 2012
104	Qualified consultant	Thote et al., 2017
106	Good subcontractor	Thote et al., 2017
17	Scope	Shokri-Ghasabeh et al., 2010
19	Well defined project scope	Nallathiga et al., 2017
21	Management of variations and change orders	Meenakshi, 2015
72	Effective change management	Maity, 2017
132	External environment [Outside Project Manager's control]	Belassi and Tukel, 1996
135	Environment impacts	Shokri-Ghasabeh et al., 2010
138	Natural phenomenon	Azeez ahamed and Asadi, 2017
143	Political environment	Belassi and Tukel, 1996
156	Economical environment	Belassi and Tukel, 1996
158	Social environment	Belassi and Tukel, 1996
160	Technological environment	Belassi and Tukel, 1996
197	Unpredictable government policies and priorities	Azeez ahamed and Asadi, 2017
43	Urgency [Time imposed by Client]	Belassi and Tukel, 1996
32	Schedule (time)	Shokri-Ghasabeh et al., 2010
33	Schedule/ plans	Pinto and Slevin, 1988b
32	Schedule (time)	Shokri-Ghasabeh et al., 2010
39	Project completed on time	Meenakshi, 2015
268	Technical tasks	Pinto and Slevin, 1988b
264	Uniqueness (high technical knowledge)	Belassi and Tukel, 1996
271	Utilising up-to-date technology	Garbharran et al., 2012
272	Effective use of technology	Belassi and Tukel, 1996
275	Quality of construction project design	Ononuju et al., 2016
276	Efficiency of drainage system	Ononuju et al., 2016
278	Poor design capacity and frequent design	Azeez ahamed and Asadi, 2017
281	Meeting the specifications	Meenakshi, 2015
286	Use of good quality material	Thote et al., 2017
287	Functionality or fitness for purpose	Meenakshi, 2015
288	An excellent product to specification	Howsawi et al., 2014
76	Quality control	Thote et al., 2017

Table 3: Selection of criteria and factors from literature review

ANNEXURE B

Final conceptual framework model

Scope of project success

Scope of project management success

Indication of time	1		2		3		4	5		6		
Project stage number	**1**		**2**		**3**			**4**	**5**	**6**		
Example of stage or phase names of a project life cycle	Conception		Planning		Production			Handover	Utilisation	Closedown		(Munns and Bjeirmi, 1996)
	Conceptualisation		Planning		Execution			Termination				(Pinto and Slevin, 1988b)
	Starting the project		Organising and preparing		Carrying out the work			Ending the project				(PMI, 2017)
	Feasibility		Design and development		Execution			Commissioning and handover				(Burke, 2017)
	Project Initiation and Briefing	Concept and Feasibility	Design Development	Tender Documentation and Procurement	Construction Documentation and Management			Project Close Out				(SACPCMP, 2006)
	Inception	Concept and Viability	Design Development	Documentation and Procurement	Construction			Close-Out				(SACPCMP, 2019)
Example of interested parties/ stakeholders (not exhaustive)	Client Project manager Users Third Parties	Client Project manager Consultants Users Third Parties	Client Project manager Consultants Third Parties	Contractor	Client Project manager Consultants Contractor Producer/ Manufacturer Third Parties			Client Project manager Consultants Contractor Producer/ Manufacturer Third Parties	Client Users Third Parties	Client Third Parties		Adapted from Munns and Bjeirmi (1996) with changes.
"Group" Client related Factor	317 **Project mission [Goal]**		317 **Project mission [Goal]**		317 **Project mission [Goal]**			317 **Project mission [Goal]**	***Operations Management.***	***Operations Management.***		
	154 Business opportunity & market impact		28 Clear objectives		322 Clearly identified tangible benefits carried out.			316 Tangible benefits for the organisation	Not part of project management scope	Not part of project management scope		
	294 Clear project definition; sound business case		320 A realistic goal [and timeline]					306 Economic benefits to the owner	Servicing	Tangible benefits for the organisation		
	28 Clear objectives							295 Client/ sponsor brief-achievement of intended outcomes	Maintenance			
	320 A realistic goal [and timeline]								Contractor liability period	Economic benefits (profitability) to the owner		
	295 Client/ sponsor brief-achievement of intended outcomes								External environment			
									Warrantees and Guarantees in place	Client/ sponsor brief-achievement of intended outcomes		
Organisation related Factor	299 **Top management support**		299 **Top management support**		299 **Top management support**			299 **Top management support**				
	301 Top management (or sponsor) support and commitment, appropriately engaged.		301 Top management (or sponsor) support and commitment, appropriately engaged.		301 Top management (or sponsor) support and commitment, appropriately engaged.			301 Top management (or sponsor) support and commitment, appropriately engaged.				
	80 Continuous improvement of business, project and support processes		80 Continuous improvement of business, project and support processes		80 Continuous improvement of business, project and support processes			80 Continuous improvement of business, project and support processes				
Organisation related Factor	302 **Project organisational structure**		302 **Project organisational structure**		302 **Project organisational structure**							
	23 Project size and value		23 Project size and value		23 Project size and value							
	6 Employ an effective project management process		323 Project management organisational understanding and competence in project management		323 Project management organisational understanding and competence in project management							
	7 Project management control and execution systems in place											
	323 Project management organisational understanding and competence in project											

Final conceptual framework model (continued)

Integration and Risk related Factor	3	**Monitoring and feedback**		3	**Monitoring and feedback**		3	**Monitoring and feedback**		3	**Monitoring and feedback**				
		8	Effective planning and control		8	Effective planning and control		8	Effective planning and control		8	Effective planning and control			
		9	Effective control & monitoring		9	Effective control & monitoring		9	Effective control & monitoring		9	Effective control & monitoring			
		126	Project risk management		125	Risk management and mitigation of risk		130	Health, safety and zero accidents		126	Project risk management			
								125	Risk management and mitigation of risk						
Communication related Factor	109	**Communication**		109	**Communication**		109	**Communication**		109	**Communication**				
		113	Effective coordination & communication		113	Effective coordination & communication		113	Effective coordination & communication		119	Client consultation & acceptance			
		119	Client consultation & acceptance		117	Frequent project meetings		117	Frequent project meetings		113	Effective coordination & communication			
					118	Response time		118	Response time						
					119	Client consultation & acceptance		119	Client consultation & acceptance						
					309	Poor site coordination- Slow decision from owner		309	Poor site coordination- Slow decision from owner						
Stakeholder related Factor	178	**Stakeholder**		178	**Stakeholder [Except end user]**		178	**Stakeholder [Except end user]**		178	**Stakeholder [Except end user]**				
		180	Effective stakeholder engagement [includes identification]		179	Stakeholder satisfaction		179	Stakeholder satisfaction		179	Stakeholder satisfaction			
					184	Client's emphasis, ability & contribution		184	Client's emphasis, ability & contribution		185	Client satisfaction			
					185	Client satisfaction		185	Client satisfaction		190	Sub-contractors			
					188	Competitors		190	Sub-contractors		193	Intervention of Gov. agencies			
					190	Sub-contractors		193	Intervention of Gov. agencies		195	Government and professional bodies' regulations			
					193	Intervention of Gov. agencies		195	Government and professional bodies' regulations						
					195	Government and professional bodies' regulations									
Stakeholder related Factor				198	**End-users expectations**		198	**End-users expectations**		198	**End-users expectations**				
					199	Users of the project are satisfied		203	Community involvement		199	Users of the project are satisfied			
					203	Community involvement					202	Acceptance of the project by the community			
					202	Acceptance of the project by the community									
Cost related Factor	49	**Cost [budget]**		49	**Cost [budget]**		49	**Cost [budget]**							
		51	Preliminary estimates		52	Estimating		58	Control of cash flow						
		313	Adequate funding		313	Adequate funding		63	Price fluctuation						
		312	Financial strength [ability to pay]		312	Financial strength [ability to pay]		64	Project completed within budget						
								313	Adequate funding						
								62	Slow payment of completed works						
								312	Financial strength [ability to pay]						
Procurement related Factor	324	**Supply chain**		324	**Supply chain**		324	**Supply chain**							
		165	Procurement method		165	Procurement method		165	Procurement method						
		299	Top management support		329	E-commerce system quality		329	E-commerce system quality						
					299	Top management support		299	Top management support						
					325	customer-supplier relationship		325	customer-supplier relationship						
					326	schedule reliability		326	schedule reliability						
					327	budget reliability		327	budget reliability						
					328	logistics integration		328	logistics integration						
					166	Shortage of material		166	Shortage of material						
Governance related Factor	151	**Contract and legal agreements**		151	**Contract and legal agreements**		151	**Contract and legal agreements**							
		163	Influence of corruption		163	Influence of corruption		163	Influence of corruption						
		104	Qualified consultant		174	Approvals and clearances		152	Dispute resolution						
		173	Land acquisition		171	Bidding process (awarding a project)		161	Fraud						
		172	Tendering method		172	Tendering method		147	Comprehensive contract documentation						
		161	Fraud		161	Fraud									
		175	Awarding bids to the right project manager		175	Awarding bids to the right contractor									

Final conceptual framework model (continued)

Project manager related Factor	220	**Competence [of the project manager]**	220	**Competence [of the project manager]**	220	**Competence [of the project manager]**					
	223	Commitment to the project	223	Commitment to the project	223	Commitment to the project					
	233	Effective use of managerial skills	233	Effective use of managerial skills	233	Effective use of managerial skills					
	239	Emotional intelligence	239	Emotional intelligence	239	Emotional intelligence					
	242	Leadership	242	Leadership	242	Leadership					
	246	Team building	246	Team building	248	Communication					
	247	Motivation	247	Motivation	249	Influencing					
	248	Communication	248	Communication	252	Political and cultural awareness					
	249	Influencing	249	Influencing	253	Negotiation					
	252	Political and cultural awareness	252	Political and cultural awareness	254	Trust building					
	253	Negotiation	253	Negotiation	255	Conflict management					
	254	Trust building	254	Trust building	257	Experience					
	255	Conflict management	255	Conflict management							
	256	Coaching	256	Coaching							
	257	Experience [relevant to project]	257	Experience [relevant to project]							
	35	Planning (time)	35	Planning (time)							
	93	Ethical and cultural issues	93	Ethical and cultural issues							
	251	Decision-making and problem-solving skills	251	Decision-making and problem-solving skills							
	213	Project manager's performance on the job	213	Project manager's performance on the job							
Human resources related Factor	88	**Project team [Human Resources]**	88	**Project team [Human Resources]**							
	85	Resource availability	85	Resource availability							
	93	Ethical and cultural issues	93	Ethical and cultural issues							
	99	Teamwork	99	Teamwork							
	104	Qualified consultant	106	Good subcontractor							
	96	Cooperation among the project participants	104	Qualified consultant							
			96	Cooperation among the project participants							
			102	Inefficient site management. Poor labour productivity							
Scope related Factor	17	**Scope**	17	**Scope**							
	19	Well defined project scope	72	Effective [scope] change management							
	72	Effective [scope] change management	21	Management of variations and change orders							
Exogenous related Factor	132	**External environment [Outside Project Manager's control]**	132	**External environment [Outside Project Manager's control]**							
	135	Environment impacts	135	Environment impacts							
	138	Natural phenomenon	138	Natural phenomenon							
	143	Political environment	143	Political environment							
	156	Economical environment	156	Economical environment							
	158	Social environment	158	Social environment							
	160	Technological environment	160	Technological environment							
	197	Unpredictable government policies and priorities	197	Unpredictable government policies and priorities							
Time related Factors	43	**Urgency [Time imposed by Client]**	33	**Schedule/ plans**							
	32	Schedule (time)	32	Schedule (time)							
			39	Project completed on time							
Quality and Design related Factor	268	**Technical tasks [Technology and Design]**	268	**Technical tasks [Technology and Design]**							
	271	Utilising up-to-date technology	272	Effective use of technology							
	275	Quality of construction project design	288	An excellent product to specification							
	287	Functionality/fitness for purpose	286	Use of good quality material							
	278	Poor design capacity and frequent design changes	76	Quality control							
			281	Meeting the specifications							
	264	Uniqueness (requires high technical knowledge)	276	Efficiency of drainage system							
			278	Poor design capacity and frequent design changes							
			264	Uniqueness (requires high technical knowledge)							

Figure 2: Conceptual framework

ANNEXURE C

The key role-players' influence after the final round of survey.

								Likert Scale Used For Rating 0= not applicable, 1= not influential, 2= slightly influential, 3= moderately influential, 4= very influential, 5= extremely influential											
								Client/ Employer			**Project Manager or Lead Consultant**			**Contractor**			**Client/ Employer**	**Project Manager or Lead Consultant**	**Contractor**
								e.g. • Client project management office (strategic, monitoring and governance functions)			e.g. • Construction project manager (SACPCMP) • Project manager (PROCSA)			e.g. • Construction manager					
								NB. Contracts with consultant/s and contractor/s			*NB. Responsible for management of related professional services*			*NB. Responsible for construction but not responsible for design*					
No.	**Project Stage (as per Conceptual Framework)**					**Stage or Phase name (as per Burke, 2017)**	**Ref no.**	**Critical Factor**	**Average Rating of Survey Population**	Standard Deviation of Survey Population	**Rank of influence (within stage)**	**Average Rating of Survey Population**	Standard Deviation of Survey Population	**Rank of influence (within stage)**	**Average Rating of Survey Population**	Standard Deviation of Survey Population	**Rank of influence (within stage)**	Rank of influence (each role-player)	Rank of influence (each role-player)	Rank of influence (each role-player)
1	1					Feasibility	317	**Project mission [Goal]**	4.8	0.4	1	3.3	0.4	2	0.3	0.4	3	1	45	47
2		2				Design and development	317	**Project mission [Goal]**	3.9	0.8	2	4.0	0.9	1	0.5	0.5	3	15	28	39
3			3			Execution	317	**Project mission [Goal]**	2.9	0.6	3	4.8	0.4	1	3.5	0.5	2	30	1	17
4				4		Commissioning and handover	317	**Project mission [Goal]**	3.0	0.9	3	4.1	0.6	1	3.9	0.8	2	27	24	15
5	1					Feasibility	299	**Top management support**	4.6	0.5	1	3.3	0.8	2	0.6	0.9	3	3	45	33
6		2				Design and development	299	**Top management support**	4.0	0.9	1	3.5	0.9	2	0.4	0.5	3	10	41	45
7			3			Execution	299	**Top management support**	2.8	0.7	2	3.9	0.8	1	2.4	0.7	3	36	33	20
8				4		Commissioning and handover	299	**Top management support**	3.0	0.9	2	3.5	0.9	1	2.3	0.7	3	27	41	21
9	1					Feasibility	302	**Project organisational structure**	3.8	0.8	2	3.9	0.8	1	0.5	0.5	3	18	33	39
10		2				Design and development	302	**Project organisational structure**	3.5	0.9	2	4.5	0.7	1	0.5	0.5	3	19	7	39
11			3			Execution	302	**Project organisational structure**	2.9	0.8	3	4.4	0.7	1	3.5	0.5	2	30	13	17
12	1					Feasibility	3	**Monitoring and feedback**	4.0	0.9	2	4.1	0.8	1	0.6	0.7	3	10	24	33
13		2				Design and development	3	**Monitoring and feedback**	4.0	0.9	2	4.4	0.7	1	0.6	0.7	3	10	13	33
14			3			Execution	3	**Monitoring and feedback**	3.4	0.5	3	4.6	0.5	1	4.3	0.7	2	20	3	5
15				4		Commissioning and handover	3	**Monitoring and feedback**	3.3	0.7	3	4.5	0.5	2	4.8	0.4	1	22	7	1
16	1					Feasibility	109	**Communication**	4.3	0.8	1	4.0	0.9	2	0.5	0.7	3	8	28	39
17		2				Design and development	109	**Communication**	3.9	0.8	2	4.5	0.7	1	0.6	0.7	3	15	7	33
18			3			Execution	109	**Communication**	3.0	0.5	3	4.6	0.5	1	4.6	0.5	1	27	3	3
19				4		Commissioning and handover	109	**Communication**	3.1	0.6	3	4.5	0.5	2	4.6	0.5	1	24	7	3
20	1					Feasibility	178	**Stakeholder**	4.5	0.7	1	3.4	0.5	2	0.4	0.5	3	5	43	45
21		2				Design and development	178	**Stakeholder [except end user]**	3.3	0.8	2	3.4	0.7	1	0.8	0.8	3	22	43	30
22			3			Execution	178	**Stakeholder [except end user]**	2.5	0.9	3	4.0	0.7	2	4.1	0.8	1	40	28	9
23				4		Commissioning and handover	178	**Stakeholder [except end user]**	2.4	0.7	3	3.9	0.8	2	4.0	0.9	1	43	33	12
24		2				Design and development	198	**End-users expectations**	4.5	0.7	1	3.9	0.8	2	0.5	0.7	3	5	33	39
25			3			Execution	198	**End-users expectations**	3.1	0.8	3	4.0	0.7	1	3.9	0.8	2	24	28	15
26				4		Commissioning and handover	198	**End-users expectations**	2.5	1.2	3	3.9	0.8	2	4.0	0.9	1	40	33	12
27	1					Feasibility	49	**Cost [budget]**	4.6	0.5	1	3.9	0.8	2	1.0	0.9	3	3	33	27
28		2				Design and development	49	**Cost [budget]**	4.0	0.7	2	4.1	0.8	1	0.6	0.7	3	10	24	33
29			3			Execution	49	**Cost [budget]**	3.4	0.7	3	4.3	0.8	1	4.3	0.7	1	20	19	5
30	1					Feasibility	324	**Supply chain**	2.9	0.6	2	3.9	0.8	1	0.8	0.8	3	30	33	30
31		2				Design and development	324	**Supply chain**	2.9	0.3	2	4.3	0.8	1	0.9	0.8	3	30	19	28
32			3			Execution	324	**Supply chain**	2.3	0.8	3	4.1	0.8	2	4.3	0.7	1	44	24	5
33	1					Feasibility	151	**Contract and legal agreements**	4.1	0.8	2	4.3	0.8	1	0.9	0.9	3	9	19	28
34		2				Design and development	151	**Contract and legal agreements**	4.0	0.9	2	4.5	0.7	1	1.5	0.7	3	10	7	24
35			3			Execution	151	**Contract and legal agreements**	2.9	0.8	3	4.6	0.5	1	4.1	0.9	2	30	3	9
36		2				Design and development	220	**Competence [of the project manager]**	3.1	0.8	2	4.5	0.7	1	0.3	0.4	3	24	7	47
37			3			Execution	220	**Competence [of the project manager]**	2.0	0.9	3	4.8	0.4	1	2.0	0.5	3	45	1	22
38				4		Commissioning and handover	220	**Competence [of the project manager]**	1.0	0.7	3	4.3	0.7	1	2.0	0.7	2	48	19	22
39		2				Design and development	88	**Project team [Human Resources]**	3.9	0.9	2	4.3	0.8	1	0.6	0.7	3	15	19	33
40			3			Execution	88	**Project team [Human Resources]**	2.8	0.7	3	4.4	0.9	1	4.1	0.8	2	36	13	9
41		2				Design and development	17	**Scope**	4.5	0.7	1	4.4	0.7	2	0.5	0.7	3	5	13	39
42			3			Execution	17	**Scope**	2.5	1.2	3	4.4	0.9	1	4.0	0.7	2	40	13	12
43		2				Design and development	132	**External environment [Outside project manager's control]**	2.9	0.6	1	2.1	0.9	2	0.8	1.0	3	30	48	30
44			3			Execution	132	**External environment [Outside project manager's control]**	2.8	0.4	3	2.8	0.7	3	3.0	0.7	1	36	47	19
45		2				Design and development	43	**Urgency [Time imposed by Client]**	4.8	0.4	1	4.4	0.9	2	1.3	0.7	3	1	13	26
46			3			Execution	33	**Schedule/ plans**	2.8	0.8	3	4.6	0.5	2	4.8	0.4	1	36	3	1
47		2				Design and development	268	**Technical tasks [Technology and Design]**	1.9	0.6	2	3.8	0.8	1	1.4	0.7	3	46	40	25
48			3			Execution	268	**Technical tasks [Technology and Design]**	1.5	0.9	3	4.0	0.9	2	4.3	0.8	1	47	28	5

Table 6: Average ratings of influence, standard deviation and rankings