Determinants of Professional Service Output Quality in the South African Construction Industry

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Declaration

I declare that this thesis is my own unaided work. It is being submitted for the Degree of Doctor of Philosophy to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

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Date: 12 January 2024

Abstract

The debate regarding the relationship between fees and the quality of professional services in the construction industry has persisted since the 1980s. In the South African context, members of professional industry bodies have strongly suggested that the declining quality of professional service outputs (PSOs) in the construction industry is due to low fees. While various studies in the construction literature have asserted that low or "discounted" fees are one of the main factors influencing the quality of PSOs, other studies have rejected this assertion. However, a comprehensive investigation into the major built environment professions, aimed at identifying and evaluating various factors influencing PSO quality, as well as understanding how and to what extent quality is specifically influenced by fees, is notably absent from the construction literature. To address this gap, a three-stage research design was employed. This design included an industry-wide survey with 604 participants, a survey of nine industry experts averaging 38 years of experience, and case studies conducted with seven built environment consulting companies. The data analysis involved a combination of content analysis, descriptive analysis, and thematic analysis. The study revealed nuances in the key factors influencing PSO quality across various built environment professions. While fees were identified as a key factor influencing PSO quality, other key factors, such as the time required to produce PSOs, experience, available information, and project briefs, were also identified. This highlights the need for project stakeholders to effectively manage professional fees in conjunction with these other key factors to ensure the quality of PSOs is not diminished. The findings of this study provide both clients and professionals with the knowledge to navigate the complex interplay between fees and PSO quality, ultimately fostering more successful and efficient projects.

Keywords: Fees, Quality, Professional Services, Construction Industry

Publications

The following research papers were published during this study:

1. Laryea, S., Watermeyer. R. and Govender, N. (2021). *The influence of fees on the quality of professional services in South Africa*. Proceedings of the Institution of Civil Engineers - Management, Procurement and Law, 174(4):163-173. DOI: https://doi.org/10.1680/jmapl.20.00022.

2. Govender, N., Laryea, S. and Watermeyer. R. (2022). *A framework for assessing quality of tender documents*. Built Environment Project and Asset Management, 12(4):573-589. DOI: https://doi.org/10.1108/BEPAM-07-2021-0094.

3. Govender, N., Laryea, S. and Watermeyer. R. (2022). *Conceptual research methodology to investigate the relationship between fees and quality of professional service outputs*. Journal of Engineering, Design and Technology, Ahead of print. DOI: https://doi.org/10.1108/JEDT-11-2021-0629.

4. Govender, N., Laryea, S., Watermeyer, R. (2023). *Implications of competitive tendering on consulting engineering services in South Africa: a thematic analysis*. Journal of Financial Management of Property and Construction, Ahead-of-print. DOI: https://doi.org/10.1108/JFMPC-06-2022-0029.

5. Govender, N., Laryea, S., Watermeyer, R. (2023). *Price Tendering in the South African Consulting Engineering Industry*. In: Lindahl, G., Gottlieb, S.C. (eds) SDGs in Construction Economics and Organization. CREON 2022. Springer Proceedings in Business and Economics. Springer, Cham. DOI: https://doi.org/10.1007/978-3-031-25498-7_24

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List of Acronyms

ASAQS	Association of South African Quantity Surveyors
BIM	Building Information Modelling
BoQ	Bill of Quantities
CESA	Consulting Engineers South Africa
CPM	Construction Project Manager
DSO	Dam Safety Office
ECSA	Engineering Council of South Africa
FIDIC	International Federation of Consulting Engineers
ISO	International Organisation for Standardisation
MV	Medium Voltage
Pr	Professional
PSO	Professional Service Output
QC	Quality Control
SACAP	South African Council for the Architectural Profession
SACPCMP	South African Council for the Project and Construction Management Professions
SACQSP	South African Council for the Quantity Surveying Profession
SAIA	South African Institute of Architects
SAICE	South African Institution of Civil Engineering
SAIEE	South African Institute of Electrical Engineers
SAIMechE	South African Institution of Mechanical Engineering
UK	United Kingdom
USA	United States of America
VAT	Value Added Tax

Chapter 1: Introduction

1.1 Background to the Study

Infrastructure projects play a crucial role in fostering development and driving economic growth, especially in developing countries (Turin, 1973; Wells, 1987). Built environment professionals render professional services in the construction industry that are critical for the successful delivery of infrastructure projects (Winch *et al.*, 1998; Watermeyer, 2020). As part of their professional services, built environment professionals produce professional service outputs (PSOs) such as design documentation, drawings, project specifications and bills of quantities (BoQ) that are used by clients and contractors (ECSA, 2011; Watermeyer, 2020). Various authors (Burati *et al.*, 1992; Abdel-Razek, 1998; Andi and Minato, 2003; Love *et al.*, 2006; Oyedele and Tham, 2007; Slater and Radford, 2012; Philips-Ryder *et al.*, 2013) found that poor-quality PSOs (e.g., design and project documentation) have negative impacts on construction project outcomes such as construction durations and costs. This highlights the importance of producing good-quality PSOs.

Several studies assessing factors influencing the quality of PSOs were conducted in Australia, Ghana, Japan, Nigeria, Saudi Arabia, South Africa and Syria. Some of the key factors identified in the studies included low fees (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Zidan, 2013; Akampurira and Windapo, 2018; Abu Fatawu *et al.*, 2020), insufficient time to produce design documents (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Zidan, 2013; Dosumu *et al.*, 2017; Akampurira and Windapo, 2018), last-minute or frequent changes by clients (Darwish, 2005; Zidan, 2013; Dosumu *et al.*, 2017; Abu Fatawu *et al.*, 2020), lack of available documents or information (Zidan, 2013; Abu Fatawu *et al.*, 2020) and designer experience (Dosumu and Iyagba, 2013). Clearly, low fees are one of many factors influencing the quality of PSOs. The prominence of fees in previous studies suggests it is a key factor. However, other studies in the construction literature failed to establish a relationship between fees and the quality of professional services or project success (Hoxley, 2000; Phua, 2005; Wimalasiri *et al.*, 2010; Sporrong, 2011; Awolesi and Ayedun, 2012; Cirelli, 2017; Marisa and Yusof, 2020). The strong interest in fees as a key determinant of quality requires further examination.

Professional fees are remuneration provided by clients to built environment professionals for professional services, which are usually executed as part of a professional services contract. The capital costs of construction projects are generally used as a benchmark for built

environment professional fees. Publication of historical fees to guide clients and consultants on the suitability of professional fees is also a global norm. In the United Kingdom (UK), historical data (usually not more than two years old) from different types of construction projects are used to develop typical curves illustrating professional fees for various types of construction projects.

Historically, in South Africa, professional fees have been gazetted and regulated by statutory councils for the various built environment professionals through the publication of recommended fees in the form of fee guidelines. Figure 1 shows the professional fee curve used by consulting engineers in South Africa. The two curves provide an upper and a lower limit for professional fees. The professional fee is guided by the capital cost of works, with an appropriate fee typically being between the upper and lower limits. Several factors such as level of effort, risk, liability, and complexity may influence the professional fee (ECSA, 2021). A similar method to determine professional fees is used by other built environment professions. However, they use a single curve instead of multiple curves. Figure 2 illustrates an average plot of fee curves between 2011 and 2013 from the various built environment professional councils in South Africa.

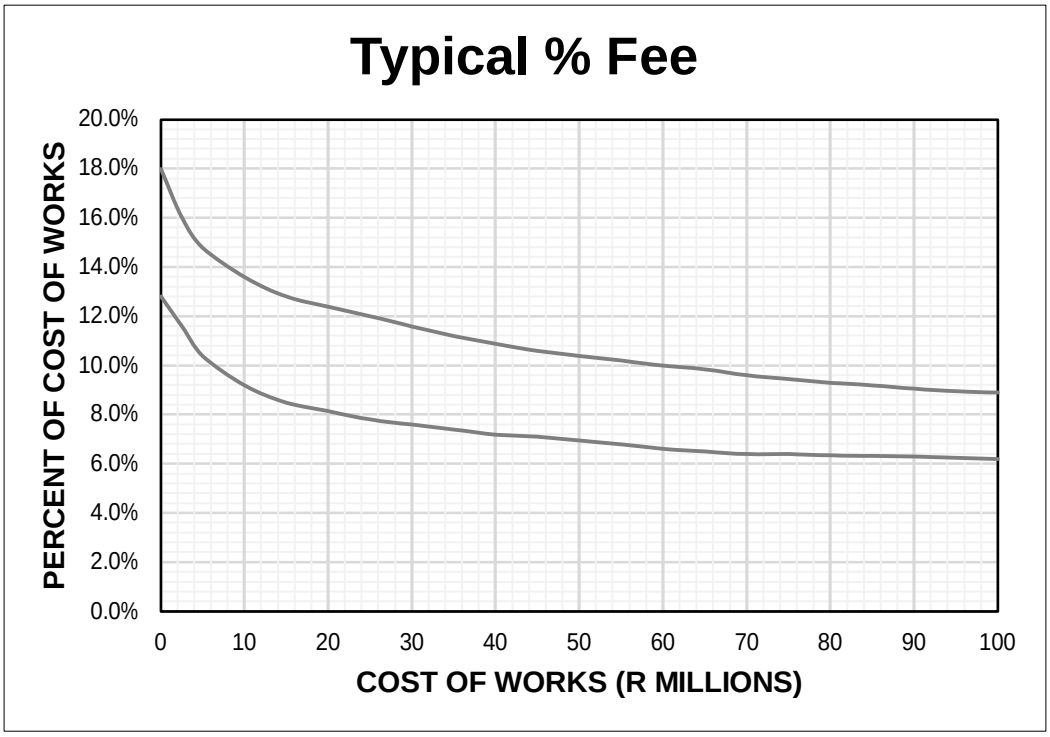


Figure 1: Remuneration for consulting engineering services based on the cost of works (Source: ECSA (2011))

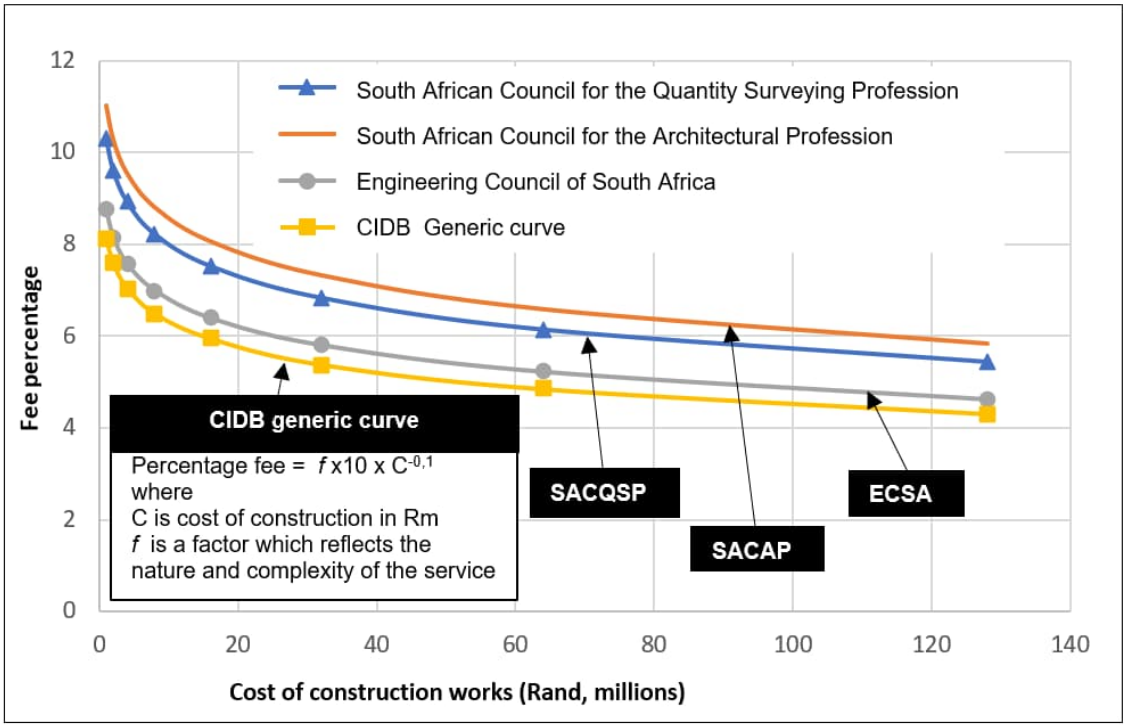


Figure 2: Comparative historic basic fee percentage curves published by the built environment professional councils from 2011 to 2013

Built environment professional councils provide no rationale or scientific evidence associated with the setting or adjustment of fees as illustrated in fee curves. Therefore, fee curves may be considered arbitrary as no evidence to justify using them as a benchmark is available. The continued use of a recommended fee scale is also questionable since most clients generally insist on a systematic breakdown of prices and place emphasis on procuring services that represent value for money.

In practice, variables at organisational, industry and project levels contribute to the level of fee tendered by built environment consulting companies. Firstly, at an organisational level, variables such as overhead costs, utilisation rates and profit markup influence the level of fee charged (DPSA, 2013). Secondly, at an industry level, the amount of competition and availability of projects influence the level of fees. Lastly, at a project level, the size, complexity and level of effort required contribute to the fee charged (ECSA, 2011). The influence and quantum of variables that contribute to professional fees differ among consulting companies, which results in varying levels of fees. This makes it difficult to determine an "appropriate" level of fee that should be used as a benchmark in industry and research.

In 2016, the Competition Commission of South Africa ruled that the publication of fee guidelines restricts competition and results in indirect price fixing (CCSA, 2016). The finding

by the Competition Commission followed international best practices whereby many other countries have moved away from using published or recommended fees to price professional services. The ruling to suspend fee scales in the South African context is relatively recent when compared to events internationally.

Internationally, the abolition of fee scales and the introduction of competitive bidding facilitated increased competition, leading to a decline in fees. The phenomenon of abolishing fee scales began in Europe in the 1980s with the UK being one of the first countries to abolish fee scales. The rest of Europe gradually followed after a report commissioned by the European Union (EU) entitled Report on Competition in Professional Services (2004) found that recommended prices negatively influenced competition. The report emphasised that professional fee scales of various professions (including architects, other built environment professionals and lawyers) were already abolished in regions such as Finland, France and the UK. Germany was one of the last countries in the EU opposed to abolishing fee scales for built environment professionals (particularly architects and engineers). However, in 2019, a court judgement by the Court of Justice of the European Union (CJEU) rejected contentions by the German government that fee scales protect consumers and safeguard quality (Laryea *et al.*, 2021). The CJEU found that the use of fee scales in Germany was contradictory to EU law.

Following the Competition Commission of South Africa ruling, there has been increased interest in the South African construction industry around the issue of fees and their influence on the quality of PSOs.

1.2 Substantiation of the Problem

The construction literature contains studies that both support and reject the notion that low fees are detrimental to PSO quality. Studies conducted in Saudi Arabia (Bubshait *et al.*, 1998; Darwish, 2005), Australia (Tilley and McFallan, 2000), Japan (Andi and Minato, 2003), the United States of America (USA) (Gransberg *et al.*, 2007), Syria (Zidan, 2013), Austria (Bauer and Heck, 2015) and Ghana (Abu Fatawu *et al.*, 2020) all suggest that low fees are one of the primary factors adversely impacting PSO quality. However, there is also evidence asserting that other factors apart from professional fees are key factors contributing to PSO quality. Studies conducted in the UK (Hoxley, 2000; Wimalasiri *et al.*, 2010), Hong Kong (Phua, 2005), Sweden (Sporrong, 2011), Nigeria (Awolesi and Ayedun, 2012), the USA (Cirelli, 2017) and Indonesia (Marisa and Yusof, 2020) all suggest that other factors (e.g., experience, competence and professionalism) have a greater impact on PSO quality compared to fees.

In the South African context, Malinda (2017), Moos (2017), Okonkwo and Wium (2018) and Akampurira and Windapo (2018) published studies following the Competition Commission's decision to suspend the publication of fee tariffs. All the studies posited that low fees were one of the primary factors responsible for the deteriorating quality of professional services. An earlier study in the South African context, conducted by Liebenberg and Wilson (2011), also suggested that the quality of professional services was adversely influenced by low fees. A recent study by Laryea *et al.* (2021) challenged the prevailing view in the South African construction industry that low fees adversely impact the quality of professional services. The study used construction project outcomes (e.g., time, cost and quality during construction) associated with constructed infrastructure at two new universities to examine the relationship between fees and the quality of professional services. The study found that fees were not a key determinant of the quality of professional services. Despite the study by Laryea *et al.* (2021), there is overwhelming evidence in the South African construction literature supporting the assertion that quality is negatively impacted by low fees. However, previous studies lacked academic rigour and used simplistic methodologies. Therefore, they cannot be used as reliable sources to explain the complex relationship between fees and quality.

Evidence in studies by Hoxley (2000), Wimalasiri *et al.* (2010), Phua (2005), Sporrong (2011), Awolesi and Ayedun (2012), Cirelli (2017) and Marisa and Yusof (2020) and rulings by various competition bodies contradicts the assertion in local (Liebenberg and Wilson, 2011; Malinda, 2017; Moos, 2017; Okonkwo and Wium, 2018; Akampurira and Windapo, 2018) and international (Bubshait *et al.*, 1998; Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Gransberg *et al.*, 2007; Zidan, 2013; Bauer and Heck, 2015; Abu Fatawu *et al.*, 2020) construction literature that low fees adversely impact PSO quality. Studies both supporting and refuting this notion employed simplistic methodologies that did not fully explain how and to what extent the quality of PSOs is specifically influenced by fees. The studies also failed to fully define and investigate the complex array of key variables influencing the quality of PSOs. Therefore, there is still uncertainty about the existence of a direct relationship between fees and the quality of PSOs.

Literature from other major professions (e.g., medicine, law and finance) was sourced to determine if similar studies investigated the deterioration in the quality of services due to low fees. Only the finance profession significantly investigated the influence of low fees (arising from market competition) on the quality of professional services (mainly auditing services). Studies conducted in the finance profession contained findings that both support (Hoitash *et*

al., 2007; Suseno, 2013) and reject (Climent-Serrano *et al.*, 2018; Salehi *et al.*, 2019; Chen *et al.*, 2018) the notion that the quality of professional services is adversely influenced by low fees. The research in the finance profession highlights that the debate around fees and the quality of professional services is not limited to the construction sector.

From a theoretical perspective, the influence of low fees on quality can be examined using motivation theory. Studies involving motivation theory assessed the influence of various incentives (including financial incentives) on people's performance. Although performance and quality are two different concepts, it can be argued that job performance in a professional environment is a function of producing good-quality outputs and services. The literature provides compelling evidence suggesting that financial incentives improve both performance and motivation (Jenkins *et al.*, 1998; Condly *et al.*, 2003; Garbers and Konradt, 2014). However, in the context of this study, other factors (e.g., competence and using adequate project resources) must be satisfied as a pre-requisite for financial incentives to improve performance. Furthermore, most of the studies around motivation theory failed to include professionals in performance experiments and generally used students or non-professional employees as participants. Another key difference between previous experiments and the built environment profession relates to the distribution of incentives. In the experiments, incentives were given directly to participants. However, in the built environment, professional fees or financial incentives are paid directly to companies. Companies then pay salaries and bonuses (depending on profitability) to their employees. Nonetheless, the influence of fees or financial incentives on the performance of professionals is particularly concerning when considering principles related to professionalism. Built environment professional councils in South Africa address professionalism in their respective codes of conduct. For example, the ECSA Code of Conduct for Registered Persons asserts "that registered persons must not undertake work under conditions or terms that would compromise their ability to carry out their responsibilities in accordance with the norms of the profession" (ECSA, 2017). This implies that a professional should not agree to undertake work for a low fee if it will compromise the quality of the output. Considering the principles of professionalism, professionally registered persons undertaking projects and rendering sub-standard quality services due to low fees conflict with norms and standards expected from a true professional. Therefore, claims that low fees adversely impact PSO quality may not be valid when examined using the theory of professionalism.

To date, a comprehensive study of the relationship between fees and PSO quality has not been conducted. An in-depth investigation into factors influencing the quality of PSOs is required

to identify key variables that may influence the relationship between fees and PSO quality. This will inform an extensive investigation into how and to what extent PSO quality is specifically determined by fees.

1.3 Problem Statement

Built environment professionals and several researchers assert that low professional fees are one of the primary factors causing poor-quality PSOs in the construction industry. Built environment professionals in various studies, particularly in the South African context, use low fees to legitimise poor-quality PSOs. However, there is no comprehensive understanding of key factors influencing PSO quality and how and to what extent PSO quality is specifically influenced by fees.

1.4 Primary Research Question

The primary research question is stated below:

What are the key determinants of PSO quality in the South African construction industry and how and to what extent is quality specifically influenced by the level of fees charged by built environment professionals?

1.5 Secondary Research Questions

The secondary research questions are provided below:

- What are the key factors influencing PSO quality?
- What is the significance of key factors influencing PSO quality among different built environment disciplines in the South African construction industry?
- How and to what extent does the level of fees charged by built environment professionals influence PSO quality?

1.6 Research Aim

This research aims to identify and evaluate key determinants of PSO quality and specifically examine the influence of fees on the quality of PSOs produced by built environment professionals.

1.7 Research Objectives

The research objectives are outlined below:

- To identify and evaluate the key factors influencing PSO quality.

- To examine the significance of the key factors influencing PSO quality among different built environment disciplines in the South African construction industry.
- To critically examine how and to what extent the level of fees charged by built environment professionals influences PSO quality.

1.8 Brief Overview of Research Design

Considering the complexity and nature of the primary and secondary research questions, a mixed-method approach (primarily qualitative) was identified as an appropriate methodological framework to help answer the research questions. Due to the complexity of the research questions, a three-stage research design was used. This involved a combination of survey and case study research strategies. The rationale for the three-stage research design was to ensure that the research questions were comprehensively answered and that the study contained strong validity and reliability. An illustration of the three-stage research design is provided in Figure 3.

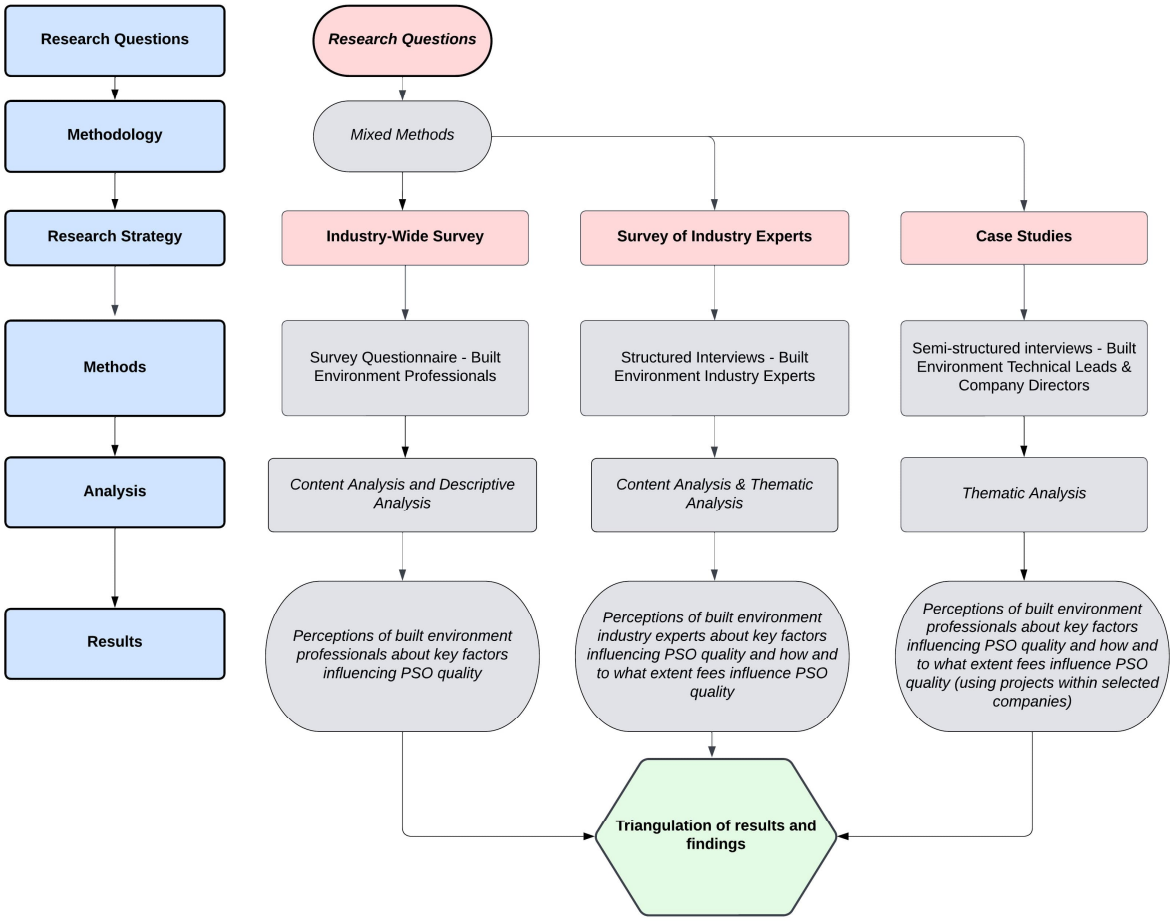


Figure 3: Illustration of three-stage research design

The first stage of the research design included an online industry-wide survey. Care was taken to ensure that only participants with requisite knowledge and experience producing PSOs were included in the survey. The survey was divided into two sections. The first section contained an open-ended question asking built environment professionals to identify key factors influencing the quality of PSOs based on their experience. Participants provided factors in either list format or narrative format, which included motivation for the key factors they selected. Data from the first section of the survey were analysed using content analysis. The subsequent sections of the survey included Likert scale questions asking participants to indicate their level of agreement with various factors influencing the quality of PSOs. Factors were extracted from the construction management literature and divided into client, professional, company and industry factors. A descriptive analysis of the Likert scale data was conducted.

The second stage of the research design included a survey of industry experts that used structured interviews as the research method and data collection technique. Nine interviews were undertaken with industry experts with an average of 38 years of experience. All built environment disciplines forming part of the study were represented during the survey of industry experts. Data from the interviews were analysed using a combination of content and thematic analysis.

Lastly, case studies were conducted in seven built environment consulting companies. Three projects from each company were evaluated to determine the key factors influencing the quality of PSOs and how and to what extent fees influenced the quality of PSOs. The key factors were informed by interviews with the project technical lead and senior director in each company. Data from case studies were analysed using thematic analysis.

1.9 Scope of the Study

The nature of the research question necessitated the inclusion of built environment professionals with experience producing PSOs. Importantly, all participants in the study were professionally registered with their respective built environment professional councils. Being professionally registered suggests that these participants were technically competent and had a firm understanding of the requirements to produce good-quality PSOs. Several built environment disciplines formed part of the study, including architects, civil/structural engineers, electrical engineers, mechanical engineers and quantity surveyors.

The examination of quality was limited to PSOs used by contractors during construction (i.e., BoQ, drawings and technical specifications). Good-quality PSOs are critical for construction

projects to be delivered on time and within budget. Therefore, the quality examination was limited to construction PSOs.

The geographic scope of the data collection was limited to South Africa.

1.10 Thesis Structure

This thesis contains six chapters; a brief description of each chapter is provided below.

- Chapter 1: Introduction

Chapter 1 provides an outline of the study along with introductory remarks. The chapter begins with the background of the study and substantiation of the problem. This is followed by the problem statement, research questions, aims and objectives. An overview of the research design is then discussed, followed by the scope of the study. The chapter concludes with the thesis structure.

- Chapter 2: Literature Review

Chapter 2 includes the literature review that was undertaken as part of this study. The chapter commences by defining the concept of quality. This is followed by an examination of previous studies on factors impacting design or document quality. A review of the literature assessing the relationship between fees and the quality of professional services from an international and South African perspective was then conducted. Additionally, a methodological appraisal of previous studies investigating the impact of fees on PSO quality was conducted. Motivation theory and the theory of professionalism were then explored as potential theoretical underpinnings for this study. The chapter concludes with the boundary of existing findings and gaps in the literature that need to be addressed.

- Chapter 3: Research Design and Methods

Chapter 3 commenced by exploring the context of the research design, which used the research onion by Saunders *et al.* (2019) as a guiding framework. A three-stage research design was proposed that suitably matched the complexity of the research problem. The research design was comprehensively described and justified using the key components presented in the research onion. The chapter concludes with ethical considerations relevant to this study.

- Chapter 4: Data collection, presentation, analyses and results

Chapter 4 outlines the data collected and presents and analyses results from the industry-wide survey, survey of industry experts and case studies. Importantly, a discipline-specific analysis and presentation of data was conducted for the industry-wide survey and survey of industry experts. Similarly, the analysis of each case study was divided by company, with each company focused on a specific built environment discipline. A cross-discipline analysis was conducted at the end of each stage of the research design to compare results across the different disciplines.

- Chapter 5: Discussion

Chapter 5 provides a discussion of results obtained in the study. The discussion focuses on the three research objectives, namely:

- The key factors influencing PSO quality.
- The significance of the key factors influencing PSO quality in the South African construction industry.
- How and to what extent the level of fees charged by built environment professionals influences PSO quality.

The discussion comprehensively explores and interprets the research results within the context of existing literature and research questions, delving into their significance and implications. It provides readers with insight into the research's broader significance.

- Chapter 6: Conclusion and Recommendations

The conclusion provides an overview of the key research questions and findings. The discussion of the research findings forms the basis of the conclusion. The conclusion responds to the following questions:

- What are the key factors influencing PSO quality?
- What is the significance of key factors influencing PSO quality among different built environment disciplines in the South African construction industry?
- How and to what extent does the level of fees charged by built environment professionals influence PSO quality?

The chapter also provides the contribution to knowledge from an academic and industry perspective. The chapter concludes with limitations of the research and recommendations for future work.

Chapter 2: Literature Review

2.1 Introduction

The literature review focuses on six key aspects, namely:

1) Defining the quality of PSOs.

2) Factors impacting PSO quality in the construction industry.

3) International and South African literature on how and to what extent fees influence the quality of PSOs (including a methodological appraisal of existing studies).

4) The role of financial incentives in performance and motivation.

5) The theory of professionalism in the context of the ongoing debate between fees and the quality of PSOs.

6) Boundary of existing knowledge and gaps in the literature.

The literature review highlights various factors influencing the quality of PSOs but shows that a comprehensive discipline-specific study analysing key factors and investigating the influence of fees on the quality of PSOs has not yet been conducted. Furthermore, several methodological shortcomings have been identified in previous studies. From a theoretical perspective, the equity theory of motivation and the theory of professionalism are discussed and related to the ongoing debate around fees and the quality of PSOs in the construction industry.

2.2 Defining the Quality of PSOs

Quality is an obscure concept that is challenging to describe and explain (Parasuraman, 1985). In the context of quality management, the International Organization for Standardization (ISO) defines quality as the "degree to which a set of inherent characteristics fulfils requirements" (ISO, 2015). However, Grönroos (1984) argued that "too often the term 'quality' is used as if it were a variable itself, and not a function of a range of resources and activities". Berry *et al.* (1988) acknowledged that quality refers to "the conformance to specifications" but also argued that the definition of quality on its own is misleading. Berry *et al.* (1988) opined that satisfying a customer's definition of quality is most important when providing a service. Different features or characteristics are relevant depending on the outputs being evaluated. For example, when evaluating the quality of a design, functionality, constructability, aesthetics and cost-effectiveness may be important (Tilley *et al.*, 1999). However, when evaluating project documentation, characteristics such as completeness, accuracy and consistency may be

priorities (Tilley *et al.,* 1999). Watermeyer (2018) provided an appropriate definition that considers different applicable characteristics when evaluating PSO quality in the construction industry. Watermeyer (2018) defined quality as "the totality of features and characteristics of a product or service that bears on the ability of the product or service to satisfy stated or implied needs".

Govender *et al.* (2022) conducted an investigation with experienced professionals in the South African construction industry to pinpoint pertinent indicators for assessing quality of PSOs. Govender *et al.* (2022) asserted that when assessing PSO quality, essential indicators include accuracy, clarity, relevance of technical information, completeness, certainty and standardisation. Govender *et al*. (2022) stated that the significance of these diverse indicators can be tailored based on the type of project.

2.3 Factors Impacting PSO Quality in the Construction Industry

Busbshait *et al.* (1999) assessed the prevalence of different quality practices used by design organisations in Saudi Arabia. Questionnaire surveys (25) were used to determine the frequency with which various quality practices were used by design organisations. Design organisations employ three primary quality practices to enhance design quality: establishing an organisational quality policy, ensuring designer qualifications, and providing employee training and designer education (Busbshait *et al.,* 1999). The findings by Busbshait *et al.* (1999) are relevant to the proposed study as they provide insight into various practices employed by design organisations to improve quality. These practices are essentially factors that influence and can improve PSO quality. However, the main shortcoming of the study is that it failed to provide a discipline-specific analysis of factors within design organisations. Secondly, the level of experience of participants within the sample was unclear, which may impact the validity of the study. The use of a single-stage research design without any triangulation of findings may also impact validity. Lastly, findings in the study may have limited generalisability due to the small number of participants and differences in global construction markets.

Tilley and McFallan (2000) conducted a large study in Australia to assess the fees paid to design consultants over 15 years and the corresponding level of service and quality of design and documentation. The study used questionnaire surveys to elicit 818 responses, which included 491 designers and 327 contractors. Designers in the study mentioned that low fee structures were one of the main factors adversely impacting design and documentation quality. The increase in 'backyard' operators prepared to work for low fees and insufficient overall

design time were two additional factors mentioned. Designers in the study further asserted that "the amount of time necessary to complete the design and documentation process is not adequately accounted for in the fee structure" (Tilley and McFallan, 2000). The findings by Tilley and McFallan (2000) are relevant to the proposed study as they provide evidence about the effect of fees on PSO quality. However, the main shortcoming of the study was the lack of clarity regarding the level of experience of participants within the sample, which may impact the validity of the study. The study also used surveys to identify low fees as the primary factor responsible for declining PSO quality and simply accepted the results from the surveys without further interrogation to improve the validity of the study. The study did not include an additional stage in the research design to closely examine the effect of fees on PSO quality.

Andi and Minato (2003) conducted a study in the Japanese construction industry that assessed factors influencing design document quality. The study used interviews and surveys to collect data from designers (105) and construction personnel (91). Designers in the study identified several factors affecting design document quality. The three main factors included insufficient design time (most important), clients comparing design companies and services before eventually appointing a consultant, and low fee structures. Despite feedback provided by designers about low fees, the study concluded "that the problems of defective designs are complex and deep-rooted, influenced by many factors operating at individual designer, company, construction industry and global or national levels" (Andi and Minato, 2003). The findings by Andi and Minato (2003) are relevant to the proposed study as they provide further evidence about the adverse impact of low fees on PSO quality and the complexity of the relationship. However, the main shortcoming of the study is the failure to provide a discipline-specific analysis of factors influencing the quality of PSOs. The study also failed to comprehensively examine the effect of fees on PSO quality. Andi and Minato (2003) merely mention that fees are one of the factors influencing the quality of design documentation but failed to go further and include an additional stage in the research design to examine the relationship between fees and the quality of design documentation.

Darwish (2005) conducted a study on factors affecting design documentation quality in the construction industry in Saudi Arabia using a survey of contractors (21), consultants (19), and clients (14). This study used factors from Andi and Minato (2003) and Tilley and McFallan (2000) as a theoretical framework. The respondents were presented with a questionnaire listing 39 different factors affecting design documentation quality. The six top-ranked factors by consultants were (1) a low fee structure for the designer, (2) inefficient overall design time, (3)

last-minute changes by the client, (4) increasing difficulty in getting paid on time by clients, (5) client requesting design changes, without being prepared to pay for them, and (6) waiting for client decision. The study included a large portion of contractors as part of the sample. Contractors do not have the necessary expertise to comment on factors influencing the quality of design documentation as they are not responsible for the production of these documents. This was viewed as a major shortcoming in the study, which could have skewed the results as contractors comprised 39% of the overall sample. Another shortcoming was the failure to provide a discipline-specific analysis of factors influencing the quality of PSOs. Lastly, the study featured a single-stage research design and did not include any triangulation of the findings, which raises concerns about the validity of the study. An additional stage in the research design should have been used to validate top-ranked factors.

Love *et al.* (2006) investigated contract documentation variables that influence rework costs on construction projects in Australia. Various factors such as ineffective use of information technology, staff turnover and incomplete design at the time of tender were identified by designers as contributors to rework on construction projects (Love *et al.*, 2006). Notably, low fees were not mentioned as one of the primary factors contributing to rework on construction projects. Love *et al.* (2006) concluded that differences in opinions of contractors and built environment professionals regarding contract documentation rework suggest "that an intricately 'complex' interwoven array of variables contribute to rework". The study further stated that "to simply isolate one variable, such as fees, and state that their increase will improve the quality of contract documentation produced by consultants would be rather naïve" (Love *et al.*, 2006). The findings by Love *et al.* (2006) are relevant to the proposed study as they provide evidence about factors influencing the quality of contract documentation (i.e., PSOs). However, the study had a few shortcomings. Firstly, the study failed to provide a discipline-specific analysis of factors influencing the quality of contract documentation. The study also failed to include an additional stage in the research design to validate variables that were uncovered. The generalisability of the study with developing countries is limited due to the differences in construction markets.

Lopez *et al.* (2010) conducted a literature review of factors that cause design errors in construction projects. The study found that competitive fees are one of the factors resulting in design errors but also mentioned various other factors (e.g., inadequate training, inadequate quality assurance, time constraints, ineffective coordination). The various factors in the study were categorised into three broad groupings, namely, people, organisational and project. The

factors identified by Lopez *et al.* (2010) are relevant to the proposed study as they are further evidence of the adverse impact of low fees on PSO quality. However, the study did not comprehensively investigate factors influencing design errors or the effect of fees on PSO quality. Instead, the study used a literature review as the primary form of data collection. The lack of empirical evidence and the narrow focus on design errors were the two major shortcomings of the study.

A narrowly-focused study by Wimalasiri *et al.* (2010) assessed factors associated with designer errors in the UK. The study involved interviewing designers (13), end users (7) and safety representatives (3). Wimalasiri *et al.* (2010) found that the main factor associated with designer errors was designer competence. The findings by Wimalasiri *et al.* (2010) are important to the proposed study as they support the notion that professional fees are not one of the primary factors resulting in design errors. Competence is an important concept related to professionals. If a professional does not have the required competence, the quality of service will be poor regardless of the fees charged. The main shortcoming of the study was the limited generalisability due to the small sample size and narrow focus on the oil and gas industry.

A study by Sporrong (2011) supports the assertions made by Wimalasiri *et al.* (2010) that competence has a direct influence on PSO quality. Sporrong (2011) did not deal specifically with fees and quality but rather used questionnaires to assess the perceived challenges of consultancy procurement for engineering and architectural services in Sweden. The questionnaires were completed by clients (93) in various Swedish municipalities and found "that most municipal officials (87%) believe that consultant competence is decisive for the success of a project".

Slater and Radford (2012) assessed deficiencies of architectural design documentation in the Australian building industry and their impacts on project procurement. A total of 25 people in the Australian building industry participated in a survey and interviews as part of the study. Slater and Radford (2012) identified six factors that influence deficient architectural documentation, namely, external time pressures, disregard of required documentation standards, pressure on architectural firms to become leaner due to competition, reduced consultancy fees, the extensive use of CAD and direct information transferral resulting in reduced opportunity for review, and inadequate coordination between design disciplines (Slater and Radford, 2012). The findings by Slater and Radford (2012) are relevant to the proposed study as they provide factors influencing the quality of architectural documentation. Slater and

Radford (2012) also support the assertion that reduced fees contribute to deficient documentation. However, the generalisability of the study with developing countries such as South Africa is limited due to differences in construction markets. The small sample size (25) may also limit the generalisibility of the findings.

Philips-Ryder *et al.* (2013), obtained perspectives from subcontractors in Australia to identify attributes influencing the quality of project documentation. Following five semi-structured interviews with subcontractors, Philips-Ryder *et al.* (2013) posited that the three primary reasons for poor-quality documentation include lack of coordination between consultants, insufficient alignment between design disciplines, and lack of consistency between specifications and design drawings. The findings by Philips-Ryder *et al.* (2013) are relevant to the proposed study as they provide further evidence about factors impacting project documentation quality. Factors outlined by Philips-Ryder *et al.* (2013) included perspectives of subcontractors; therefore, they differ from the factors provided by other studies, which were given from the perspective of designers. The study has several shortcomings. Firstly, Philips-Ryder *et al.* (2013) elicited feedback exclusively from subcontractors. Subcontractors are not responsible for the production of project documentation; therefore, they are unlikely to know the full range of factors influencing the quality thereof. This is viewed as a major flaw in the study.

A study by Zidan (2013) identified factors affecting design quality in the construction industry in Syria based on interviews and questionnaire surveys involving 54 designers, contractors and construction professionals. The survey was based on 45 different factors classified based on the designer, management of the design process, owner and design documents. The study identified (1) insufficient overall design time, (2) the method of selecting the designer based on the lowest price offer, (3) lack of documentation and (4) changes to the client's requirements as the most important factors. The results also showed that designers and contractors have different perceptions about factors influencing the quality of design. The main shortcoming of the study was the lack of discipline-specific feedback about factors influencing design quality. The study concentrated on the Syrian construction industry, which potentially limits generalisability. Moreover, it employed a single-stage research design without any triangulation, which may adversely impact validity of the findings.

Dosumu and Iyagba (2013) investigated factors causing errors in construction documents in the Nigerian construction industry. The study included 78 participants from different built environment professions. Approximately 60% of participants were consultants while the remaining 40% were contractors. The study identified designer experience, lack of design reviews and erratic decision-making as the top three factors causing construction document errors. Interestingly, when focusing solely on responses from consultants, the top three factors were erratic decision-making, insufficient funds to create quality documents and designer experience. Notably, insufficient funds or fees were a top-ranked factor for consultants. However, when a combined analysis with contractors was conducted, this was not highlighted as a top factor. This suggests that contractors do not see the relationship and significance of fee levels and document quality. Shortcomings in this study were similar to other studies on the topic (i.e., contractors formed a large percentage of the participants, discipline-specific analysis of factors was not conducted and the study included a single-stage research design with no triangulation of data). Additionally, 67% of participants had less than ten years of experience. Notably, there was no breakdown of participants with less than five years of experience. This absence suggests that this subgroup might have included a substantial number of participants with insufficient experience to contribute effectively to the study. Feedback from these participants may have skewed the results. A similar study investigating the causes of errors in construction documents in the Nigerian construction industry was conducted four years later by Dosumu *et al.* (2017). A questionnaire survey that included 86 consulting and 98 contracting companies was used to identify factors. Additionally, 51 interviews were conducted with built environment professionals in the different companies to elicit additional project data. The study found that frequent design changes by clients, lack of adequate time to prepare documents and design management experience were the main causes of errors in construction contract documents. The shortcomings in this study were similar to other studies on the topic (i.e., contractors formed a large percentage of the participants and discipline-specific analysis of factors was not conducted). Several participants (27%) also had between one and five years of experience, which may have impacted the validity of the findings.

Assaf *et al.* (2018) investigated factors causing deficiencies in project documents on large-scale construction projects. The study used a questionnaire survey to identify significant factors among 37 consultants in Saudi Arabia. The most important factor was “assigning design tasks to designers who lack work experience”. Other factors with high significance included “team members’ communication skills”, “level and quality of design professionals’ education” and

"cross-disciplinary coordination". Notably, "accepting a low design fee" was not a significant factor. This study had four shortcomings. Firstly, participants' experience was not mentioned. The absence of information about participants' experience raises concerns about the reliability of their feedback, especially if they lacked the necessary expertise to provide informed comments on the topic being investigated. Secondly, the study did not provide discipline-specific feedback about factors causing deficient project documents. Thirdly, the study only included a single-stage research design without triangulation of the findings. Lastly, the study focused on a single engineering consulting company; hence, generalisability may be limited.

In the South African context, a study by Akampurira and Windapo (2018) used web-based questionnaires to determine factors influencing design documentation quality on civil engineering projects. Consulting engineers (91) in South Africa were the sole participants in the study. Akampurira and Windapo (2018) used feedback from questionnaires to identify and rank factors. The study found that low design fees were the most important factor influencing design documentation quality. The selection of consulting engineering companies based on the lowest price tendered had the second-highest influence on design documentation quality. The findings by Akampurira and Windapo (2018) are relevant to the proposed study as they provide perspectives of a large sample of consulting engineers on factors influencing design documentation quality. However, the main critique of the methodology used by Akampurira and Windapo (2018) is its lack of an additional stage to corroborate the questionnaire findings or enhance the study's validity. Moreover, a portion of the study's participants lacked professional registration and substantial experience, which may skew the results.

Abu Fatawu *et al.* (2020) investigated factors responsible for poor-quality design and documentation in the Ghanaian construction industry. Forty factors from the literature were presented to participants using a questionnaire and analysed using a relative importance index. A total of 85 participants were selected from across the built environment disciplines (i.e., architects, engineers and quantity surveyors) including consultants and contractors. The study identified six key factors causing deficient design or documents, namely, selection of designers based on the lowest price, unwillingness to pay fees commensurate with design services, last-minute changes by clients, insufficient design reviews, inadequate client briefs, slow payment systems and insufficient or missing information from the client. The main shortcomings of the study were the failure to provide a discipline-specific analysis of key factors and the use of a single-stage research design with no triangulation of data.

Table 1 provides a summary of some of the key factors influencing the quality of PSOs that emerged from the literature.

Table 1: Factors influencing the quality of project and design documents

Factor	**References**	**Total**
Low fees	Tilley and McFallan (2000); Andi and Minato (2003); Darwish (2005); Slater and Radford (2012); Zidan (2013); Akampurira and Windapo (2018); Abu Fatawu *et al.* (2020)	7
Time available	Tilley and McFallan (2000); Andi and Minato (2003); Darwish (2005); Slater and Radford (2012); Zidan (2013); Dosumu *et al.* (2017); Akampurira and Windapo (2018)	7
Changes by client	Darwish (2005); Zidan (2013); Dosumu *et al.* (2017); Abu Fatawu *et al.* (2020)	4
Experience	Busbshait *et al.*, (1999); Dosumu and Iyagba (2013); Dosumu *et al.* (2017); Assaf *et al.* (2018)	4
Inadequate coordination	Slater and Radford (2012); Philips-Ryder *et al.* (2013); Assaf *et al.* (2018)	3
Insufficient review	Slater and Radford (2012); Dosumu and Iyagba (2013); Abu Fatawu *et al.* (2020)	3
Difficulty getting paid	Darwish (2005); Abu Fatawu *et al.* (2020)	2
Inadequate project brief	Tilley and McFallan (2000); Abu Fatawu *et al.* (2020)	2
Ineffective use of information technology	Love *et al.*, (2006); Slater and Radford (2012)	2
Lack of information available	Zidan (2013); Abu Fatawu *et al.* (2020)	2
Slow decision-making by clients	Darwish (2005)	1
Communication	Assaf *et al.* (2018)	1
Competence	Wimalasiri *et al.* (2010)	1

Factor	**References**	**Total**
Failure to adhere to standards	Slater and Radford (2012)	1
Incomplete design at the time of tender	Love *et al.,* (2006)	1
Erratic decision-making	Dosumu and Iyagba (2013)	1
Level and quality of design professional's education	Assaf *et al.* (2018)	1
Pressure on firms to become leaner due to competition	Slater and Radford (2012)	1
Quality management systems	Busbshait *et al.*, (1999)	1
Staff turnover	Love *et al.,* (2006)	1
Training	Busbshait *et al.*, (1999)	1

Although various studies in the research literature investigated factors influencing different aspects of PSO quality, several shortcomings were identified. Firstly, only studies by Tilley and McFallan (2000), Slater and Radford (2012) and Akampurira and Windao (2018) provided discipline-specific feedback about key factors influencing the quality of PSOs; all other studies conducted a combined analysis of factors. This may be inappropriate as different disciplines may have increased preference for specific factors that cannot be uncovered during a combined analysis. Secondly, none of the studies provided the magnitude and significance of the fee variable relative to other key factors. Examination of this aspect is important as it will highlight the importance of the fees compared to other key factors. Thirdly, the studies did not apply a rigorous methodology to answer the research questions; most rely on questionnaires or surveys to simply gather perceptions of either consultants or contractors. The studies do not include an additional stage in the research design to confirm findings from questionnaires or surveys and improve validity. Studies that heavily rely on respondents' perceptions are prone to bias; hence, findings need to be triangulated. Based on the research literature examined, none of the previous studies to date has comprehensively investigated factors influencing PSO quality in the construction industry.

2.4 Research on How and to What Extent Fees Influence the Quality of PSOs

2.4.1 International Perspective

The international literature consists of studies that both support and challenge the notion that low fees adversely impact PSO quality in the construction industry. Debate on this topic was initiated in the late 1980s with two opinion pieces published in the *Journal of Professional Issues in Engineering* by Parks and McBride (1987) and DeFraites (1989). The piece by Parks and McBride (1987) suggested that the use of competitive bidding processes was detrimental to the quality of consulting engineering services, while DeFraites (1989) asserted the importance of employers balancing fees and the quality of output required when appointing the professional team. The piece highlighted concerns about incompetent or inexperienced professionals being appointed if fees were too "low". Notably, neither study provided data to support their assertions.

In this context, Bubshait *et al*. (1998) assessed the influence of design fees on design deficiency. The study used data from 58 construction projects in Saudi Arabia and found that design deficiency decreases as design fees increase. The study further found that the quality of construction projects was dependent on the quality of design professionals involved in the project. The research by Bubshait *et al.* (1998) is relevant to the proposed study as it assessed the influence of fees on quality (with specific focus on the design stages of projects). However, the study has several shortcomings. Firstly, Bubshait *et al.* (1998) did not comprehensively examine the complex relationship between fees and quality. Instead, the study narrowly focused on the effect of design fees on design deficiencies. Secondly, due to the narrow focus of the study, it failed to evaluate other extraneous variables that may influence design quality. To this end, the study did not provide the magnitude of the fee variable relative to other key factors influencing design and the extent to which fees influences design quality.

A study conducted by Hoxley (2000) strongly dispels the notion that low fees adversely impact PSO quality. Hoxley (2000) sought to ascertain whether the quality of professional services declined after the discontinuation of fee scales in the UK in the 1980s. Hoxley (2000) investigated clients' (244) perceptions about the quality of services provided by consultants in the construction industry. The study involved submitting a rating scale to clients to anonymously assess the quality of services rendered by built environment consultants. Interestingly, no significant evidence of a decline in clients' perceptions of professional service quality was collected. The primary reason was due to professionalism and professional standards. Hoxley (2000) concluded that despite the abolition of fee scales, built environment

consultants in the UK "have not allowed fee competition to compromise professionalism". A second study by Hoxley (2007) followed seven years later. The study adopted a similar methodology and sought to understand if client perceptions had changed since the earlier study. The study included questionnaires from 133 UK-based construction clients consisting of surveyors (56%), architects (25%), engineers (8%) and other disciplines (5%). The study reaffirmed findings from Hoxley (2000) indicating that clients' perceptions of service quality were not lower for work let out by competitive fee tendering. The findings by Hoxley (2000; 2007) are relevant to the proposed study as they provide specific evidence about the impact of abolishing fee scales on PSO quality. However, both studies have shortcomings. Firstly, although Hoxley (2000;2007) provided evidence asserting that reduced professional fees did not negatively influence the quality of professional services, the study failed to comprehensively examine the effect of fees on PSO quality. The study primarily gathered feedback from clients regarding the quality of professional services through a survey and accepted the results without conducting additional in-depth analysis or triangulation of the data. Secondly, both studies narrowly focused on fees or competitive tendering without accounting for the effect of extraneous variables or other factors impacting the quality of PSOs. The studies did not provide the magnitude of the fee variable relative to other key factors. Lastly, the study was conducted in the UK and may not be generalisable to the South African construction industry.

Ling (2004) investigated the importance of fees among architects and engineers in the Singapore construction industry. The study contained 12 in-depth interviews with project owners (3), contractors (3), architects (3) and civil engineers (3). Interview participants were regarded as subject matter experts with 20 to 36 years of experience. Architects and engineers in the study argued that fees should not be reduced as this may result in a lack of motivation. The study further suggested that low fees may adversely impact the quality of service due to less time spent on the project and the allocation of less-capable staff. The study had a few shortcomings. Firstly, the study narrowly focused on the importance of fees without accounting for the effect of extraneous variables or other factors impacting the quality of PSOs. Additionally, the study did not provide the significance of the fee variable relative to other key factors and the extent to which it influences quality. Secondly, the study only included a single-stage research design without additional means of triangulating the findings. Lastly, the limited number of participants, i.e., three participants per grouping, may limit the generalisability of the findings.

Phua (2005) investigated the relationship between professional fees and project success in the Hong Kong construction industry. The study rejected the prevailing industry perception that professional fees are linked to project success. Questionnaires were used to collect data from senior managers (398) at contracting and consulting firms in Hong Kong. A statistically significant relationship between fees and project success was not established in the study, which suggests that other key factors contribute to project success. Phua (2005) further stated that "the notion that steep competition and inadequate fee structure are the biggest culprits that lead to poor project performance seemed unfounded." The study concluded that "in all likelihood, it can be argued that the general anecdotal impression that fee structure is critical to project performance stems largely from firms' vested interests, hence painting a biased picture that does not reflect the overall sentiment of the construction industry". Although Phua (2005) does not seek to specifically assess the effect of fees on PSO quality, it can be argued that a successful project will include high-quality PSOs. The study's conclusion provides evidence that fees are not a determinant of project success. However, the study failed to elicit in-depth qualitative feedback to develop a deep understanding of the relationship between fees and project success. The study was also conducted in Hong Kong and may have limited generalisability to the South African construction industry.

Gransberg *et al*. (2007) used a quantitative methodology to evaluate professional fees by analysing the percentage growth of engineers' construction estimates during 31 bridge and road projects in the United States of America (USA). Gransberg *et al*. (2007) discovered that a reduction in professional fees leads to corresponding increases in engineers' estimates during projects. The relationship appeared to be strongest for technically complex projects. Gransberg *et al*. (2007) went on to state that using higher fees will "not necessarily guarantee superior design". The findings by Gransberg *et al*. (2007) are relevant to the proposed study as they provide insights into the effect of fees on the quality of services rendered by engineering professionals. Gransberg *et al.* (2007) asserted that the effect of low fees was more pronounced on complex projects. However, the study failed to comprehensively assess the effect of fees on PSO quality. The study's main deficiency is the narrow focus on the growth of engineers' cost estimates. The quantitative assessment failed to critically assess the influence of extraneous variables on the growth of engineers' estimates, which raises questions about the validity of the findings. Furthermore, no triangulation of the findings was undertaken to improve the validity of the study. The generalisability of the research is also limited due to the narrow focus on the engineering discipline and the exclusive use of bridge and road projects from the USA.

Koutsikouri *et al.* (2008) investigated critical success factors in multidisciplinary design projects in the UK. A combination of interviews (22), a workshop (36 participants in groups of between four and six people) and a survey (47 participants) was used to collect data in a multinational consulting engineering company. The study identified 31 critical success factors that were subsequently grouped into inter-related group factors, namely, management factors, design team factors, competencies and resources and project enablers. Notably, resources' technical skills were raised as one of the critical factors. Participants asserted that the provision of appropriate resources on projects was directly linked to the fee available. Regarding the motivation of professionals, Koutsikouri *et al.* (2008) found that "budget and profit does not increase motivation *per se* but if it means that it allows the members to spend more time on refining and working on the design, it is critical to the design process". Although the study did not specifically deal with quality, it can be argued that quality output is an indicator of successful projects, i.e., for a project to be successful, quality outputs need to be produced. The study had three shortcomings. Firstly, since the study did not specifically investigate the relationship between fees and the quality of PSOs, an in-depth assessment of how and to what extent fees influence the quality of PSOs was not provided. Secondly, the magnitude of the fee variable relative to other critical success factors was not provided. Lastly, the study focused on a single engineering consulting company; hence generalisability may be limited.

Awolesi and Ayedun (2012) assessed the effect of financial compensation on the performance of built environment professionals in Nigeria. The study used questionnaires to elicit responses from clients (18) and professionals (26) in the construction industry. Various built environment professionals such as quantity surveyors, electrical engineers, town planners and architects participated in the study. Awolesi and Ayedun (2012) were unable to establish a relationship between fees and the quality of service rendered. The findings by Awolesi and Ayedun (2012) were important to the proposed study as they provided further evidence that fees may not be one of the primary factors responsible for PSO quality. However, the study had four major shortcomings. Firstly, the study failed to comprehensively examine the effect of fees on PSO quality. The study simply elicited feedback from clients about the quality of professional services using a survey and accepted the results without further interrogation or triangulation of the data. Secondly, the study narrowly focused on fees without accounting for the effect of extraneous variables or other factors impacting the quality of PSOs. Additionally, the study did not provide the magnitude of the fee variable relative to other key factors and the extent to which it influences quality. Thirdly, factors used to measure the service quality of built

environment professionals were simply accepted as those in the SERVQUAL model, without any rigorous interrogation of the suitability of the model. Lastly, the small number of participants (44) may limit generalisability.

Lam (2012) investigated how economic forces should be used to maximise performance quality in the Hong Kong property market. A case study consisting of data from various projects within the Hong Kong Housing Authority (HKHA) was used to determine the impact of economic forces on property management services, including civil/structural engineering, architectural and quantity surveying. A regression model was developed to analyse the impact of the quality of services provided by 50 consultants using fee level and competition level as predictor variables. The study did not find any significant correlation between fee levels and the quality of services, which was congruent with findings by Hoxley (2000; 2007). However, the study had a few shortcomings. Firstly, the study narrowly focused on fees and economic forces without accounting for the effect of extraneous variables or other factors impacting the quality of PSOs. Additionally, the study does not provide the magnitude of the fee variable relative to other key factors and the extent to which it influences quality. Secondly, the study used a single-stage research design without any triangulation, which may impact validity. Lastly, the study was conducted in Hong Kong and may have limited generalisability to the South African construction industry.

A study by Shrestha and Mani (2014) investigated the impact of design cost on project performance in road projects in the USA. The study analysed 64 road projects that were completed between 1991 and 2009 to determine if there was a correlation between design costs and the growth in final project costs. The study identified a statistically significant relationship between design costs and total cost growth. A negative correlation between the two variables was obtained, suggesting higher design costs result in lower final project cost growth. Notably, the correlation between the two variables was stronger in larger projects. The authors suggested that better fees enable better performance of consultants. However, similar to the Gransberg *et al.* (2007) study, the quantitative assessment failed to critically address the influence of extraneous variables on the growth of engineers' estimates, which raises questions about the validity of the findings. Triangulation was also not carried out to enhance validity. The findings' generalisability was limited by the study's narrow focus on the engineering discipline and its exclusive reliance on road projects from the USA.

Bauer and Heck (2015) assessed the effect of professional fees on the quality of planning services rendered by professional planners in the Austrian construction industry. The study used interviews to elicit responses from managers (9) of planning firms in the architectural and engineering fields. Bauer and Heck (2015) provided further evidence about the adverse impact of low fees on PSO quality. The study found that discounted professional fees for planners resulted in poor planning, reduced effort, and overall low quality of service. However, the study contained several shortcomings. Firstly, a comprehensive investigation was not conducted to identify other key variables in the relationship between fees and quality. Therefore, the magnitude of the fee variable relative to other key factors was not established. Secondly, the extent to which fees influences quality was not examined. Thirdly, a simplistic single-stage methodology with a limited sample was used. Triangulation was not conducted to improve the validity of the findings. Lastly, the study failed to operationalise the concept of quality.

Cirelli (2017) conducted a study that assessed the influence of design fees and time taken to produce designs on construction quality. Quantitative and qualitative methodologies were used in the study. The quantitative methodology involved a correlational research design to understand the relationship between, design fees, duration and errors. The sample for the correlational research included 515 building projects that commenced and were completed in the New York State area between 2011 and 2015. Interviews with seven design firm managers, including senior engineers and architects, formed part of the qualitative research methods adopted in the study. Cirelli (2017) did not find a relationship between design fees and design-related errors and omissions. Furthermore, Cirelli (2017) asserted that design duration only had a minor influence on design errors and omissions. Although Cirelli (2017) did not comprehensively examine the effect of fees on PSO quality, the findings are relevant to the proposed study as they provide a quantitative perspective on the effect of fees on construction quality. The interviews in the study provide senior designers' experiences of reasons for design errors and ways to mitigate those errors. However, one of the major shortcomings in the study was the failure to adequately account for extraneous variables that influence design quality. Cirelli (2017) also failed to provide rich in-depth qualitative data when examining the influence of fees on construction quality. From a theoretical perspective, limited sections (i.e., the first two blocks – (1) improve quality and (2) decrease costs) of Deming's Chain Reaction theory were used as the theoretical framework in the study. Chain Reaction theory posits that improving quality will result in declining costs. This may apply to the construction process, where good-quality project documentation assists to control construction costs. However, the

Chain Reaction theory is inappropriate for assessing the relationship between fees and quality as it is inconsistent with the sequence of events during the procurement of professional services. The assertion by various authors (e.g., Bubshait *et al*., 1998; Tilley and McFallan, 2000; Andi and Minato, 2003; Gransberg *et al*., 2007; Liebenberg and Wilson, 2011; Bauer and Heck, 2015; Malinda, 2017; Moos, 2017; Okonkwo and Wium, 2018; Akampurira and Windapo, 2018) that reduction of costs or fees among built environment professionals adversely impacts quality contradicts Chain Reaction theory.

Marisa and Yusof (2020) assessed factors influencing the performance of architects using a questionnaire survey to elicit responses from professionally registered architects (222) in Indonesia. The study found that fees are not the main factor influencing the performance of architectural professionals. Marisa and Yusof (2020) posited that an effective design process has the greatest influence on architects' performance. Additional factors influencing architectural performance to a lesser extent included working conditions and organisational support. Although Marisa and Yusof (2020) did not deal directly with the effect of fees on PSO quality, the findings are relevant to the proposed study as they provide evidence of factors influencing the performance of architects. The narrow focus on the architectural profession and failure to include an additional stage in the research design to validate findings from the survey were the main shortcomings of the study.

Ali and Au-Yong (2021) investigated risk factors related to the design process for building refurbishment projects in Malaysia. The study used a combination of semi-structured interviews and questionnaires for data collection. Participants in the interviews were selected from prominent construction companies. A total of 21 semi-structured interviews were conducted with architects while the questionnaire was completed by 82 professional architects. The study found a negative correlation between design fees and design changes during construction, i.e., projects with lower fees had a higher number of design changes. During the interviews, participants stated that they were unwilling to offer fee discounts even when their workload was insufficient, as they aimed to maintain the dignity of the profession. Participants highlighted that the risk profile for refurbishment projects was higher than for greenfield developments, which may have also influenced their view on fee discounting. The study had a few shortcomings. Firstly, it did not specifically investigate the complex relationship between fees and the quality of PSOs. Therefore, key variables influencing the quality of PSOs were not identified. Secondly, the study only focused on the architectural profession. Lastly, the

study was restricted to refurbishment projects conducted in Malaysia; therefore, the generalisability of findings in the South African context may be limited.

Table 2 provides a summary of studies investigating the relationship between fees and the quality of professional services and highlights different aspects of professional services impacted by "low" fees. Based on the literature, the two main constraints placed on consultants due to "low" fees are (1) a reduction in the time available to perform tasks, resulting in "time boxing" practices and (2) constraints on the quantity and quality of resources allocated to projects.

Table 2: Influence of "low" fees on the quality of professional services

How do "low" fees influence the quality of professional services?	**References**	**Total**
Not mentioned in the study	Bubshait *et al*. (1998); Marisa and Yusof (2020).	2
Low fees do not influence the quality of professional services	Hoxley (2000); Phua (2005); Hoxley (2007); Awolesi and Ayedun (2012); Lam (2012); Laryea *et al*. (2020).	6
Restricts resources used on projects	DeFraites (1989); Ling (2004); Gransberg *et al*. (2007); Koutsikouri *et al*. (2008); Lopez *et al*. (2010); Shrestha and Mani (2014); Bauer and Heck (2015); Assaf *et al*. (2018); Akampurira and Windapo (2018); Okonkwo and Wium (2018); Quapp and Holschemacher (2021).	11
Reduces the time available for tasks	Parks and McBride (1987); Ling (2004); Koutsikouri *et al*. (2008); Lopez *et al*. (2010); Bauer and Heck (2015); Cirelli (2017); Akampurira and Windapo (2018); Okonkwo and Wium (2018); Ali and Au-Yong (2021).	9

The generalisability of findings in the international construction literature in the South African context is limited due to differences in global construction markets, including practices to procure built environment professionals. The appointment of built environment professionals in South Africa relies significantly on price and a preference for previously disadvantaged individuals. Quality serves as a gatekeeper during tender evaluation to screen tenderers and is

not further considered during final evaluation. Consequently, concerns regarding the quality of built environment service providers, encompassing experience and competence, might be more prominent within the South African context.

The dynamic of the South African construction industry is also significantly different from other countries due to past laws in the country limiting equal participation of all races in the economy. After democracy was achieved in 1994, many new companies were established in South Africa by individuals who were previously excluded from the economy. These new companies may have lacked the benefit of institutional knowledge and other advantages prevalent in larger, more established companies. Nuances in the South African construction industry prevent generalising findings from international literature to the South African context.

2.4.2 South African Perspective

In the South African context, several studies investigating the influence of fees on the quality of PSOs have been published. Most of the studies were published after the 2016 ruling by the Competition Commission to suspend the publication of fee guidelines in South Africa.

Liebenberg and Wilson (2011) conducted a study using South African National Roads Agency Limited (SANRAL) data from 131 projects and information elicited from four different surveys among consulting engineering firms (19), engineers (42) and contractors (7). The study investigated the impact of competitive tendering since its introduction in 2000 on roads and pavement projects in the engineering industry. Liebenberg and Wilson (2011) found that a reduction in quality was consistently raised by participants in the study. Consultants admitted that quality was suffering because of reduced rates. Declining quality was attributed to the implementation of a tendering system that failed to incentivise participants to undertake additional services such as value engineering. The findings by Liebenberg and Wilson (2011) are relevant to the proposed study as they provide evidence about the adverse impact of low fees on PSO quality. The findings also highlight the role of incentives in eliciting increased performance. However, the study did not comprehensively investigate the effect of fees on PSO quality. The methods used were too simplistic, extraneous variables were not adequately dealt with, and the authors simply accepted the assertion that low fees negatively impact the quality of professional services. Since extraneous variables were not identified, the study was unable to define the magnitude of the fee variable relative to other key factors and the extent

to which it influences quality. Lastly, the study failed to adequately define or operationalise the concept of quality.

Moos (2017) conducted a study to determine the effect of public sector procurement policy on the South African consulting engineering industry. The study used questionnaires to elicit feedback from provincial and municipal public sector clients in the Western Cape (24) and consulting engineers (9). The study concluded that many public sector clients believed there was a decline in "technical delivery and quality of design". More than 75% of the public sector clients interviewed noted a significant decline in experienced resources spending time on projects. However, the study failed to comprehensively investigate the effect of fees on PSO quality. Firstly, the concept of quality was not adequately defined or operationalised. Secondly, the study failed to use a rigorous methodology. Results from the questionnaire were simply accepted without further interrogation or triangulation. Thirdly, the study has limited generalisability to other built environment professions due to the narrow focus on the consulting engineering industry and the small sample size.

Malinda (2017) investigated risks associated with poor-quality project documentation in South African construction projects. The study used internet-based questionnaires to assess the perceptions of public sector clients (13), consulting engineers (14) and contractors (11). "Exceptionally low fees due to competition" was cited as the highest-ranked factor limiting project delivery. The findings by Malinda (2017) are relevant to the proposed study as they provide further evidence that low fees adversely influence PSO quality. However, the study failed to comprehensively investigate the effect of fees on PSO quality. The methodology used by Malinda (2017) was simplistic and included a small sample of participants (38), which raises concerns about the representativeness and validity of the findings. The study simply accepted results from the questionnaires without an additional stage in the research design to triangulate the data. The concept of quality was also poorly defined and there was no mention of an acceptable benchmarked quality of documentation that could be compared to the "poor" quality mentioned by the author. Lastly, generalisability to other built environment professions is limited due to the narrow focus on the consulting engineering industry and the small sample size.

Okonkwo and Wium (2018) used structured questionnaires that were distributed to consulting engineers (23) to examine the risk exposure of civil/structural engineering companies in the South African construction industry due to discounted fees. The study did not directly

investigate the effect of fees on PSO quality. However, Okonkwo and Wium (2018) supported the notion that discounted professional fees adversely impacted quality. Participants in the study mentioned that discounted professional fees were problematic and had a bearing on risk exposure. However, the study did not use a rigorous methodology, which casts doubt on the findings. A limited sample of participants was used during the questionnaires. Some of the participants were not professionally registered and did not have significant experience, which may skew the results. Furthermore, no triangulation was used to strengthen the validity of the study. Lastly, generalisability to other built environment professions is limited due to the narrow focus on the consulting engineering industry and the small sample size.

A preliminary study examining the influence of fees on the quality of professional services in South Africa was undertaken by Laryea *et al*. (2021). The construction of two new universities was selected as case studies since they consisted of large-scale multidisciplinary teams of built environment professionals. The study found that despite consultants on the projects offering fees that were lower than the gazetted fee in their respective professional fee guidelines, good-quality services were rendered. Laryea *et al.* (2021) presented additional evidence that the level of professional fees doesn't inherently dictate the quality of rendered professional services. The main shortcoming in the study was its failure to specifically assess PSO quality. Instead, project outcomes associated with the constructed infrastructure (e.g., time, cost and quality during construction) were used as a proxy to assess the quality of professional services. The approach by Laryea *et al*. (2021) provides a preliminary insight into the relationship between fees and the quality of PSOs. However, further investigation is required, as successful project outcomes are due to a range of factors. Those factors influencing PSO quality need to be clearly understood as part of any study investigating the relationship between fees and PSO quality.

Interestingly, five studies undertaken in South Africa (Liebenberg and Wilson, 2011; Moos, 2017; Malinda, 2017; Akampurira and Windapo, 2018; Okonkwo and Wium, 2018) all assert that low fees adversely influence PSO quality. Studies in the international literature from other developing countries such as Saudi Arabia (Bubshait *et al.*, 1998), Singapore (Ling, 2004) and Malaysia (Ali and Au-Yong, 2021) also support the assertion that low fees adversely influence PSO quality, while studies in Hong Kong (Phua, 2005; Lam, 2012), Nigeria (Awolesi and Ayedun, 2012) and Indonesia (Marisa and Yusof, 2020) rejected this assertion. Similarly, in several developed countries, there is equal support for and dismissal of the assertion that low fees adversely influence PSO quality.

The prevalent narrative in the South African context suggests that low fees have a negative impact on PSO quality, a perspective supported by industry professionals across various studies. The competitive nature of tendering in South Africa is compelling built environment consultants to reduce fees in order to enhance competitiveness. Nevertheless, this does not necessarily need to result in diminished quality of PSOs, as demonstrated by Laryea *et al.* (2021).

2.5 Methodological Appraisal of Studies Investigating the Influence of Fees on PSO Quality

Various studies have been presented that argue both in favour of and against the notion that low fees adversely influence PSO quality. However, a methodological appraisal exposed deficiencies in the various methodologies and demonstrated that the relationship between fees and quality has not been adequately investigated. The methodological deficiencies in the various studies are outlined below.

Firstly, none of the studies has specifically investigated the effect of fees on PSO quality. Most of the studies assessed factors influencing a specific output, e.g., design or documentation. In a few cases (Busbshait *et al.*, 1999; Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Zidan, 2013; Moos, 2017; Malinda, 2017; Akampurira and Windapo, 2018; Okonkwo and Wium, 2018; Marisa and Yusof, 2020; Abu Fatawu *et al.*, 2020), questionnaires were used to elicit feedback from built environment professionals and found that low fees were one of the primary factors adversely affecting PSO quality. However, none of the studies included an additional stage in the research design to triangulate the findings and improve validity. Furthermore, most of the questionnaire studies failed to provide rich in-depth data to explain how and to what extent quality was specifically influenced by fees. Additionally, studies investigating the effect of fees on the quality of PSOs focused specifically on the fee variable without appropriately considering other key factors. Therefore, these studies were not able to fully explain the complex relationship between fees and quality. It is evident that an array of interwoven variables influences the relationship between fees and quality and, to date, methodologies used to identify these variables and investigate this topic are too simplistic. By using questionnaires, researchers in the different studies essentially gathered a collection of perceptions from industry players without validating this data.

Secondly, most of the studies investigating the decline in the quality of PSOs failed to fully define or operationalise the concept of quality. Only Hoxley (2000; 2007) and Awolesi and Ayedun (2012) used an existing instrument as a benchmark to define quality indicators.

Operationalising and defining the concept of quality is critical to the validity of studies, as most were centred around the concept of quality. Participants in different studies that were conducted would have had different perceptions about quality and used different indicators when assessing quality. However, these are not known as they were not appropriately recorded.

Thirdly, most of the studies had deficiencies in their sampling regime. Either the sample size was too small without proper justification, the participants introduced a high element of bias or some participants in the studies did not have adequate experience to provide reliable feedback. Participants lacking sufficient experience were of particular concern, as they would not know the full range of factors impacting the quality of PSOs. Moreover, their input may have incorrectly skewed results. Using deficient samples introduces doubts about the validity and reliability of the various studies.

Lastly, due to the scope, narrow focus, combined analysis of multiple built environment disciplines and location of the various studies, generalisability to other contexts and settings is limited.

2.6 The Influence of Financial Incentives in Performance and Motivation

A review of the literature on motivation theory that examined theoretical relationships between financial incentives and performance was conducted. Most of the literature did not focus on the relationship between financial incentives (fees or money) and quality but rather was centred on the influence of financial incentives on performance (quantity and quality) and motivation of employees. Although performance and quality are two different concepts, it can be argued that the performance of built environment professionals is directly related to the production of good-quality outputs and services. Therefore, this section examines motivation theory with a specific focus on the role of financial incentives on both performance and motivation.

The equity theory of motivation, developed by Adams (1963), stands as a seminal theory concerning job motivation. Adams' Equity Theory of Motivation posits that individuals are motivated when they perceive fairness and equity in how their inputs (such as effort and skills) compare to the outcomes (such as salary and recognition) they receive in the workplace relative to others. The theory outlines three key states: overpayment inequity, underpayment inequity, and equity, each with distinct reactions and cognitive processes. According to the equity theory, employees experience demotivation when the value of their inputs in a job exceeds the value of their outcomes. Consequently, they may diminish their inputs until a balance is achieved. Applying the equity theory to the built environment context, if professionals are not suitably

compensated for their rendered services, they are likely to scale back their performance to ensure a balance between their inputs and the corresponding outcomes, potentially impacting the quality of PSOs.

Studies examining motivation theory considered two facets of performance, namely, performance quality and performance quantity. Performance quantity defines performance using an objective quantitative measurement that relates to the amount of work or tasks produced, while performance quality uses a more subjective approach to determine how well a task is performed (Shaw and Gupta, 2015). Numerous investigations have been conducted into the effect of financial incentives on performance (quality and quantity) of employees. Most of the studies presented below contain a meta-analysis of literature over the past few decades. Empirical evidence suggests a direct correlation between financial incentives and employee performance (Jenkins *et al*. (1998); Condly *et al.* (2003); Garbers and Konradt (2014); Shaw and Gupta (2015)).

Jenkins *et al*. (1998) performed a meta-analytic review of 39 studies from between 1960 and 1996 containing 47 relationships to determine if there was a direct relationship between financial incentives and performance of employees. The study found that there is a "generalizable positive relationship between financial incentives and performance". The results of the study focused on the relationship between financial incentives and performance quantity. A statistically significant relationship between financial incentives and performance quality could not be established. The primary concern with the Jenkins *et al*. (1998) study is that none of the studies forming part of the meta-analysis included professionals as participants. A total of 31 of the 39 studies reviewed contained students as participants. The rest of the studies, which contained employees as participants, involved assessing their performance on tasks that were not technical or cognitive. Therefore, no inference can be drawn on whether financial incentives are effective at improving the performance of professionals. Furthermore, the Jenkins *et al*. (1998) study did not present comprehensive evidence of whether financial incentives are effective at improving performance on technical tasks. That aspect is relevant to the proposed study as professionals in the construction industry generally undertake technically challenging and complex tasks.

Condly *et al*. (2003) performed a meta-analytic review of 45 studies from between 1960 and 2000 that investigated the use of incentives, primarily financial, to improve performance. Condly *et al*. (2003) demonstrated the significant power of money in the workplace, asserting

that a higher level of performance was achieved when using financial incentives as opposed to other types of incentives. Condly *et al.* (2003) concluded that "there is strong support for the claims that incentives can significantly increase work performance". The study asserted that incentives have a positive effect on both performance quantity and quality. However, the study found a significant difference in the manner in which financial incentives influenced mental and physical work. This finding is reinforced by Bonner *et al*. (2000), who suggested that as tasks become more complex, the influence of financial incentives on performance is less effective. The main criticism of the Condly *et al*. (2003) study, is that it did not mention the type of participants (i.e., students, employees or professionals) involved in the performance experiments. Since the scope of the proposed study focuses on built environment professionals, it is important to ascertain whether financial incentives have the same influence on professionals as they do on non-professional employees. Another concern with the study, was the inherent difficulty to measure performance quality. Although Condly *et al*. (2003) recognised this challenge, the authors failed to illuminate how studies forming part of the meta-analysis overcame the difficulty of measuring performance quality. This casts doubt on the validity of finding in studies measuring performance quality.

Garbers and Konradt (2014) conducted a meta-analysis of 146 studies (between 1965 and 2010) to examine the effect of individual and team-based financial incentives on employee performance. The study identified a "positive effect of individual and team-based incentives on performance" (Garbers and Konradt, 2014). As with the previous studies, the participants that formed part of the meta-analysis were mainly students. Furthermore, there was no mention if participants from organisations in the study were professionals or non-professionals. In terms of task complexity, the authors attempted to break down tasks (in the various studies that formed part of the meta-analysis) according to complexity. However, they did not adequately describe the criteria used to categorise the tasks. This raises doubt about the finding that financial incentives were more effective for complex tasks.

Although there is overwhelming support for the use of financial incentives to improve employee performance, some sceptics (Deci and Ryan, 1985; Kohn,1993; Pink 2009) have raised concerns that financial incentives erode intrinsic motivation. However, a study by Cerasoli *et al.* (2014) found that "incentivisation actually boosted the intrinsic motivation performance link". Cerasoli *et al.* (2014) conducted a 40-year (between 1971 and 2013) meta-analytic study that focused on the relationship between intrinsic motivation, extrinsic incentives and performance. Cerasoli *et al.* (2014) posited that the unexpected effect of

financial incentivisation was that “predictive validity of intrinsic motivation did not erode, but in fact increased in the presence of incentives”. The criticism of the Cerasoli *et al*. (2014) study is similar to that of other studies in the incentive literature. Namely, studies used in the meta-analysis included students as participants or included employees but did not indicate if they were professionals. Therefore, no inference can be drawn on whether financial incentives are effective at improving the performance of professionals.

Most of the studies in the incentive literature did not adequately deal with the influence of financial incentives on the performance quantity or quality of professionals. Studies conducted either measured the influence of financial incentives on the behaviour of students or dealt broadly with the influence of financial incentives on employees.

A recent essay by Shaw and Gupta (2015) into the effectiveness of financial incentives in the workplace included a comprehensive review and analysis of studies assessing the effect of financial incentives on the performance of employees. The essay concluded that financial incentives given to employees “are effective, they improve performance quantity, they improve performance quality and they do not erode, but rather enhance the potency of intrinsic motivation”. However, Shaw and Gupta (2015) state that although financial incentives may be a factor in eliciting increased performance, it is not the only factor. Herzberg (1974) described various other motivators apart from financial incentives that are critical for employees, such as “recognition, sense of achievement, growth and promotional opportunities, responsibility and meaningfulness of work”. A study on workplace motivation by Wiley (1997) comprised over 40 years of surveys assessing the motivation of employees. The study found that good wages, appreciation for work done and job security were the three top factors motivating employees.

Financial incentives are not the only motivator for performance in the workplace. However, empirical evidence shows the efficacy of financial incentives to generate both performance and intrinsic motivation.

2.7 Theory of Professionalism

Carr-Saunders and Wilson's (1933) theory on professions explores the distinct characteristics and functions of professional groups within society. Their theory emphasises that professions emerge in response to the complex demands of modern life, addressing specialised needs that cannot be fulfilled by the general population. Carr-Saunders and Wilson's (1933) theory provides a framework for understanding the underlying principles that govern professionalism and the formation of recognised professions within society.

Numerous authors have identified several key characteristics associated with professions and professionalism (Carr-Saunders and Wilson, 1933; Elliott, 1972; Evetts, 2003; Hughes and Hughes, 2013). These include commanding a distinct body of knowledge, using barriers of entry that only allow competent individuals to join a profession, public interest and service, complying with ethical codes and mutual recognition.

The theory of professionalism holds significance in the context of the proposed study, where the investigation revolves around professionals in the construction industry. This theory serves a dual purpose: to analyse the behaviour of professionals in the construction industry and to establish a framework for critically assessing how fees influence the quality of PSOs. Claims in the construction literature that attribute a decline in PSO quality to low fees appear unsubstantiated when evaluated through the lens of professionalism theory for the following reasons:

- Firstly, the concept of serving the public and working in the interest of society implies that a true professional will put the interests of society above their own. This is particularly significant as it implies that professionals should be willing to put the interests of society (including clients) above their desire for financial remuneration. Therefore, in theory, financial remuneration should not influence the quality of professional services.
- Secondly, the competence of members in a professional industry is usually developed through formal education, training, and experience on the job (Carr-Saunders and Wilson, 1933; Elliott, 1972; Hughes and Hughes, 2013). Once a member believes they have sufficient training and experience and have satisfied all the registration criteria, they follow a registration process that assesses their competence and determines if they meet the requirements to be called a professional. Anyone who goes through a professional registration process successfully attains the right to write the letters of the profession next to their name. By ensuring the competence of members, the profession admits only individuals who have the necessary technical skills and can render tasks to an acceptable level of quality. Thereafter, professionals are obliged to provide a certain minimum “acceptable” standard of work or service to anyone engaging their professional services regardless of financial remuneration.
- Thirdly, professionalism and competence are outlined in the code of conduct of various professional councils (e.g., ECSA, 2017; SACQSP, 2013.). Agreeing to undertake work for a low fee, producing sub-standard quality, and then arguing that it was due to the

low fees falls short of what is expected from a true professional. Professionals must undertake their work with reasonable care and technical skill following the standard of care principle. Duty of care is another principle in the law literature that places a legal requirement on professionals to execute their work in a way that does not cause any harm or loss to clients or any other party (Hughes *et al.*, 2015). Failure to render services following the standard of care principle is a violation of various professional codes of conduct.

Based on the reasons above, the theory of professionalism provides no theoretical basis to support a direct relationship between fees and the quality of PSOs. Nevertheless, research in the construction industry has shown that low fees or inadequate financial incentives are commonly perceived as contributing factors to the decline in PSO quality.

2.8 Boundary of Existing Knowledge and Gaps in the Literature

The current boundary of knowledge and gaps in the construction literature relevant to this study are outlined below:

1. From an international perspective, several studies have identified and ranked factors influencing design and document quality in the construction industry. However, a stratified, discipline-specific study and a detailed analysis of key factors influencing the quality of PSOs were absent from the literature. Additionally, many of the studies that identify factors influencing the quality of design or document quality do not clearly state which were key factors. Instead, this had to be gleaned using the scores contained in the factor ranking system.
2. From a South African perspective, only one study has been conducted to date, investigating factors influencing the quality of design documentation in the civil engineering discipline. Research into other major built environment disciplines, such as architecture, electrical engineering, mechanical engineering, and quantity surveying, is notably absent from the literature.
3. Previous studies conducted internationally and in South Africa did not comprehensively address the question of how and to what extent the quality of PSOs is specifically influenced by the fees charged by built environment professionals. Studies that attempted to answer the "how" aspect of this question provided commentary that was not based on any rigorous research design. Additionally, no

studies in the construction literature have investigated and explained the extent to which fees influence the quality of PSOs.

Chapter 3: Research Design and Methods

3.1 Introduction

This chapter describes the research design and methods. It begins by contextualising the research design, which used the research onion by Saunders *et al.* (2019) as a guiding framework. The chapter then presents the research design and rationale for adopting a mixed methodological approach. The research design consisted of an industry-wide survey of built environment professionals, a survey of built environment industry experts and case studies of built environment consulting companies to determine key factors influencing the quality of PSOs and how and to what extent fees specifically influence the quality of PSOs. The research philosophy, strategy, time horizon, validity and reliability were also discussed. Finally, the chapter concludes with ethical considerations pertinent to the research.

3.2 Context of the Research Design

The research onion by Saunders *et al.* (2019) was used as a framework when considering methodological options for this study. The research onion depicts research as a complex, multi-layered process (see Figure 4).

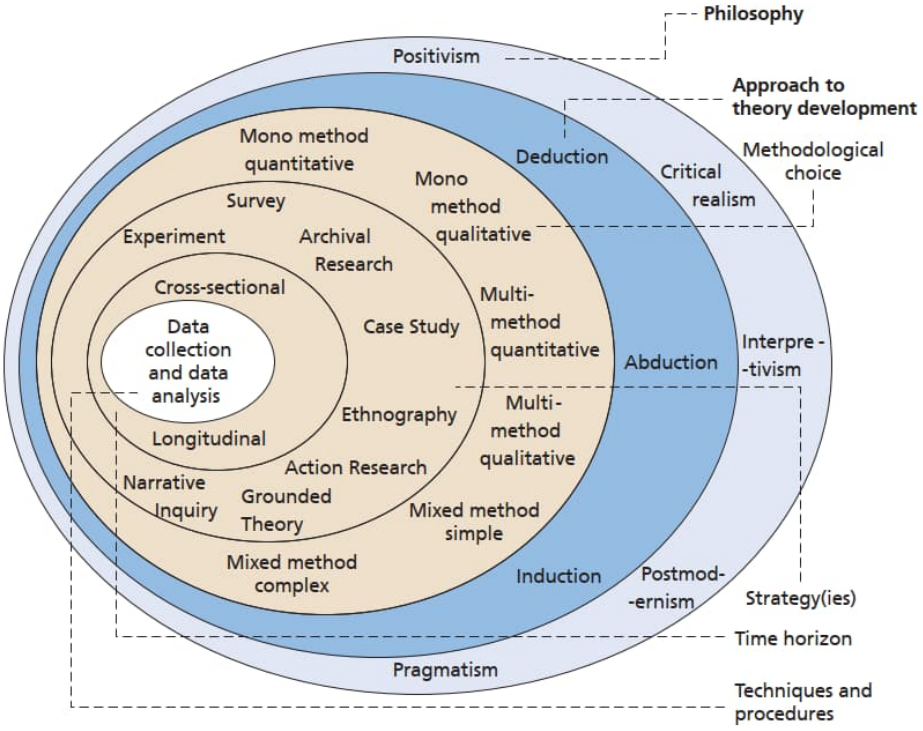


Figure 4: The research onion (Source: Saunders et al. 2019)

The outer layer of the research onion contains research philosophy with positivism and pragmatism at opposite ends of the spectrum. Positivism is closely related to single or mono-method studies with a quantitative approach while pragmatism is associated with complex mixed-method studies. The next layer is the approach to theory development. In theory development, deductive studies are more likely to follow a positivist philosophy, while inductive studies are generally pragmatic. Induction pertains to the development of theory, while deduction involves the testing of existing theory (Saunders *et al*., 2019; Bryman and Bell, 2011). The research onion presents different strategies to collect data, ranging from commonly used strategies in construction management research such as surveys and case studies to less-common strategies such as action research. The methodological choices are divided into quantitative and qualitative; these can be deployed as mono-methods, multi-methods (multiple quantitative or qualitative methods) or mixed methods (a combination of qualitative and quantitative methods). Research strategies and methods can employ either of two-time horizons: longitudinal or cross-sectional. Cross-sectional research involves collecting data at a specific point in time, while longitudinal research entails collecting data on multiple occasions at predetermined time intervals (Bryman and Bell, 2011; Fellows and Liu, 2015). Leedy and Ormrod (2015) asserted that cross-sectional studies are generally more convenient and simpler to conduct as the researcher is required to collect data at a single point in time. Data collection and data analysis are shown at the centre of the research onion and consist of different options depending on the research strategy.

The research onion developed by Saunders *et al.* (2019) provides a range of strategies that can be applied when conducting research. However, a researcher must consider various constraints (e.g., time, accessibility of information, sensitivity of the topic, and willingness of appropriate people to participate) when deciding on an appropriate research design. The researcher must ensure that the proposed research design not only responds to the research questions but is also adequately robust to deal with constraints associated with the research methods employed in the study. The process of choosing a preferred research method and assessing the limitations associated with potential methods is often referred to as “dilemmatics”, a term introduced by McGrath (1981). McGrath (1981) proposed that the selection of research methods involves a series of trade-offs, requiring researchers to opt for the method with the “least evils”. In other words, researchers should be aware that different methods in the research design may come with their own limitations. The method selection process should involve weighing the

advantages and disadvantages of each approach, ultimately opting for methods with the fewest shortcomings.

McGrath (1981) acknowledged that there is no one-size-fits-all research method for a specific research problem. Instead, it is crucial to incorporate mechanisms into the research design to improve the quality and credibility of the findings. For qualitative research, Patton (1999) suggested triangulation as a mechanism to improve the credibility and quality of research. Triangulation provides value to studies as it evaluates problems from more than one perspective thus adding rigour to the research design. Patton (1999) identified four types of triangulation, namely, triangulation of methods, triangulation of data sources, analyst triangulation and theory or perspective triangulation. Any of these approaches can be used to improve the credibility and quality of research.

3.3 Research Philosophy

Saunders *et al.* (2019) defined research philosophy as "a system of beliefs and assumptions about the development of knowledge". Two primary research philosophies used in construction management research are positivism and interpretivism (Knight and Ruddock, 2008). Positivism relates primarily to research conducted using empiricism, where the production of facts is uninfluenced by human interpretation or bias (Saunders *et al.*, 2019). Abdul Rehman and Alharthi (2016) asserted that positivist research usually results in the production of numerical data. Numerical data are the basis of quantitative methodologies associated with the positivist research philosophy (Cohen *et al.*, 2007; Knight and Ruddock, 2008; Saunders *et al.*, 2019). On the other hand, interpretivism attempts "to understand the subjective world of human experience" (Cohen *et al.*, 2007). In the social science research field, Bryman and Bell (2011) posited that the study of humans requires an approach that is cognisant of different social actions and subjective meanings. Saunders *et al.* (2019) reinforced this viewpoint, adding that humans differentiate themselves from physical phenomena through the meanings they create in their social interactions. Interpretivist research generally uses qualitative methodologies focusing on eliciting and interpreting qualitative data (Cohen *et al.*, 2007; Knight and Ruddock, 2008; Saunders *et al.*, 2019). Interpretivist research plays a role in establishing deep and rich understandings of various social contexts (Saunders *et al.*, 2019).

The primary research question in this study is complex and requires a deep understanding of perspectives from professionals in the construction industry. For ease of reference, the primary research question is presented again below:

What are the key determinants of PSO quality in the South African construction industry and how, and to what extent, is quality specifically influenced by the level of fees charged by built environment professionals?

To comprehensively answer the research question, this study required qualitative feedback from built environment professionals responsible for the production of PSOs. Since qualitative data were collected from built environment professionals, an interpretivist philosophy was adopted that allowed data to be analysed with a subjectivist approach to knowledge. The alternative approach of assuming one true reality (as per the positivist research philosophy) was not suited to this study, as the perspectives of the different research participants had to be considered. An inductive approach to theory development was adopted due to the exploratory nature of the primary research question. The interpretivist research philosophy was also well suited to an inductive approach.

3.4 Methodological Choice

Considering the complexity and nature of the primary and secondary research questions, a mixed-method approach (primarily qualitative) was identified as an appropriate methodology to answer the research questions.

A three-stage research design with a combination of survey and case study research strategies was used. The rationale for the three-stage research design was, firstly, to identify and evaluate key factors influencing PSO quality and secondly, to enable a deep understanding of how and to what extent fees influence PSO quality using a combination of research methods. The multistage research design attempted to rectify methodological shortcomings in previous studies that investigated factors influencing the quality of PSOs using a survey, with no additional stage in the research design to validate findings. Aldridge and Levine (2001) and Saunders *et al.* (2019) both stated that maximum benefit is derived from a survey when used as part of a multi-method approach. The multi-method approach allows data to be collected using different research methods, which enables findings from the survey to be triangulated as suggested by Patton (1999).

A mixed-method research design offers the advantage of approaching the research problem from different perspectives. This approach enabled the researcher to gather diverse views from participants and acquire in-depth feedback about their experiences, particularly in the second and third stages of the research. While Creswell (2013) advocated for incorporating pragmatism as the research philosophy in mixed methods research, a recent study by

McChesney and Aldridge (2019) highlighted the effective use of an interpretivist philosophy within a mixed method research design. Thus, the interpretivist philosophy aligned well with the methodological choice, particularly considering the substantial qualitative data produced in this study.

Data analysis was undertaken per discipline. This approach was followed since each discipline has its own unique set of challenges specific to its respective field, which may impact factors shortlisted as influencing the quality of PSOs. Furthermore, factors in the various disciplines are interwoven, complex and difficult to measure. Therefore, conducting a discipline-specific analysis of factors helps to simplify the analysis. A cross-discipline comparison was conducted at the end of each stage in the research design.

3.5 Research Strategy

The study employed two research strategies, namely, surveys and case studies. Surveys were used during the first two stages of the research design, while case studies were used during the third stage of the research design.

3.5.1 Survey

An industry-wide survey was developed to elicit feedback from registered built environment professionals on the following secondary research questions:

- What are the key factors influencing PSO quality?
- What is the significance of key factors influencing PSO quality among different built environment disciplines in the South African construction industry?

Gill and Johnson (2002) posited that a survey is effective at describing the "characteristics of a specific population at a specific point in time". Therefore, an industry-wide survey was chosen as the first stage of the research design as it allowed a broad section of built environment professionals to provide input into the study efficiently. Built environment professionals are producers of PSOs so they should have first-hand knowledge about factors influencing the quality of PSOs. The survey also enabled extraneous variables influencing the relationship between fees and quality to be identified.

Surveys offer a high degree of population validity and allow many respondents to provide feedback in a timely and cost-effective manner (Fellows and Liu, 2015; Wilkinson and Birmingham, 2003). The main weaknesses of surveys are that they offer poor ecological validity (Gill and Johnson, 2002) and in some instances do not provide rich in-depth data. The

use of case studies during the third stage of the research design assisted in addressing those weaknesses. Another weakness of surveys is their reliance on participants having the requisite knowledge to provide credible feedback to the study. This highlights the importance of carefully selecting participants to ensure that only those with an appropriate level of knowledge participate in the study.

Previous studies that investigated factors influencing the quality of different outputs in the construction industry all used questionnaires as the primary data collection technique. Therefore, the questionnaires were used as the data collection technique during the industry-wide survey. The questionnaire consisted of five sections. The first section included an open-ended question simply asking participants (without being prompted in any way) to list key factors influencing the quality of PSOs. This allowed participants to list the factors that were most important to them based on their experience in industry. Since key factors were raised by participants of their own volition without any prompting or leading questions, the frequency at which factors were cited was used to establish the significance of key factors (i.e., factors with the highest frequency were deemed most significant). Importantly, establishing the significance of key factors in this study should not be mistaken for statistical significance. This study was rooted in an interpretivist philosophy; hence, tests for statistical significance were not required or performed.

Sections 2 through 5 of the questionnaire contained a list of factors extracted from the literature. Factors were presented to participants who provided their level of agreement (using a five-point Likert scale) on whether factors influenced the quality of PSOs. Instead of undertaking a detailed statistical analysis of Likert scale data (see Saunders *et al*., 2019 and Bryman and Bell, 2011), a first-level descriptive analysis was conducted for four reasons. Firstly, the limited sample sizes from a few disciplines (particularly quantity surveying, mechanical engineering and electrical engineering) may have produced unreliable and inconclusive findings if statistical tests were conducted. Secondly, the presentation of factors to participants (as opposed to them being freely able to propose their factors) is akin to leading participants during data collection. This may result in some factors being inaccurately elevated as key factors. Thirdly, Section 1 of the questionnaire was used as the primary instrument to identify key factors. The identification of top-ranked factors from Sections 2 through 5 of the questionnaire was presented to industry experts in Stage 2 of the research design for confirmation of their importance. These factors were subsequently only used to validate key factors from Section 1 of the questionnaire. Lastly, the study was underpinned by an interpretivist research

philosophy, which does not necessitate a full-scale statistical analysis as required in a traditional positivist study. The descriptive analysis complemented data collected and analysed during the first part of the industry-wide survey, the survey of industry experts and case studies.

A survey of industry experts was conducted after the industry-wide survey as part of the second stage of the research design. The survey of industry experts consisted of structured interviews with industry experts from various disciplines as the research method and data collection technique. The interviews elicited in-depth viewpoints from experienced professionals that did not participate in the survey. The interviews enabled two-way interaction between the researcher and participants whereby the researcher was able to probe specific issues of interest and get clarity where required. Interviews were used to validate feedback from the industry-wide survey about key factors influencing the quality of PSOs. Additional questions exploring how and to what extent fees influence the quality of PSOs were included in the interviews to elicit in-depth feedback from industry experts.

3.5.2 Case Study

Case studies are effective at answering research questions that begin with "how" (Yin, 2009; Saunders *et al.*, 2019). Therefore, case studies of built environment consulting companies and projects they completed were used to answer the "how" portion of the remaining secondary research question:

- How and to what extent does the level of fees charged by built environment professionals influence PSO quality?

The case study research strategy complemented the first two stages of the research design by providing rich in-depth data. Feedback from questionnaires generally lacks ecological validity and rich in-depth data that are relevant when trying to understand how and to what extent the quality of PSOs is specifically influenced by fees. Therefore, a case study research strategy was selected as it provides strong ecological validity and allows rich in-depth data to be collected (Fellows and Liu, 2015), which complements the weaknesses of the survey research strategy.

The case studies included an assessment of three projects from different built environment consulting companies (i.e., architectural, civil/structural engineering, electrical engineering, mechanical engineering and quantity surveying) to understand key factors that impacted the quality of PSOs during those projects and obtain a deep understanding of how and to what extent fees influenced the quality of PSOs. Case studies contained semi-structured interviews

as the data collection technique, which enabled the researcher to deeply probe participants on topics of interest.

3.6 Time Horizon

A cross-sectional time horizon was used when conducting the data collection. The cross-sectional time horizon results in a snapshot of data at a point in time. During the three stages of the research design, research instruments were prepared to elicit participants' feedback at a specific point in time.

3.7 Data Collection Stage 1: Industry-Wide Survey

3.7.1 Sampling

The population for the industry-wide survey included built environment professionals from the architectural, civil/structural engineering, electrical engineering, mechanical engineering and quantity surveying disciplines in South Africa.

A purposive sampling regime was used for the industry-wide survey. Participants in the survey had to satisfy the following criteria:

- Hold a degree in any of the built environment disciplines included in this study.
- Be a registered professional with any of the recognised built environment professional councils overseeing architects, engineers and quantity surveyors.
- Have a minimum of five years of industry experience.

3.7.2 Development of the Questionnaire

An online questionnaire was used to collect data during the industry-wide survey. At the beginning of the questionnaire, participants were provided with a background to the study and key concepts such as PSOs and quality were explained. PSOs were defined as deliverables produced by built environment professionals for construction projects (i.e., drawings, technical specifications, reports and BoQ). The concept of quality followed on from the key quality indicators suggested by Govender *et al*. (2022). In the context of this study, participants were advised that good-quality PSOs contain a high level of accuracy, clarity, completeness, and certainty.

The questionnaire was divided into five sections. The first section consisted of a single open-ended question asking participants to provide key factors influencing the quality of PSOs based on their experience. Sections 2 through 5 included closed questions with a list of client (Section 2), company (Section 3), professional (Section 4) and industry (Section 5) factors. The

phraseology of the questions as described by Gill and Johnson (2002) was carefully planned to ensure questions were easy to understand and elicited the necessary information. The layout and sequencing of questions were also carefully structured as described by Cohen *et al*. (2007) to ensure the effectiveness of the questionnaire to obtain the necessary feedback.

For Sections 2 through 5, participants were requested to rate their level of agreement with various factors influencing the quality of PSOs. Several authors assert that questionnaires can measure the level of agreement of a population using a rating scale (Wilkinson and Birmingham, 2003; Knight and Ruddock, 2008; Saunders *et al.*, 2019). Therefore, a five-point Likert scale was used, with participants given the option of selecting "strongly disagree", "somewhat disagree", "neither agree nor disagree", "somewhat agree" and "strongly agree". "Don't know" was added to allow participants to select this option if they felt that they could not provide a credible response about a specific factor. This prevented people from responding if they were unsure about specific factors.

Factors provided in the questionnaire were extracted and amalgamated from the literature on similar topics (e.g., Tilley and McFallan, 2000; Andi and Minato, 2003; Akampurira and Windapo, 2018). Three additional factors not included in the literature were added based on the researcher's experience in the South African construction industry: "decline in the capability of university graduates", "poor quality of registered professionals" and "use of targeted enterprises".

Since most of the factors in Sections 2 through 5 of the survey were derived directly from the literature, a decision was taken not to conduct a full-scale pilot survey. Instead, five industry professionals, each with more than a decade of experience, were asked to complete a preliminary version of the survey. The purpose was for participants to comment on the clarity, ease of use and understanding of the survey. After each participant completed the survey, they provided the researcher with improvements that could be made. Most participants did not have any comments on the preliminary survey. However, two participants mentioned that two questions were unclear. Once these questions were updated by the researcher, the survey was sent back to participants for final comment before finalising for distribution.

3.7.3 Data Collection

The online questionnaire that was developed to collect data as part of the industry-wide survey was created on an online platform called Qualtrics (for further reading on Qualtrics see

www.qualtrics.com). When the questionnaire was ready for distribution, various built environment professional councils and voluntary associations were contacted to seek their permission to distribute the survey to their membership. An invitation to participate in the survey was sent to members of the following built environment voluntary associations and professional councils:

- Association of South African Quantity Surveyors (ASAQS)
- Consulting Engineers South Africa (CESA)
- South African Council for the Architectural Profession (SACAP)
- South African Council for the Quantity Surveying Profession (SACQSP)
- South African Council for the Project and Construction Management Professions (SACPCMP)
- South African Institution of Civil Engineering (SAICE)
- South African Institute of Electrical Engineers (SAIEE)
- South African Institution of Mechanical Engineering (SAIMechE)

An electronic link to the questionnaire was distributed via built environment voluntary associations and professional councils in South Africa. Participants were sent an electronic link to the questionnaire via email and all questions were answered online. By clicking on the link, participants were taken to a page containing an outline of the research and ethical statements related to consent of participants. After selecting a check box agreeing to participate in the survey, participants were taken to the first question. Importantly, at the beginning of the questionnaire, participants were given the definition of PSOs (i.e., drawings, technical specifications, reports and BoQ) and the characteristics of quality (i.e., high level of accuracy, clarity, completeness, and certainty). After the questionnaires were completed, they were captured on the Qualtrics platform and were only accessible to the researcher via his password-protected account.

3.7.4 Data Cleaning

Data from the survey were downloaded onto an Excel spreadsheet for further cleaning and analysis. Data cleaning consisted of two steps. Firstly, responses from the survey were screened to ensure that those responding met the necessary purposive sampling criteria. Secondly, responses to Section 1 of the survey that were incomprehensible were treated as blank entries. Similarly, factors that participants selected as “don’t know” in Sections 2 through 5 of the

survey were treated as blank entries. Once the survey was completed by a participant, it was stored on the Qualtrics online platform and was only accessible to the researcher.

3.7.5 Data Analysis and Reporting

Data from the survey were analysed using content analysis for Section 1 and a first-level descriptive analysis for Sections 2 through 5.

Section 1 of the survey contained a single open-ended question asking participants to list key factors influencing the quality of PSOs based on their experience. The responses from participants were generally a list of factors, which in some instances were accompanied by an explanation of why each factor was deemed important by the participant. Since the responses were in a list format, they were straightforward to analyse and code using content analysis. Due to the quantum of responses, NVivo Release 1.6.1 software was used for coding (for further reading on NVivo see Saunders *et al*., 2019 and Bryman and Bell, 2011). Once coding was complete, frequency analysis was undertaken to determine codes that were frequently cited by participants. Key factors that were cited by 25% or more of the participants were listed as preliminary key factors. These factors needed to be validated in one of the next two stages of the research design for inclusion in the final shortlist of key factors. A comparison of the frequency with which factors were cited was used to establish the significance of key factors (i.e., factors with the highest frequency were considered most significant). This was deemed to be an appropriate mechanism to establish the significance of factors since factors were put forward by participants without any prompting. Hence, the frequency of factors was a strong indicator of significance among participants. As mentioned previously, significance in this study should not be mistaken for statistical significance. This study followed an interpretivist philosophy; therefore, tests for statistical significance were neither required nor performed.

Sections 2 through 5 generated quantitative data using a five-point Likert scale rating system. A descriptive analysis was used to explore the Likert scale data using heat maps, stacked bar charts and bubble charts. The descriptive analysis provided the distribution of agreement among participants with factors in the survey. The software R (for further reading on R see www.r-project.org) was used for data analysis and generating plots as part of the descriptive analysis.

3.8 Data Collection Stage 2: Survey of Industry Experts

3.8.1 Sampling

Construction industry experts who did not participate in the survey but had vast experience and knowledge about rendering professional services and producing PSOs in a consulting environment were identified for inclusion in the survey of industry experts. The survey of industry experts consisted of structured interviews as the research method and data collection technique. Industry experts needed to satisfy the criteria below before being included in the study:

- Did not participate in the industry-wide survey.
- Holds a degree in any of the built environment disciplines included in this study.
- Is a registered professional with any of the recognised built environment professional councils governing architects, engineers and quantity surveyors.
- Has a minimum of 20 years of consulting experience in a built environment discipline relevant to the study.

A range of appropriate sample sizes for interviews was proposed in the literature (Kuzel, 1992; Francis *et al.*, 2010; Brinkmann and Kvale, 2015). However, Mason (2010) highlighted that interviews should ideally be conducted until data saturation is achieved (i.e., further interviews do not yield anything significantly new on the topic). Conducting interviews until saturation is often a function of time and resources (Patton, 2002). Saunders and Townsend (2016) stated that being unable to achieve saturation does not render findings invalid but simply means further investigation is required. They noted that the purpose of interviews should inform their sample size.

Since structured interviews were being undertaken as part of a multistage data collection process and being used as one of the three methods to triangulate findings, a minimum of one expert per built environment discipline was selected. In total, nine industry experts with an average of 38 years of experience were selected to participate in interviews. The experts had vast experience in their respective fields and an appropriate depth of knowledge to answer interview questions.

Due to concerns around the small sample of electrical and mechanical engineers participating in the industry-wide survey, a vastly experienced industry expert with over 50 years of experience was included in the survey of industry experts. The participant served as managing

director of a successful mechanical and electrical consulting engineering firm for over 30 years and had in-depth knowledge of project delivery in a consulting engineering environment. The industry expert was included to improve the validity of the study.

3.8.2 Development of Interview Guide

Structured interviews follow a defined agenda and strategically address research objectives (Wilkinson and Birmingham, 2003). They are generally formulated to collect data according to various themes (Cohen *et al.*, 2007; Saunders *et al.*, 2019). The interviews in this study assessed themes related to key factors influencing PSO quality and the extent to which fees influence the quality of PSOs.

The interviews followed on from the industry-wide survey and were structured to elicit in-depth information on the topic. Best practice guidelines from the literature (Birmingham and Wilkinson, 2003; Brinkmann and Kvale, 2015; Saunders *et al.*, 2019) were used to prepare the interview guide. A review of the interview structure and clarity of questions was conducted by a senior professional in the construction industry before the formal interview process commenced. There were no major changes to the interview guide following the review.

The interview was structured as follows:

- The interviewer provided the background of the study and an explanation of relevant concepts and terminology such as quality and PSOs.
- Background information from participants was elicited including experience, professional registrations and qualifications.
- Section 1: Participants were asked to provide key factors influencing the quality of PSOs based on their experience.
- Section 2: Top-cited factors from each section of the industry-wide survey (e.g., client, company, professional and industry factors) were presented to participants to obtain their agreement or disagreement on whether these were key factors influencing the quality of PSOs. Participants generally provided a brief narrative to substantiate their position for each factor.
- Section 3: Open-ended questions about the influence of fees on the quality of PSOs, motivation of built environment professionals and professionalism in the construction industry were asked.

3.8.3 Data Collection

The survey of industry experts included structured interviews as the data collection technique. Industry experts were identified after the researcher sent email requests to several industry leaders across various professional industry groups. Additionally, professional members of industry groups emailed the researcher to advise him about knowledgeable industry experts who could provide valuable insights into the study.

Interviews were arranged and confirmed via email. Interviews with industry experts were conducted on MS Teams. The researcher took written notes during the interviews and used the audio and transcribe function in MS Teams to validate the written notes. Data from the interview were transcribed by the researcher and stored on his password-protected laptop.

3.8.4 Data Analysis and Reporting

Data from interviews were analysed using a combination of content analysis (Sections 1 and 2) and thematic analysis (Section 3). Section 1 of the interview contained a single open-ended question asking participants to provide key factors influencing the quality of PSOs based on their experience. Similar to the industry-wide survey, the responses generated were generally a list of factors with a justification about the importance of each factor. The list of factors was analysed using content analysis. The next section entailed presenting frequently-cited factors from each section of the industry-wide survey to participants and getting their views on whether these were deemed key factors. These data were analysed using content analysis to determine if there was consensus from industry experts about frequently-cited factors emerging from the industry-wide survey. The last section contained four open-ended questions about motivation, professionalism in the industry and the implication of fees for the quality of PSOs. These questions were analysed using thematic analysis due to the rich in-depth data generated.

3.9 Data Collection Stage 3: Case Studies

3.9.1 Multiple-Case Design

Identifying factors influencing the quality of PSOs and the extent to which fees influence the quality of PSOs among the different built environment disciplines necessitated a multiple-case design. Yin (2009) asserted that multiple-case research design enables comparison across different cases. Separate case studies were required to accommodate variations that may be prevalent in the production of PSOs among different disciplines.

Yin (2009) asserted that replication logic is used in multiple-case research design to reproduce cases in different circumstances, observe results and postulate reasons for results being similar across cases (literal replication) or different following reasons derived from theory (theoretical replication). In this study, replication logic entailed reproducing cases for different built environment disciplines.

3.9.2 Selection of Cases

Case studies were focused on examining projects within built environment consulting companies in South Africa. Companies participating in the study operated in the built environment consulting industry and were selected based on the criteria outlined below:

- The company rendered professional services in one of the built environment disciplines being investigated.
- The company had been in operation for a minimum period of 20 years.
- Registered technical professionals were employed by the company to deliver projects.

3.9.3 Gaining Access

To gain access, an initial email was sent to several companies enquiring if they wanted to participate in the study. The email was sent to either the managing director or a director of each company. When a company indicated a willingness to participate in the study, a formal letter was prepared by the company managing director granting permission for the researcher to carry out research activities. The letter enabled the researcher to undertake interviews with the director or managing director and technical leads on projects and, in some instances, obtain copies of project documents that were specific to the projects being investigated. Once the letter was issued, the director or managing director provided the contact details of a technical lead who was responsible for three projects being investigated. In two cases, the director or managing director was also the technical lead responsible for the three projects being investigated. Arrangements were made to conduct interviews with participants via MS Teams. Semi-structured interviews were conducted separately with the technical leads responsible for the three projects being investigated and directors or managing directors of the companies, except in instances where the technical lead and director or managing director were the same person. During interviews, relevant terminology and concepts such as quality and PSOs were explained to the participants. In addition to interviews, samples of PSOs that were produced were provided to the researcher for inspection by three companies.

The main challenge around gaining access was the willingness of companies to participate in the study. Many directors who were contacted either did not respond or indicated that they did not have time to participate. Even companies that participated mentioned they could only commit an hour or two to the interview process. Additionally, most companies were not willing to allocate more than one technical lead to the interview process for projects being investigated. Therefore, the researcher decided to interview a maximum of two people per company (i.e., project technical leads and director or managing directors) who were most knowledgeable about factors influencing the quality of PSOs and the extent to which fees influences quality. This also helped to reduce the amount of time required to undertake each case study.

The lack of interviews with the general project team was one of the limitations of the data collection process. However, interviews with technical leads who had oversight over the full project delivery process were considered to adequately compensate for this shortcoming. Another shortcoming related to access was the unwillingness of most companies to provide access to documents for inspection as part of the data collection process.

3.9.4 Unit of Analysis

Technical leads responsible for the delivery of projects and PSOs were the unit of analysis. These individuals had first-hand knowledge of key factors influencing the quality of PSOs on projects being investigated. Since technical leads were interviewed on multiple projects, they were processed as an embedded unit of analysis per case.

3.9.5 Data Collection

Case studies were undertaken with built environment consulting companies from each of the disciplines being investigated in the study. Interviews were arranged and confirmed via email after obtaining permission from the company that they would participate in the study. Once the built environment companies agreed to participate in the study, semi-structured interviews were held with technical leads and a senior director from each company. The interviews covered a random sample of three completed projects to identify and evaluate key factors influencing the quality of PSOs and how and to what extent fees influenced the quality of PSOs on those projects.

Interviews were conducted on MS Teams. The researcher took written notes during the interviews and produced an audio recording of the meeting in MS Teams, which enabled a

verbatim transcript of the interview to be produced. Data from the interview were transcribed by the researcher and stored on his password-protected laptop.

3.9.6 Recording and Coding of Observations

For each project being investigated, an interview was conducted with the technical lead. At the beginning of the interview, the overall project scope, size and complexity were recorded. Thereafter, in-depth discussions were held to determine key factors that influenced the quality of PSOs on the project and the specific influence of fees on the quality of PSOs. Interviews with directors or managing directors focused on understanding company-related factors that may have impacted the quality of PSOs on projects that were investigated. Additionally, directors or managing directors provided specific commentary on the extent to which fees influenced the quality of PSOs on projects within their company and the industry in general.

Recording of observations:

Interviews were conducted on MS Teams with the audio recording and transcription function enabled after permission was given by the research participant. The researcher also took handwritten notes during interviews, which were later used to complement the transcription and audio recording.

Coding of observations:

Where possible, coding followed the original codes that were created as part of the open-ended section of the industry-wide survey. Most of the factors and sentiments shared by interview participants fell within these codes that were already set up; hence this approach was taken.

3.9.7 Analysis of Observations

Interview transcripts were analysed using thematic analysis. Boyatzis (1998) described thematic analysis as a comprehensive approach to coding qualitative data. A paper by Braun and Clark (2006) that is widely cited by researchers conducting thematic analysis defined thematic analysis as "a method for identifying, analysing and reporting patterns (themes) within data". Braun and Clark (2006) posited that thematic analysis is a useful and flexible technique that can be used to analyse qualitative data.

Braun and Clark (2006) supplied detailed guidelines for conducting thematic analysis. The analysis of data in this study followed guidance by Braun and Clark (2006). An inductive

approach was adopted during thematic analysis whereby themes were linked to the data provided (Patton, 2002). The thematic analysis process followed in this study is illustrated in Figure 5.

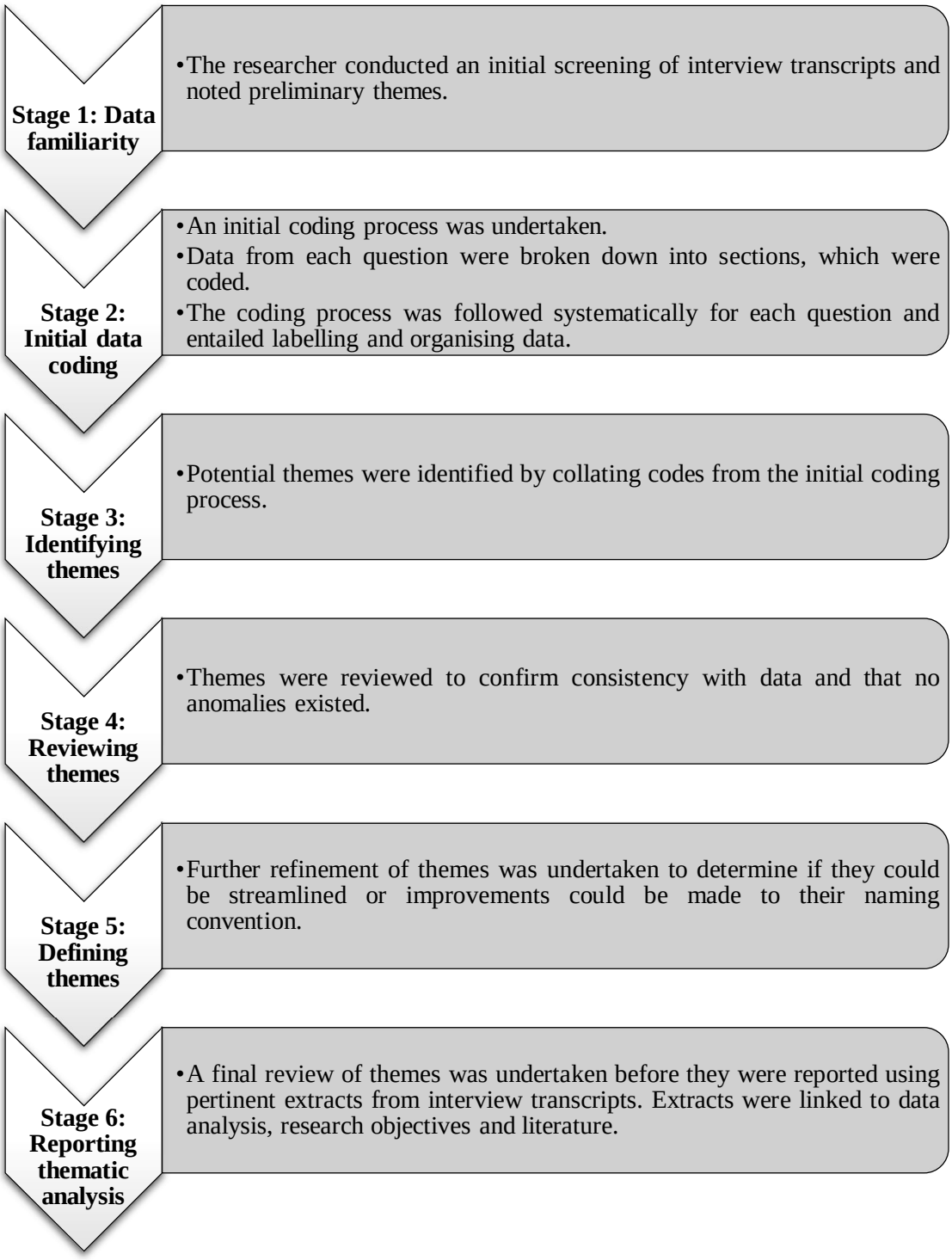


Figure 5: Six-stage thematic analysis process

3.10 Selection of Key Factors Influencing the Quality of PSOs

The open-ended question in Section 1 of the industry-wide survey was used as the starting point to identify and select key factors influencing the quality of PSOs. Factors that were cited by 25% of participants in a specific discipline in Section 1 of the survey were examined further as potential key factors influencing the quality of PSOs.

Sections 2 through 5 in the survey were used in Stage 2 (i.e., the survey of industry experts) to provide industry experts with additional key factors that may not have been considered. However, only top-ranked factors among industry participants in Sections 2 through 5 of the industry-wide survey were presented to industry experts. Presentation of factors from Sections 2 through 5 to industry experts was undertaken to ensure that none of the key factors were overlooked during the final selection process. Given the use of a limited number of industry experts for validating key factors, this step was taken to prevent any oversight.

For inclusion in the final shortlist of key factors influencing the quality of PSOs, factors identified in Section 1 of the survey by at least 25% of participants needed to be validated in either the survey of industry experts or case studies, i.e., the same factors from Section 1 of the survey needed to emerge as a key factor in either of the two subsequent stages of the research design. Figure 6 illustrates the process that was followed to select key factors influencing the quality of PSOs.

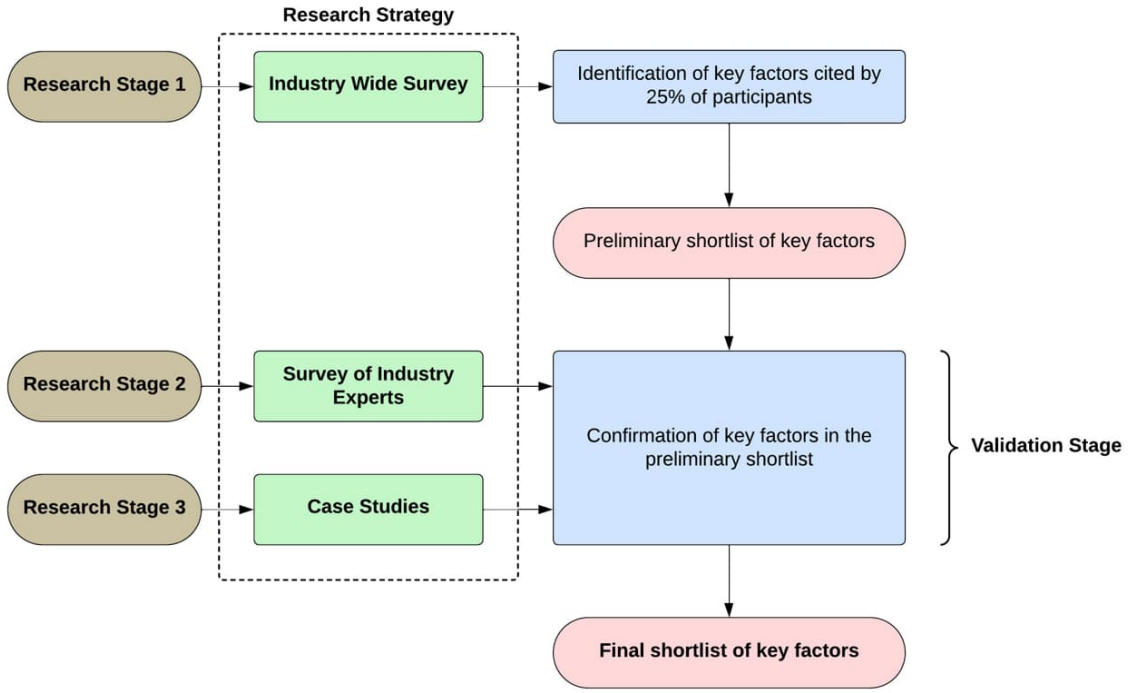


Figure 6: Process to select key factors influencing the quality of PSOs

3.11 Validity

The following mechanisms were included in the research design to improve internal validity:

- Participants were given a clear definition of quality and PSOs at the beginning of each data collection stage.
- Triangulation of data sources using a multistage research design and the careful selection of participants with requisite experience assisted in minimising bias and improving internal validity.
- Eliciting in-depth qualitative data during the survey of industry experts and case studies contributed to providing a deep understanding of the complex relationship between fees and PSO quality.

The industry-wide survey of 604 built environment professionals from different built environment disciplines strengthened the external validity of findings that identified key factors influencing PSO quality.

Theoretical saturation was used to improve the external validity of findings on how and to what extent the quality of PSOs was specifically influenced by fees. The survey of industry experts and case studies was conducted until theoretical saturation was achieved.

3.12 Reliability

The three-stage research design assisted in improving the reliability of the study. Survey and case study research strategies complement each other and improve different aspects of the research design. The industry-wide survey assisted in eliciting feedback from the wider built environment population. The survey of industry experts was necessary to validate findings from the industry-wide survey and provide in-depth feedback on the relationship between fees and the quality of PSOs. Case studies assessed actual projects conducted by built environment consulting companies. The rich in-depth qualitative data from case studies supplemented results from the first two stages of the research design and provided further detailed insights on how and to what extent fees influence the quality of PSOs produced by built environment professionals. Lastly, the research design was recorded in detail to allow future researchers to replicate the study.

3.13 Research Ethics

An ethics clearance application was submitted to the University of the Witwatersrand Ethics Committee in November 2021 before data collection commenced. Ethics clearance was granted by the committee at the beginning of 2022 (ethics protocol no. H22/01/05).

The primary research participants were built environment professionals in the construction industry. None of the research participants were included in vulnerable categories as defined by the Wits Ethics Committee (refer to the Wits Ethics Committee (Non-Medical) Ethics Clearance Application). Furthermore, the study did not pose any potential risks or harm to participants. On the contrary, participation in the study assisted in resolving the ongoing debate around fees and the quality of PSOs.

To ensure anonymity and protect the identities of participants, the researcher was the only person interacting with research participants. All data emanating from the study were either stored on a password-protected online platform or a local drive on the researcher's password-protected laptop.

Specific considerations for each stage of the research design are provided in the subsequent sections.

3.13.1 Industry-Wide Survey

The industry-wide survey used an online questionnaire as the data collection technique. At the beginning of the online questionnaire, a form was displayed to participants explaining the nature of the study and asking if they were willing to participate. Those that wanted to participate in the study were directed to the questionnaire after clicking "next" while those that did not want to participate were directed to a screen thanking them for their response. Participants contributed their time and knowledge to complete the online questionnaire without any incentives. Additionally, all feedback was provided anonymously. The online questionnaire did not require participants to provide their names. When presenting results, participants have been identified with the letter "P" followed by a sequential numbering system.

3.13.2 Survey of Industry Experts

The survey of industry experts used structured interviews as the data collection technique. Before the interviews, participant information sheets were sent to the industry experts explaining the nature of the study and their roles in it. Thereafter, participants indicated their willingness to participate. At the beginning of each interview, a background to the study was

provided and ethical protocols were discussed. The researcher advised participants that their feedback would be anonymous. Participants were asked if they consented for the audio and transcript of the interview to be captured on MS Teams. Feedback from all participants was anonymous. When presenting results, participants have been identified with the letters “IE” followed by a sequential numbering system.

3.13.3 Case Studies

A selection of built environment companies that satisfied the inclusion criteria were approached to participate in the study. A letter was sent to each company explaining the nature of the study and the extent of their proposed involvement. Companies that participated in the study issued the researcher with a formal letter signed by a director of the company indicating their willingness to participate.

Case studies used semi-structured interviews as the data collection technique. A participant information sheet was sent to potential participants explaining the nature of the study and their roles in it before the interviews. Thereafter, participants indicated their willingness to participate.

At the beginning of each interview, the background of the study was provided including discussing ethical protocols that were followed. The researcher advised participants that their feedback would be anonymous. Participants were asked if they consented for the audio and transcript of the interview to be captured on MS Teams. Names of companies were omitted from the study; instead, case studies were recorded using a sequential numbering system. Similarly, participants from each case study were either referred to as technical lead, director or managing director.

3.14 Conclusion to This Chapter

This chapter contained the research design and methods employed in this study. It elaborated on a mixed-method research design comprising three distinct stages. The discussion delved into sampling, data collection, and analysis during each stage of the research design.

The first stage of the research design included an industry-wide survey of built environment professionals. The industry-wide survey was used to identify key factors, influencing the quality of PSOs and the significance of those factors. The second stage included a survey of industry experts, which consisted of structured interviews with industry professionals from different built environment disciplines. Interviews were undertaken to validate data emerging from the industry-wide survey. Lastly, case studies of built environment consulting companies

were conducted. Interviews with technical leads and directors or managing directors were conducted to assess three projects from each company and determine key factors influencing the quality of PSOs and how and to what extent fees influenced the quality of PSOs. The chapter also described ethical considerations when undertaking this research.

Chapter 4: Data Collection, Presentation, Analyses and Results

4.1 Introduction

This chapter reports on data collection and presents and analyses results from the three-stage research design. The chapter includes results from the industry-wide survey, the survey of industry experts and the case studies.

Section 4.2 presents and analyses results from the industry-wide survey. The section commences with a summary of the profile of participants. Results are then presented according to the structure of the survey (i.e., Section 1 contained results from the open-ended questions and Sections 2 through 5 contained results from the Likert scale questions). At the end of each section, a cross-discipline analysis of results was conducted.

Section 4.3 presents and analyses results from the survey of industry experts. The profile of interview participants and duration of interviews are highlighted for context at the beginning of the section. This is followed by the interview results. The structure of the interviews and results are similar to the industry-wide survey, i.e., five sections assessing key factors influencing the quality of PSOs. However, the interviews also included open-ended questions investigating key areas such as the impact of fees on the quality of PSOs, professionalism and motivation among built environment professionals. Perspectives from industry experts about these key areas are provided.

Section 4.4 presents and analyses results from case studies of built environment consulting companies. The section commences with a description of companies participating in the case studies and participants who were included in interviews. The results presented include key themes emerging from the seven cases. Additionally, the impact of fees on the quality of PSOs in the various cases was also presented.

4.2 Industry-Wide Survey

4.2.1 Data Collection

The survey was conducted from 10 March through 10 April 2022. The survey was distributed by various built environment voluntary associations and professional councils in South Africa. A total of 604 built environment professionals participated in Section 1 of the survey with 507 built environment professionals participating in Sections 2 through 5. Responses from the survey were downloaded from Qualtrics into an Excel file for further analysis in NVivo (Section 1) and R (Sections 2 through 5).

4.2.1.1 Survey Section 1 (Open-Ended Question)

Table 3 and Figure 7 provide a breakdown of participants in the study. The two largest participants groups were architects and civil/structural engineers, with these disciplines comprising 45% and 43% of the total number of participants, respectively. As per the sampling criteria, only participants who were registered professionals with one of the relevant built environment professional councils formed part of the study. Electrical and mechanical engineers comprised the fewest participants in the study, contributing approximately 3% and 1%, respectively, to the number of participants.

Table 3: Profile of participants

Discipline	No. of Participants	Professionally Registered	% Composition
Architect	272	272	45%
Civil/Structural Engineer	262	262	43%
Electrical Engineer	16	16	3%
Mechanical Engineer	8	8	1%
Quantity Surveyor	46	46	8%
Total	**604**	**604**	100%

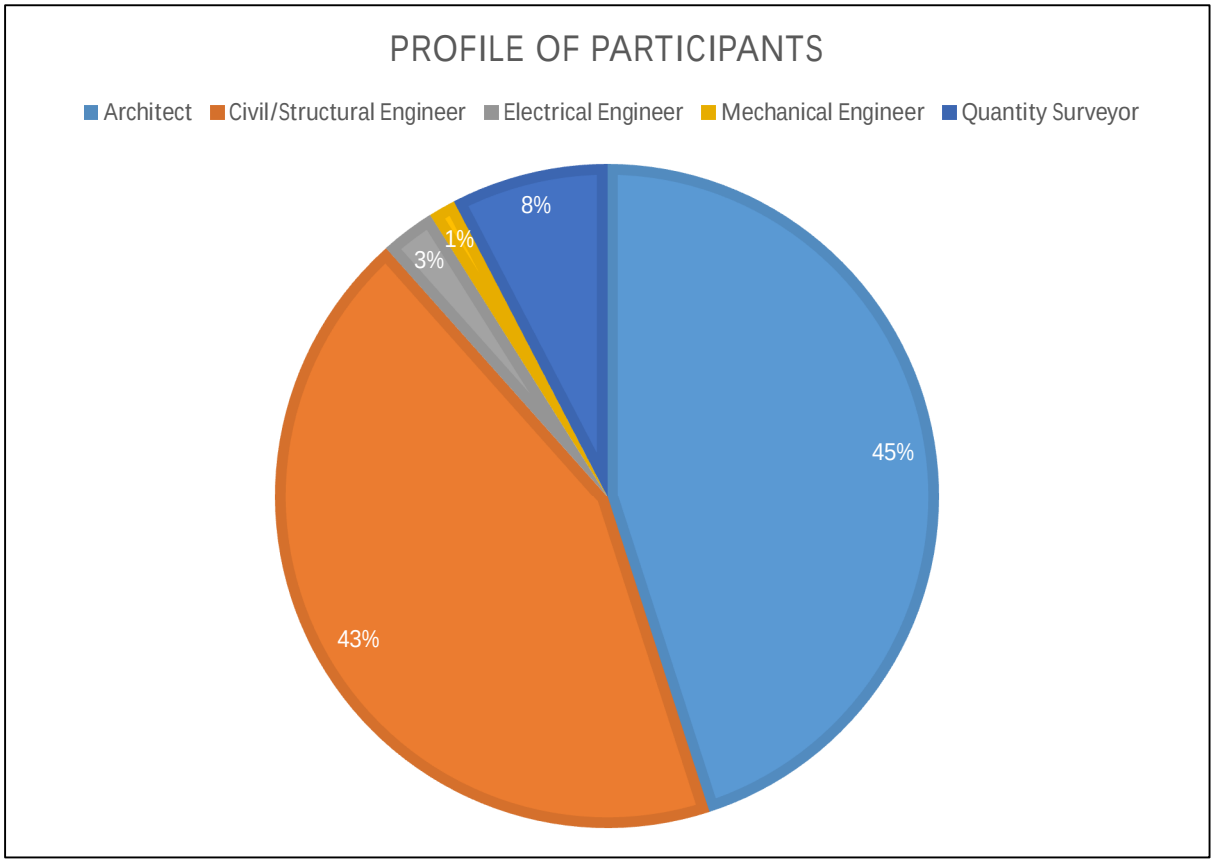


Figure 7: Pie chart showing the distribution of participants

Table 4 and Figure 8 provide a breakdown of the experience of participants. It is important to note that more than 50% of participants belonging to architectural, civil/structural engineering and electrical engineering had more than 20 years of experience. The experience of participants improves the potential for their feedback to be valid due to their vast experience in the industry. Overall, more than half of the participants in the study had more than 20 years of experience in the industry.

Interestingly, the distribution of experience for the quantity surveying participants in the study is opposite to the other disciplines. That is, for the quantity surveying profession, the number of participants decreases as the level of experience rises whereas the opposite is true for the architectural, civil/structural engineering and electrical engineering disciplines.

Table 4: Experience of participants

Discipline	**Number of participants**	**Level of experience**					
		6-10 years of experience	**Percentage composition**	**11-20 years of experience**	**Percentage composition**	**More than 20 years of experience**	**Percentage composition**
Architect	272	52	19%	76	28%	144	53%
Civil/Structural Engineer	262	38	15%	71	27%	153	58%
Electrical Engineer	16	1	6%	4	25%	11	69%
Mechanical Engineer	8	3	38%	2	25%	3	38%
Quantity Surveyor	46	24	52%	14	30%	8	17%
Total	**604**	**118**	**20%**	**167**	**28%**	**319**	**53%**

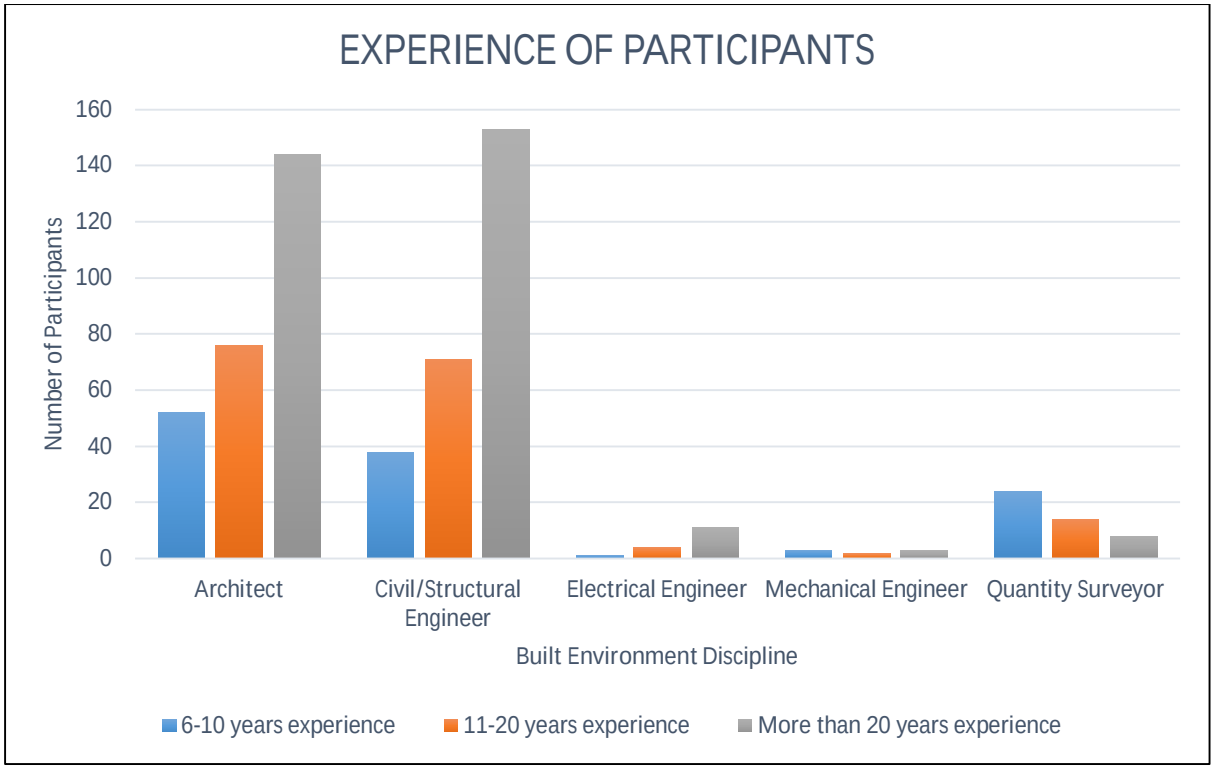


Figure 8: Bar chart showing the experience of participants

Table 5, Figure 9 and Figure 10 illustrate the employers of participants in the study. Most participants (68%) were employed by built environment consultants, with clients of built environment services and "other" employers comprising 12% and 18%, respectively. "Other" employers included development finance institutions, suppliers and any other category of employer that is not defined as client, consultant or contractor. Interestingly, participants for civil/structural engineering (83%), electrical engineering (81%), mechanical engineering (75%) and quantity surveying (72%) professions were heavily skewed in favour of consultants. The smallest employers of participants in the study were contractors, who comprised 3% of the total participants.

Table 5: Employers of participants

Discipline	**No. of participants**	**Employer**							
		Consultant	**Percentage composition**	**Client**	**Percentage composition**	**Contractor**	**Percentage composition**	**Other**	**Percentage composition**
Architect	272	141	52%	46	17%	3	1%	82	30%
Civil/Structural Engineer	262	217	83%	17	6%	7	3%	21	8%
Electrical Engineer	16	13	81%	2	13%	0	0%	1	6%
Mechanical Engineer	8	6	75%	0	0%	2	25%	0	0%
Quantity Surveyor	46	33	72%	5	11%	6	13%	2	4%
Total	**604**	**410**	**68%**	**70**	**12%**	**18**	**3%**	**106**	**18%**

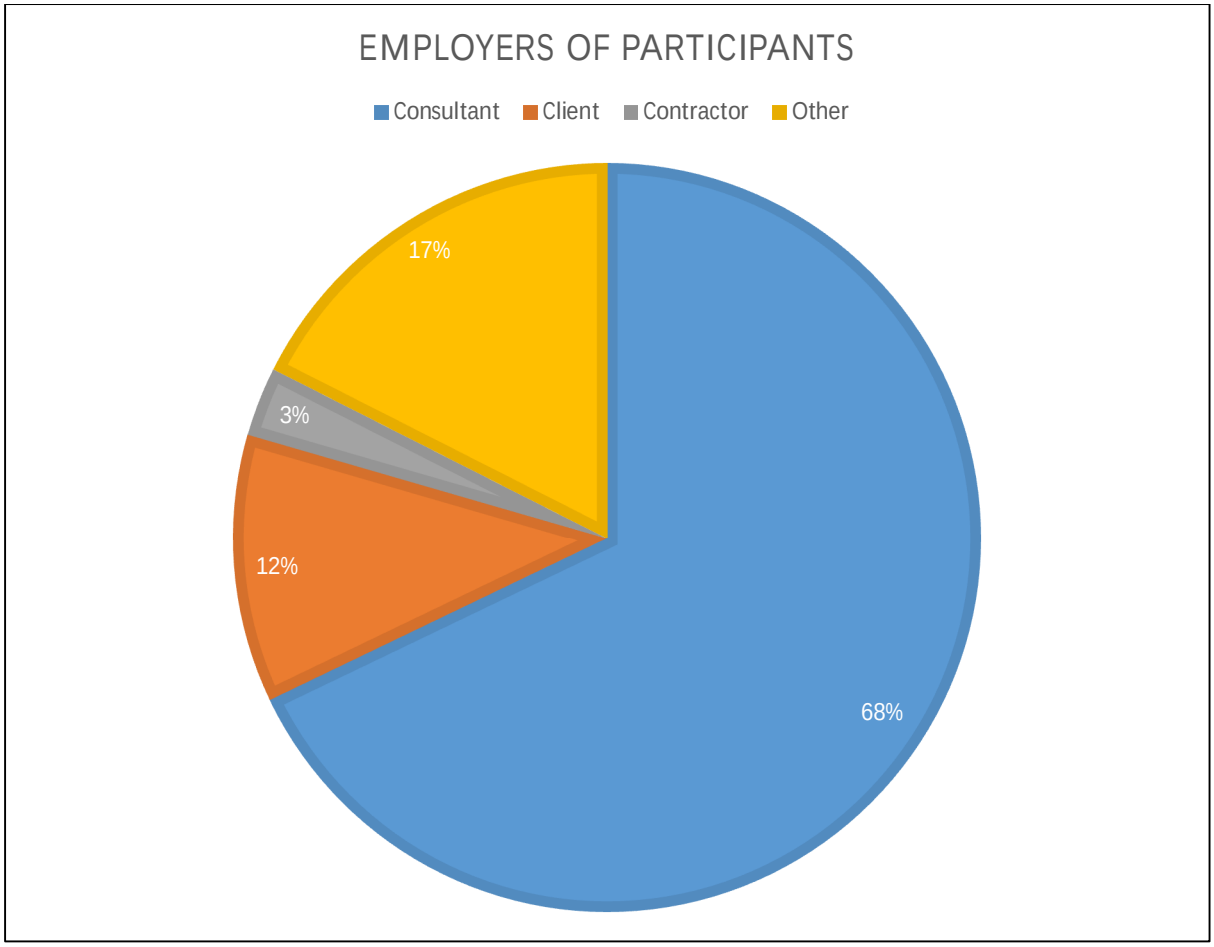


Figure 9: Pie chart showing the distribution of participants' employers

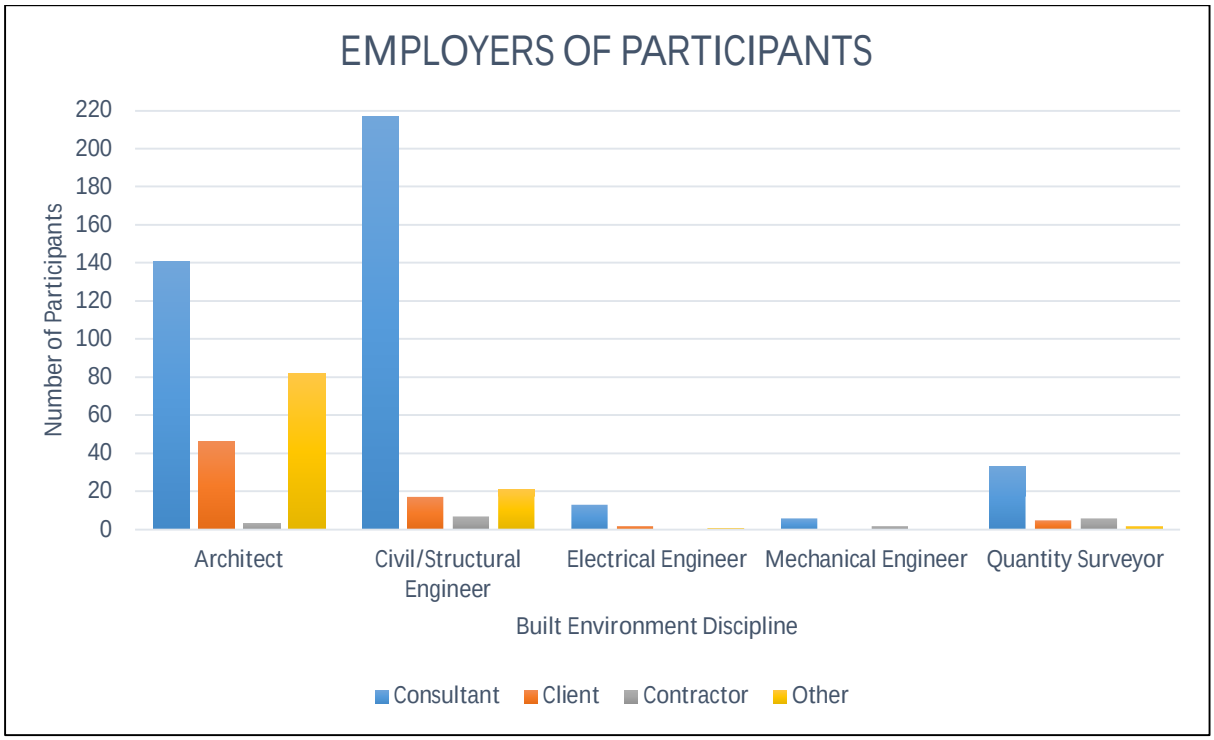


Figure 10: Bar chart showing the distribution of participants' employers

4.2.1.2 Survey Sections 2 through 5 (Likert Scale Questions)

Table 6 and Figure 11 provide a breakdown of participants in the study. The two largest participants groups were architects and civil/structural engineers, with these disciplines comprising 43% and 45% of the total number of participants, respectively. This was similar to the distribution of participants in the open-ended section of the survey. Electrical and mechanical engineers comprised the fewest participants in the study, contributing approximately 3% and 1%, respectively.

Table 6: Profile of participants

Discipline	No. of Participants	Professionally Registered	% Composition
Architect	216	216	43%
Civil/Structural Engineer	231	231	45%
Electrical Engineer	14	14	3%
Mechanical Engineer	7	7	1%
Quantity Surveyor	39	39	8%
Total	**507**	**507**	**100%**

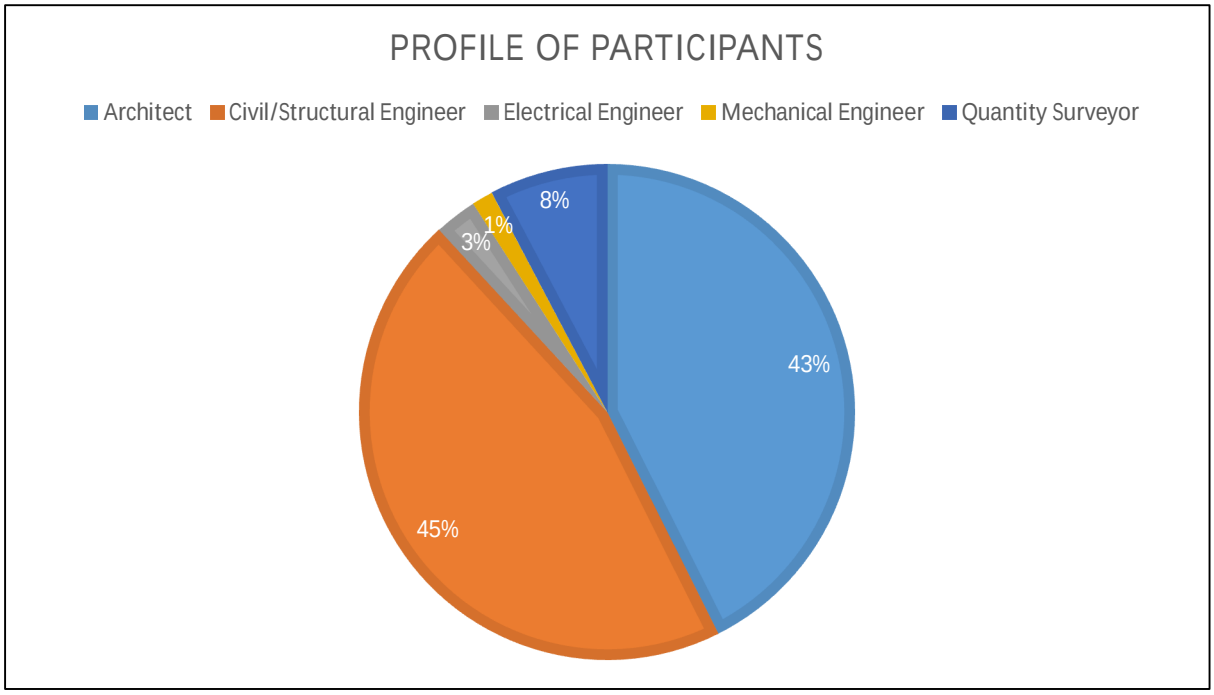


Figure 11: Pie chart showing the distribution of participants

Table 7 and Figure 12 provide a breakdown of the experience of participants. More than 50% of participants belonging to the architectural, civil/structural engineering and electrical engineering professions had more than 20 years of experience. Similar to the open-ended section in the survey, the distribution of experience for the quantity surveying participants in

the study is opposite to the other disciplines. That is, for the quantity surveying profession, the number of participants decreases as the level of experience increases whereas the opposite is true for the architectural, civil/structural engineering and electrical engineering disciplines.

Table 7: Experience of participants

Discipline	**Number of participants**	**Level of experience**					
		6-10 years of experience	**Percentage composition**	**11-20 years of experience**	**Percentage composition**	**More than 20 years of experience**	**Percentage composition**
Architect	216	43	20%	55	25%	118	55%
Civil/Structural Engineer	231	33	14%	63	27%	135	58%
Electrical Engineer	14	0	0%	3	21%	11	79%
Mechanical Engineer	7	3	43%	2	29%	2	29%
Quantity Surveyor	39	20	51%	12	31%	7	18%
Total	**507**	**99**	**20%**	**135**	**27%**	**273**	**54%**

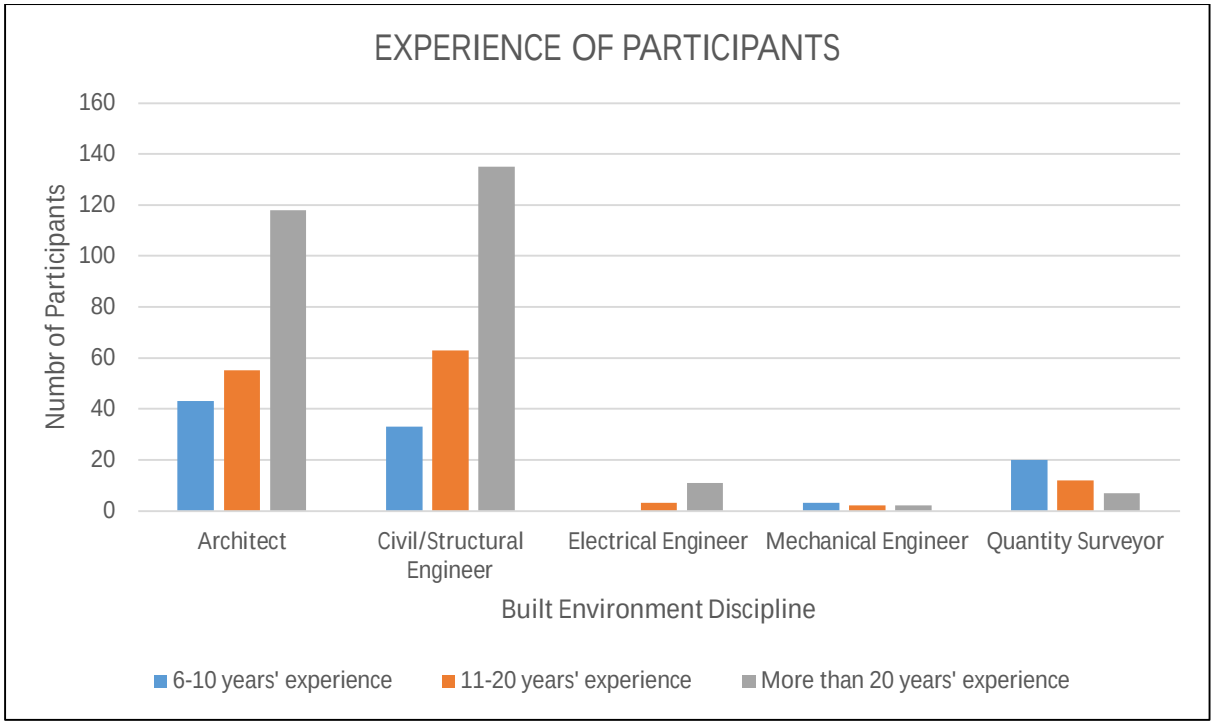


Figure 12: Bar chart showing the experience of participants

Table 8, Figure 13 and Figure 14 illustrate the employers of participants in the study. Most participants (69%) were employed by built environment consultants, with clients of built environment services and "other" employers comprising 10% and 18%, respectively. Similar to the open-ended section of the survey, the participants for civil/structural engineering (83%), electrical engineering (93%), mechanical engineering (71%) and quantity surveying (69%) professions were heavily skewed in favour of consultants. The smallest employers of participants in the study were contractors, who comprised 3% of the total participants. The general distribution of employers from the open-ended section of the survey was maintained.

Table 8: Employers of participants

Discipline	**No. of participants**	**Employer**							
		Consultant	**Percentage composition**	**Client**	**Percentage composition**	**Contractor**	**Percentage composition**	**Other**	**Percentage composition**
Architect	216	113	52%	35	16%	1	0%	67	31%
Civil/Structural Engineer	231	191	83%	14	6%	6	3%	20	9%
Electrical Engineer	14	13	93%	0	0%	0	0%	1	7%
Mechanical Engineer	7	5	71%	0	0%	0	0%	2	29%
Quantity Surveyor	39	27	69%	4	10%	6	15%	2	5%
Total	**507**	**349**	**69%**	**53**	**10%**	**13**	**3%**	**92**	**18%**

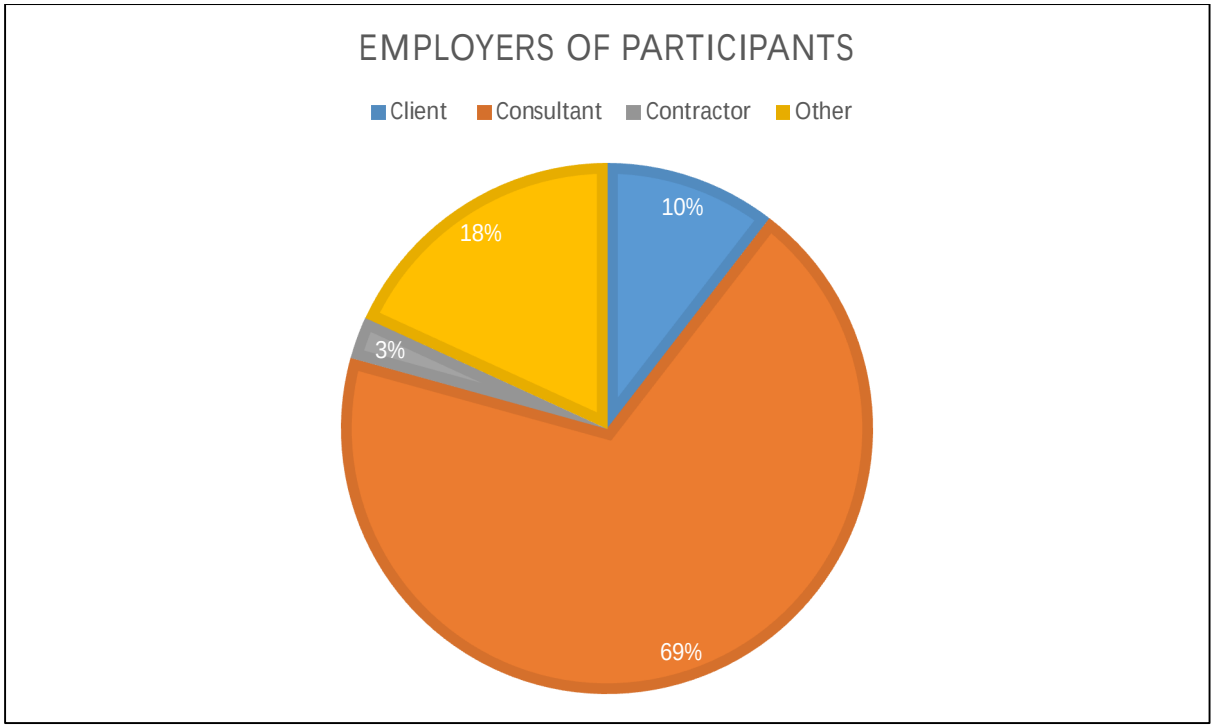


Figure 13: Pie chart showing the distribution of participants' employers

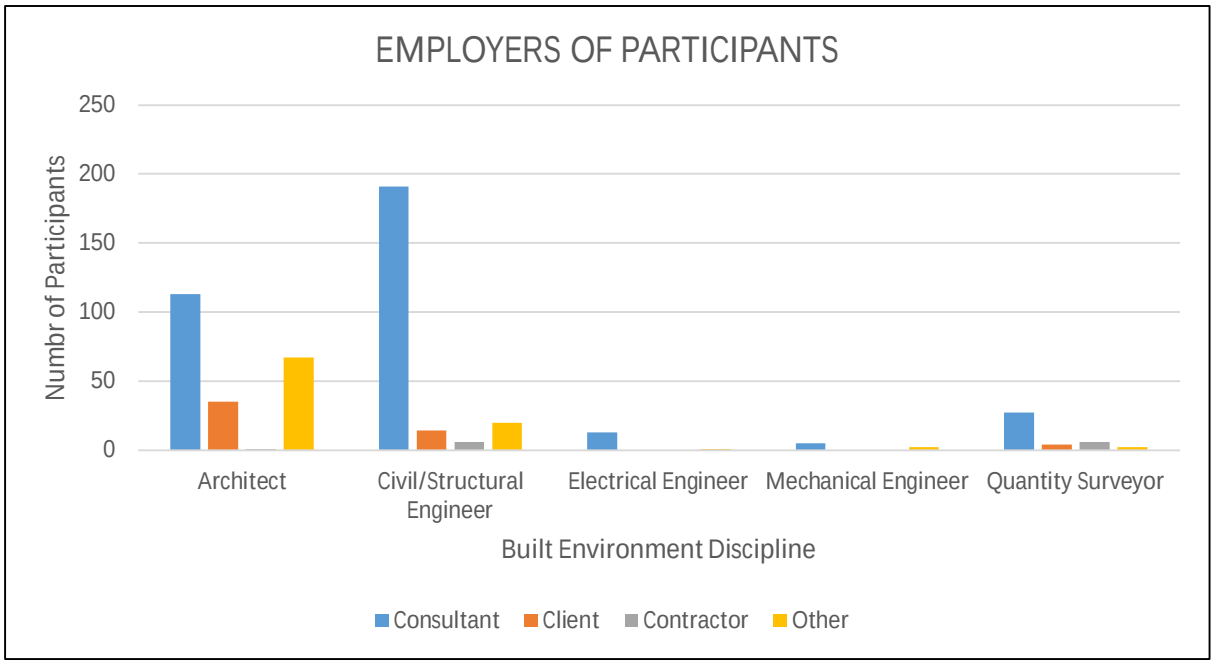


Figure 14: Bar chart showing the distribution of participants' employers

4.2.2 Section 1: Key Factors Influencing the Quality of PSOs (Open-Ended)

Section 1 reports on feedback provided by built environment professionals when asked to "list key factors that influence the quality of PSOs" based on their experience. The factors have been grouped into four broad themes (as illustrated in Figure 15), namely, client factors, company factors, professional factors and industry factors. The four broad themes were formulated based on themes highlighted in the construction management literature on this topic.

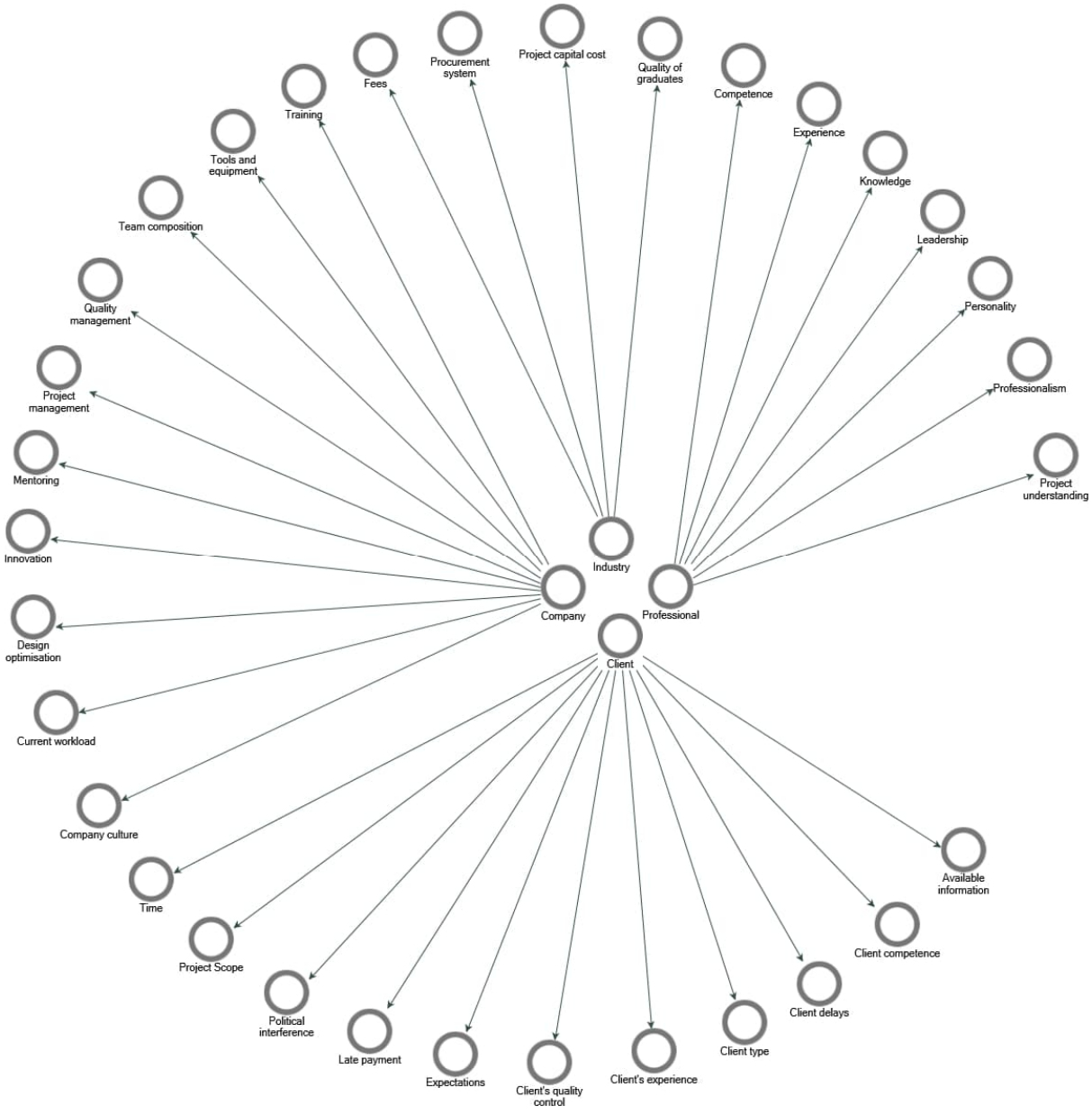


Figure 15: Concept map of themes and key factors from Section 1 of the industry-wide survey

A detailed analysis of themes and key factors is provided in the next few sections.

4.2.2.1 Thematic analysis

Client Factors

Factors within the client's control on projects were included as client factors. Key client factors included time, project scope, available information, client competence, expectations, client type, client experience, client delays, late payment, political interference and clients' quality control.

- Time

The amount of time available to produce PSOs was one of the frequently-cited key factors influencing the quality of PSOs. Participants mentioned that lack of time during the different project stages placed additional pressure on consultants and adversely impacted the quality of PSOs. Participants asserted that lack of time was often linked to clients' lack of experience and understanding regarding the time required to produce PSOs. Furthermore, participants highlighted a growing trend of compressed timeframes to produce PSOs before construction. This was dictated by clients wanting to spend budgets within a particular financial year. Several participants also associated the lack of time available on projects with fee structures, indicating that fees available on projects often limited the amount of time that could be allocated to project tasks. A few participants felt strongly that insufficient time on projects adversely impacted attention to detail, level of checking and coordination on projects. Table 9 shows selected verbatim data extracts from participants.

Table 9: Selected verbatim data extracts for "time" (Total pieces of coded text relating to this theme = 295)

Participant ID	Occupation	Employer	Verbatim data extract
P03	Civil/Structural Engineer	Consultant	*"Unrealistic timelines - clients have unrealistic expectations of time taken to deliver quality PSOs, there is no time to think twice about a concept, it's bullied into a working design because of time constraints. Design optimisation also suffers as a result of this."*

Participant ID	Occupation	Employer	Verbatim data extract
P118	Architect	Other	*"PSOs are influenced by time, where the employer understands that more time equals a higher quality PSO."*
P131	Civil/Structural Engineer	Client	*"Time - reduction in time allowed for designs etc. leads to a reduction in quality of drawings."*
P219	Architect	Consultant	*"Unreasonable time constraints by the client/employer leads to poor-quality output."*
P228	Quantity surveyor	Consultant	*"Insufficient time allowed in the project programme to sufficiently design all the elements required to produce a technically correct and sound BoQ."*
P269	Civil/Structural Engineer	Consultant	*"Sufficient time allowance for coordination between professionals."*
P408	Architect	Consultant	*"Time Constraints – Rushing projects to achieve departmental milestones reduces attention to detail during the project technical documentation, especially in government projects."*
P411	Architect	Consultant	*"Time frame and project programme to complete work stages to an acceptable industry standard."*
P438	Architect	Client	*"Timeous delivery of information. We work in a team environment and others must be given the opportunity to comment on the design and working drawings."*
P449	Architect	Consultant	*"Timeframes. Usually, there are unrealistic timelines. Consultants have to rush and this can influence the quality of their work."*

Participant ID	Occupation	Employer	Verbatim data extract
P535	Civil/Structural Engineer	Consultant	*"The time available to produce the outputs. It happens often that a Client suddenly wants to go out on tender to procure a contractor, even though more time is needed to complete the PSOs up to the required standard."*
P541	Architect	Consultant	*"Time - a too tight timeframe will not allow time for thorough coordination of information prior to construction."*

- Project scope

Having a clearly defined project scope was identified as a key factor that influences the quality of PSOs. Participants highlighted the importance of having a clear brief outlining the project scope and deliverables for the project. A clear project brief and scope of work enable the professional team to plan work and requirements up front, including addressing risks on the project. Several other aspects related to the project scope were defined by participants, such as project brief, scope creep, risk related to project scope and complexity. The items mentioned were coded as part of the project scope. Table 10 shows selected verbatim data extracts from participants.

Table 10: Selected verbatim data extracts for "project scope" (Total pieces of coded text relating to this theme = 252)

Participant ID	Occupation	Employer	Verbatim data extract
P95	Architect	Other	*"Clear scope of works and mandate from the client and finalised before technical documentation commences."*
P97	Architect	Consultant	*"If clients are clear what they require, we can do great drawings, non-information gives us low-grade drawings."*

Participant ID	Occupation	Employer	Verbatim data extract
P138	Civil/Structural Engineer	Consultant	*"Understanding the scope of work and set boundaries."*
P203	Civil/Structural Engineer	Consultant	*"Clarity of scope."*
P244	Civil/Structural Engineer	Client	*"Clarity of scope work definitions from the Client."*
P263	Architect	Other	*"Clarity on Scope of Work."*
P444	Quantity Surveyor	Consultant	*"Clarity of project brief to professional team."*
P550	Civil/Structural Engineer	Consultant	*"Scope clarity."*

- Available information

Several participants posited that "available information" was a key factor influencing the quality of PSOs. Participants highlighted that available information (e.g., surveys, site investigations or other reference information) was important as it informed the design and production of PSOs on projects. Participants asserted that the quality of information was also important, as poor-quality information adversely impacted the quality of PSOs. The quality of the information also impacted the level of additional effort required to undertake background work on the project.

Several participants from the quantity surveying profession raised the availability of information as a key factor. Quantity surveyors are heavily reliant on other disciplines when producing BoQ and tender documents. When there is a lack of available information, it becomes challenging for quantity surveyors to produce the BoQ, which often leads to assumptions to fill gaps in information. Table 11 shows selected verbatim data extracts from participants.

Table 11: Selected verbatim data extracts for "available information" (Total pieces of coded text relating to this theme = 129)

Participant ID	Occupation	Employer	Verbatim data extract
P60	Architect	Client	*"Availability and quality of information for the task to be done."*
P145	Architect	Consultant	*"Adequate site information - Surveys etc."*
P168	Civil/Structural Engineer	Consultant	*"Adequate information about site conditions, services, material sources etc."*
P228	Quantity Surveyor	Consultant	*"Quality of design information often sparse, with too many assumptions required by QS's when producing BOQ's."*
P230	Quantity Surveyor	Consultant	*"Quality of the Architect and Engineer's information."*
P286	Civil/Structural Engineer	Consultant	*"Available information and the accuracy thereof."*
P421	Quantity Surveyor	Consultant	*"Quality of information provided to generate outputs."*
P574	Architect	Other	*"The amount of information provided on the site and project beforehand."*

- Client competence

Client competence was raised by several participants as a key factor influencing the quality of PSOs. Participants asserted that client competence impacted the ability of the client to make key decisions and provide necessary information to the professional team promptly to drive the project forward. Another concern raised by participants was the inability or inexperience of clients to critique tenders and other proposals submitted by consultants; this comment was more relevant to large public sector clients. Participants highlighted that frequent project changes due to a lack of client competence were obstructive to projects and adversely influenced the quality of PSOs. Table 12 shows selected verbatim data extracts from participants.

Table 12: Selected verbatim data extracts for "client competence" (Total pieces of coded text relating to this theme = 49)

Participant ID	Occupation	Employer	Verbatim data extract
P03	Civil/Structural Engineer	Consultant	*"Lack of direction/clear client requirements and standards – many clients don't have the experience/capacity to evaluate and critique the proposals and designs on the table, which can lead to poor PSOs."*
P70	Architect	Other	*"Decisive clients, who don't keep making changes and resetting the entire process."*
P85	Architect	Client	*"Client not having adequate technical understanding."*
P321	Architect	Other	*"Client decision-making ability."*

- Expectations

Client expectations were raised as one of the key factors influencing the quality of PSOs. Participants claimed that clients often had high expectations on projects that were generally not aligned with the time, fee or scope provided by the professional team. Participants stated that clients lacked appreciation of what was required to develop quality PSOs, with some attributing this to clients' lack of experience in the field. This resulted in a misalignment of expectations around what could reasonably be delivered considering constraints on projects. One of the constraints highlighted by participants was the competence of contractors on projects. Participants mentioned that a lack of skills on construction sites and a "nanny culture" necessitated surplus information being required in construction documents to accommodate contractors' lack of competence. One participant indicated that providing surplus information to contractors was time-consuming and often in conflict with tight project schedules. Table 13 shows selected verbatim data extracts from participants.

Table 13: Selected verbatim data extracts for "expectations" (Total pieces of coded text relating to this theme = 49)

Participant ID	Occupation	Employer	Verbatim data extract
P37	Architect	Other	*"Unrealistic expectations of clients and stakeholders and a lack of appreciation for the craft*
P61	Architect	Client	*"Client expectations vs. reality."*
P205	Architect	Other	*"Unrealistic expectations."*
P302	Architect	Client	*"Alignment of expectations between the Employer and the Professional Service Provider."*
P551	Civil/Structural Engineer	Consultant	*"Unrealistic timeframes and expectations by the Employer. Unrealistic budgets vs. client's expectations."*

- Client type

The type of client was also raised as one of the key factors that influence the quality of PSOs. Participants asserted that the relationship with the consultant and clients' in-house technical team reviewing PSOs was an important aspect that contributed to the quality of PSOs. Several participants mentioned that the client's attitude to quality also influenced the quality of PSOs. Several participants stated that public sector clients in South Africa did not have the appropriate skills and capacity to deliver infrastructure projects like clients in the private sector. Furthermore, some participants admitted that work was prioritised for clients depending on their reputation. Table 14 shows selected verbatim data extracts from participants.

Table 14: Selected verbatim data extracts for "client type" (Total pieces of coded text relating to this theme = 25)

Participant ID	Occupation	Employer	Verbatim data extract
P22	Quantity Surveyor	Consultant	*"Nature of client and reputation. Unfortunately, work gets prioritised for certain clients and work for others may get neglected."*

Participant ID	**Occupation**	**Employer**	**Verbatim data extract**
P358	Electrical Engineer	Consultant	*"Type of client."*
P535	Civil/Structural Engineer	Consultant	*"Government Clients are prone to force Engineers to produce high-level outputs for tender stage, when those outputs definitely require more work to meet the tender-stage design requirements. The reason for this is the way budgets are allocated by government departments for a financial year. 'The contractor needs to be appointed still in this financial year' is what has been said."*

- Client experience

Many participants cited client experience as a key factor influencing the quality of PSOs. A few participants stated that larger client bodies required people in their organisation with relevant skills, qualifications and experience to review the quality of PSOs as part of the project delivery process. Participants asserted the importance of clients having experience and appreciation of what was required to produce PSOs as this assisted in setting realistic expectations, especially regarding time. The overwhelming sentiment among participants indicated client experience was crucial to ensuring the provision of key information, both technical and non-technical, and making decisions that allowed projects to progress and prevented professional teams from being stifled during the project delivery process. Participants also mentioned that experienced clients generally understood the roles and responsibilities of all parties on projects, which contributed to efficient project delivery. Table 15 shows selected verbatim data extracts from participants.

Table 15: Selected verbatim data extracts for "client experience" (Total pieces of coded text relating to this theme = 19)

Participant ID	Occupation	Employer	Verbatim data extract
P15	Civil/Structural Engineer	Consultant	*"Inexperienced clients also translate to poor PSOs."*
P20	Quantity Surveyor	Consultant	*"An informed and experienced client on the particular project."*
P201	Civil/Structural Engineer	Consultant	*"Suitably qualified, registered and experienced professionals within the Client body, to review PSOs."*
P213	Civil/Structural Engineer	Other	*"Experience of the client personnel."*
P570	Quantity Surveyor	Consultant	*"Experience or Non-experienced client."*

- Client delays

Clients delays in making decisions were highlighted as one of the key factors influencing the quality of PSOs. Delays in making decisions often hampered the efficient delivery of projects, especially in situations where the professional team was already under time constraints. Participants mentioned that additional pressure was placed on teams due to the client's failure to make decisions promptly. Delays caused by a complete stop and subsequent restart of projects were also cited as having a detrimental effect on the team and adversely impacting the quality of PSOs. Table 16 shows selected verbatim data extracts from participants.

Table 16: Selected verbatim data extracts for "client delays" (Total pieces of coded text relating to this theme = 18)

Participant ID	Occupation	Employer	Verbatim data extract
P15	Civil/Structural Engineer	Consultant	*"Client delays in decision-making cause projects to stop-start, leaving room for errors to creep in."*
P206	Civil/Structural Engineer	Consultant	*"Client responses to queries are timeous and consistent."*

Participant ID	Occupation	Employer	Verbatim data extract
P232	Civil/Structural Engineer	Consultant	*"Prompt and consistent decision-making by client."*

- Late payment

A few participants stated that late payment was a key factor that influenced the quality of PSOs. Participants equated not being paid to working at risk, which impacted the amount of time and resources committed to projects and influenced the quality of PSOs. Some participants mentioned delays in payment impacted motivation to deliver projects, while others stated that late payments impacted cash flow and the ability to retain quality resources. Table 17 shows selected verbatim data extracts from participants.

Table 17: Selected verbatim data extracts for "late payment" (Total pieces of coded text relating to this theme = 14)

Participant ID	Occupation	Employer	Verbatim data extract
P85	Architect	Client	*"Late payment of fees."*
P141	Civil/Structural Engineer	Consultant	*"Delays in payment of professional fees by clients."*
P391	Civil/Structural Engineer	Consultant	*"Timely payment. Concept of using your service provider as a bank for project is not ethical."*
P556	Architect	Consultant	*"Economic stability - allows us to maintain quality personnel."*

- Political interference

Some participants, particularly from the civil/structural engineering discipline, mentioned that political interference was a key factor influencing the quality of PSOs. Political interference was usually in the form of politicians dictating deadlines or interfering with overall progress made by the team, which was disruptive on projects. Table 18 shows selected verbatim data extracts from participants.

Table 18: Selected verbatim data extracts for "political interference" (Total pieces of coded text relating to this theme = 7)

Participant ID	Occupation	Employer	Verbatim data extract
P141	Civil/Structural Engineer	Consultant	*"Political interference on service delivery dictating deadlines."*
P366	Civil/Structural Engineer	Consultant	*"Protection against political interference with the progress or direction of the assignment."*
P573	Civil/Structural Engineer	Consultant	*"Interference by Politicians in Projects."*

- Clients' quality control

Clients' lack of quality control received the least amount of support but was still highlighted by a few participants as a key factor influencing the quality of PSOs. Although the professional team has a responsibility to produce PSOs, some participants indicated that clients' lack of quality control and review processes before finalising PSOs at the end of each project stage may have a detrimental impact on quality. Table 19 shows selected verbatim data extracts from participants.

Table 19: Selected verbatim data extracts for "clients' quality control" (Total pieces of coded text relating to this theme = 6)

Participant ID	Occupation	Employer	Verbatim data extract
P193	Civil/Structural Engineer	Consultant	*"Insufficient quality control on the client side."*
P201	Civil/Structural Engineer	Consultant	*"Internal PSP review and client review."*

Company Factors

Factors within the ambit of the company producing PSOs were included as part of company factors. The key company factors included quality management, project management, team composition, tools and equipment, training, mentoring, company culture, current workload, innovation, and design optimisation.

- Quality management

Quality management was cited as a key factor influencing the quality of PSOs. A few participants highlighted the practice of "cut and paste" when producing PSOs without adequate checking as one of the causes of errors and poor-quality PSOs. Participants mentioned that peer review and checking of PSOs by experienced professionals was an aspect of quality management that was integral to maintaining the quality of PSOs. Ensuring that staff, especially junior staff, had the requisite level of supervision was also highlighted as a critical part of producing quality PSOs.

Participants stressed that companies producing PSOs should have formal quality management processes with documented reviews, which creates awareness for those working on the project about quality processes. Some participants mentioned that companies should have appropriate quality management processes that were aligned with the six project stages, to ensure that due diligence was conducted at each project stage. Participants stated that companies strictly adhering to quality management processes generally produced better-quality PSOs.

A few participants linked the implementation of quality management systems with time and fees. Participants cited short timeframes on projects as one of the reasons for a lack of comprehensive due diligence and in-depth reviews as part of the quality management process. Similarly, where fees on a project were perceived to be low, there was pressure to produce correct designs and documents at the first attempt to prevent financial losses on the project; this was problematic when quality-related issues had to be addressed. Table 20 shows selected verbatim data extracts from participants.

Table 20: Selected verbatim data extracts for "quality management" (Total pieces of coded text relating to this theme = 227)

Participant ID	**Occupation**	**Employer**	**Verbatim data extract**
P01	Electrical Engineer	Consultant	*"Quality control and systems for review of design company."*
P17	Civil/Structural Engineer	Consultant	*"Quality control applied during and at the end of the process."*

Participant ID	Occupation	Employer	Verbatim data extract
P22	Quantity Surveyor	Consultant	*"Most importantly, internal quality control and QA processes must be done."*
P79	Architect	Other	*"Check, check again and triple-check everything."*
P220	Civil/Structural Engineer	Consultant	*"The quality management system of the company and the drive to implement it. Drawing procedures and drawing management should be laid out in any good QMS system in a company but often it is overlooked or ignored. Companies which have a strict adherence to the QMS usually produce better drawings."*
P360	Civil/Structural Engineer	Consultant	*"Quality systems put in place."*
P543	Architect	Other	*"Quality control and checking of documentation before it leaves the office also reduces errors from becoming costly problems on site."*

- Project management

Project management was cited frequently by participants as a key factor influencing the quality of PSOs. Participants indicated that collaboration, communication and coordination among disciplines (particularly on multidisciplinary projects) were all important aspects of project management that influence the quality of PSOs. Communication was highlighted as an important aspect of project management that was fundamental to ensuring the quality of PSOs on projects. Planning of the project and project-related tasks was also cited as one of the factors influencing the quality of PSOs. Several participants stressed the importance of coordination between disciplines and ensuring that an appropriate level of interfacing was conducted on projects. Overall, project management was viewed as a key factor influencing the quality of PSOs. However, some participants cautioned against excessively bureaucratic project

management processes, which absorbed time and resources without much benefit. Table 21 shows selected verbatim data extracts from participants.

Table 21: Selected verbatim data extracts for "project management" (Total pieces of coded text relating to this theme = 203)

Participant ID	Occupation	Employer	Verbatim data extract
P27	Civil/Structural Engineer	Consultant	*"Project Management control during all phases of project."*
P91	Architect	Consultant	*"Coordination of consulting team."*
P201	Civil/Structural Engineer	Consultant	*"Adequate planning by the PSP during the PSO compilation process."*
P323	Architect	Consultant	*"Effective Project Management, Effective proper Planning, Effective Coordination, Effective Communication."*
P524	Civil/Structural Engineer	Consultant	*"Proper coordination between disciplines."*

- Team composition

The composition of the team and having appropriate resources on a project was highlighted as a key factor influencing the quality of PSOs. Participants mentioned the importance of ensuring the availability of resources and staffing projects with an appropriate blend of junior and senior resources. Participants also mentioned that resources on projects needed to be competent: Simply loading resources onto projects to improve productivity did not always benefit the quality of PSOs. Having appropriately skilled personnel who were committed to projects was equally important as having a sufficient quantity of resources. Participants highlighted that project teams should consult with experts in specialist fields, especially if specialist skills were lacking in the team. This would help to improve the quality of PSOs where the project scope requires specialist involvement. Table 22 shows selected verbatim data extracts from participants.

Table 22: Selected verbatim data extracts for "team composition" (Total pieces of coded text relating to this theme = 100)

Participant ID	Occupation	Employer	Verbatim data extract
P47	Architect	Consultant	*"Insufficient human resources being available for any given project."*
P83	Architect	Consultant	*"Competent and appropriately qualified professional team with a mix of 'experienced' and 'less-experienced' professionals."*
P343	Civil/Structural Engineer	Consultant	*"Team (resources) allocated to the project."*
P540	Architect	Consultant	*"Skills and experience of the team of professionals."*

- Tools and equipment

Participants cited tools and equipment as a key factor influencing the quality of PSOs. Software is an important piece of equipment used by built environment professionals that is critical to the delivery of infrastructure projects. Several participants highlighted the importance of having appropriate software to produce designs and automate processes. A few participants mentioned that clients often have project-specific requirements related to the production of PSOs (e.g., 3D drawings or BIM functionality), which makes it important for consultants to have appropriate software to deliver projects. Participants stated that firms unable to procure necessary software or equipment were viewed by clients as lagging and not having the ability to produce quality PSOs. Participants indicated that in addition to having access to relevant software, project resources required a firm grasp of operating and maximising software capabilities. Participants mentioned that company facilities and equipment other than software (e.g., vehicles, hardware, office equipment) also influenced the quality of PSOs as they impacted the resource's ability to perform their tasks. Table 23 shows selected verbatim data extracts from participants.

Table 23: Selected verbatim data extracts for "tools and equipment" (Total pieces of coded text relating to this theme = 89)

Participant ID	Occupation	Employer	Verbatim data extract
P51	Architect	Consultant	*"Equipment and technology (hardware and software)."*
P66	Architect	Consultant	*"Firms lagging behind in terms of technological advancements, viz. software, construction technologies and materials etc."*
P184	Civil/Structural Engineer	Consultant	*"Available software programs to produce PSOs."*
P220	Civil/Structural Engineer	Consultant	*"The programs used for drawings - in my experience, Revit drawings look a lot worse than AutoCAD drawings. But with the push in the industry to drive digitization, there is a big push towards BIM software including Revit."*
P240	Civil/Structural Engineer	Consultant	*"Technology and Software."*
P347	Civil/Structural Engineer	Consultant	*"Access to tools/software."*
P542	Architect	Other	*"Technical Equipment."*

- Training

Training of resources was highlighted as a key factor influencing the quality of PSOs. Training was described as on-the-job experiential training and formal learning such as attendance of courses. Participants mentioned that formal training should include technical and commercial training. Lack of continuous professional development was highlighted by many participants as one of the key factors influencing the quality of PSOs. Similarly, the lack of in-house training on technical, commercial and quality control was highlighted as problematic by participants. Table 24 shows selected verbatim data extracts from participants.

Table 24: Selected verbatim data extracts for "training" (Total pieces of coded text relating to this theme = 40)

Participant ID	Occupation	Employer	Verbatim data extract
P17	Civil/Structural Engineer	Consultant	*"Training."*
P28	Civil/Structural Engineer	Consultant	
P41	Architect	Other	
P270	Civil/Structural Engineer	Client	*"Technical Training and Commercial/Contracts Training."*
P561	Civil/Structural Engineer	Consultant	*"Training and education."*

- Mentoring

Participants cited mentoring as a key factor influencing the quality of PSOs. The quality of mentoring was also highlighted as an important part of the mentoring experience. Participants mentioned that experienced mentors were required to ensure an adequate transferral of skills. Participants stressed the importance of mentoring graduates in the built environment, especially during their initial experiential years. However, several participants stated that one of the problems facing the construction industry was the inability of senior resources to dedicate time to mentor junior resources on projects due to tight deadlines and workload. Table 25 shows selected verbatim data extracts from participants.

Table 25: Selected verbatim data extracts for "mentoring" (Total pieces of coded text relating to this theme = 28)

Participant ID	Occupation	Employer	Verbatim data extract
P09	Civil/Structural Engineer	Consultant	*"Mentoring."*
P146	Civil/Structural Engineer	Consultant	*"Good mentorship."*
P178	Civil/Structural Engineer	Consultant	*"Quality mentoring."*

Participant ID	Occupation	Employer	Verbatim data extract
P262	Civil/Structural Engineer	Consultant	*"Mentoring of young engineers."*
P500	Civil/Structural Engineer	Consultant	*"Mentoring and coaching of juniors by seniors."*

- Company culture

Participants highlighted company culture as a key factor influencing the quality of PSOs. Participants linked company culture to company leadership and management. Participants asserted that companies striving for excellence, with a culture of learning and delivering quality services generally ensured quality PSOs were produced. Table 26 shows selected verbatim data extracts from participants.

Table 26: Selected verbatim data extracts for "company culture" (Total pieces of coded text relating to this theme = 14)

Participant ID	Occupation	Employer	Verbatim data extract
P132	Civil/Structural Engineer	Consultant	*"Culture of learning."*
P279	Civil/Structural Engineer	Consultant	*"Company and employee culture. Companies that prioritise PSOs consistently do better."*
P485	Architect	Consultant	*"Work environment and culture."*

- Current workload

Workload was highlighted by a few participants as a key factor influencing the quality of PSOs. Participants asserted that a heavy workload made it difficult to allocate sufficient time to tasks, which had a detrimental effect on the quality of PSOs. One participant provided an example related to changes requested by the client during construction or late in the tender stage when the professional team was already involved in other projects. In such a case, resources joining the team to update PSOs were inclined to perform updates expeditiously without the same level

of precision and rigour compared to updates earlier in the project. Table 27 shows selected verbatim data extracts from participants.

Table 27: Selected verbatim data extracts for "current workload" (Total pieces of coded text relating to this theme = 12)

Participant ID	Occupation	Employer	Verbatim data extract
P26	Quantity Surveyor	Consultant	*"Amount of work on my table."*
P321	Architect	Other	*"Professionals' current workload."*
P419	Quantity Surveyor	Other	*"Workload and juggling various projects."*

- Innovation

A handful of participants cited innovation as a key factor influencing the quality of PSOs. The participants noted that innovative thinking was an important part of designs. Table 28 shows selected verbatim data extracts from participants for this sub-theme.

Table 28: Selected verbatim data extracts for "innovation" (Total pieces of coded text relating to this theme = 5)

Participant ID	Occupation	Employer	Verbatim data extract
P487	Architect	Other	*"Innovative thinking."*
P532	Civil/Structural Engineer	Consultant	*"Be innovative while accountable and responsible."*

- Design optimisation

A few participants highlighted design optimisation as a key factor influencing the quality of PSOs. Some participants mentioned that design optimisation was not conducted due to a lack of time and fees on a project. Table 29 shows selected verbatim data extracts from participants.

Table 29: Selected verbatim data extracts for "design optimisation" (Total pieces of coded text relating to this theme = 5)

Participant ID	Occupation	Employer	Verbatim data extract
P214	Civil/Structural Engineer	Consultant	*"Optimising designs."*
P399	Architect	Client	*"Value engineer as a team to provide options."*

Professional Factors

Factors related to built environment professionals producing PSOs were included as professional factors. The key professional factors included experience, competence, knowledge, professionalism, project understanding, personality and leadership.

- Experience

Experience was cited as a key factor influencing the quality of PSOs. Many participants drew a link between the experience of staff producing and reviewing PSOs and the quality of PSOs. A few participants used the example of gaining site experience as an important part of knowing "which designs work, and which don't". Other participants mentioned that gaining experience was important to refine the technical skills that were necessary to produce quality PSOs. One participant raised a concern regarding the emergence of new consultancy firms, where many office principals did not spend sufficient time mastering technical aspects in a design office before starting their own company. This can adversely impact the quality of PSOs. A few participants posited that many experienced professionals emigrated, resulting in senior posts being filled by less-experienced staff, which can adversely impact the quality of PSOs.

Participants also highlighted the benefit of companies having exposure to similar types of projects and being able to draw on their institutional knowledge, which assists in delivering quality PSOs. One participant mentioned that some consultants use employees with less experience in designing or drawing and, in some cases, these individuals do not have adequate supervision, often due to budgetary constraints. This has a detrimental impact on the quality of PSOs. Table 30 shows selected verbatim data extracts from participants.

Table 30: Selected verbatim data extracts for "experience" (Total pieces of coded text relating to this theme = 277)

Participant ID	Occupation	Employer	Verbatim data extract
P08	Civil/Structural Engineer	Consultant	*"Experience."*
P09	Civil/Structural Engineer	Consultant	
P11	Civil/Structural Engineer	Consultant	
P45	Architect	Client	*"Experience in the field greatly influences PSO."*
P96	Architect	Client	*"Staff level of experience."*
P132	Civil/Structural Engineer	Consultant	*"Experience and capacity of design staff."*
P253	Civil/Structural Engineer	Consultant	*"Insufficient on-site experience to understand how site conditions can and will impact designs and influence constructability positively or negatively."*
P267	Mechanical Engineer	Consultant	*"Mostly experience and exposure is the key factor which affects the quality of work."*
P299	Civil/Structural Engineer	Consultant	*"Experience, particularly project-related experience. You can't be a leading bridge engineer without having designed several bridges."*
P523	Civil/Structural Engineer	Consultant	*"With the emergence of new consulting firms in the country, some of the design office principals never spent enough time in the design office with their previous employers to learn and understand what is expected from them."*
P559	Civil/Structural Engineer	Consultant	*"Lack of experienced staff affects the quality of documentation."*

Participant ID	Occupation	Employer	Verbatim data extract
P599	Civil/Structural Engineer	Consultant	*"The experience of the consultant and their 'library of designs'."*

- Competence

Closely linked to experience is competence, which various participants cited as a key factor influencing the quality of PSOs. Participants mentioned it was important for clients to ensure that competent teams were appointed to deliver projects. Participants highlighted the importance of having competent staff and reviewers producing PSOs. Participants mentioned that professional teams should have knowledge and understanding of built environment fields better than the clients they serve. Participants also mentioned that fee discounting impacted companies appointing and deploying an appropriate number of competent resources on projects. Table 31 shows selected verbatim data extracts from participants.

Table 31: Selected verbatim data extracts for "competence" (Total pieces of coded text relating to this theme = 121)

Participant ID	Occupation	Employer	Verbatim data extract
P154	Civil/Structural Engineer	Consultant	*"Competent professional team."*
P202	Civil/Structural Engineer	Consultant	*"Competence of design team."*
P483	Architect	Consultant	*"The appointment of competent professional specialist consultants where required."*
P545	Architect	Consultant	*"Adequate/Specialised competence to deal with the scope (e.g., drawing from previous experience)."*
P592	Architect	Consultant	*"Appointment of competent professional team including a project manager that is able to take the role as project lead."*

- Knowledge

Participants highlighted knowledge as a key factor influencing the quality of PSOs. Participants asserted that professionals in the construction industry should have relevant knowledge, e.g., technical and commercial, to produce PSOs. Participants stated that resources involved in technical work should also have knowledge or awareness about relevant software used in the production of PSOs. Some participants mentioned that knowledge of senior staff formed the basis of knowledge within a company. Table 32 shows selected verbatim data extracts from participants.

Table 32: Selected verbatim data extracts for "knowledge" (Total pieces of coded text relating to this theme = 107)

Participant ID	Occupation	Employer	Verbatim data extract
P84	Architect	Consultant	*"Knowledge of construction. Knowledge of documentation norms and standards. Knowledge of contract administration."*
P93	Architect	Consultant	*"Knowledge base of the practice principal forms the foundation of the group. Knowledge and skills of employees."*
P185	Civil/Structural Engineer	Consultant	*"Knowledge of the specifications and conditions of contract utilised."*
P200	Architect	Consultant	*"Knowledge of the subject matter."*
P393	Civil/Structural Engineer	Consultant	*"Reduced knowledge retention in the industry."*
P557	Civil/Structural Engineer	Client	*"Knowledge of the area of design."*

- Professionalism

Participants cited professionalism as a key factor influencing the quality of PSOs. Several participants mentioned that the professionalism of the individuals producing PSOs was integral to ensuring the quality of PSOs. Participants stressed the importance of integrity and ethics as part of professionalism. Conflicts often arise between professionalism and commercial interests when delivering projects. On the topic of professionalism and perceived "low" fees,

one participant mentioned that "a poor-quality PSO cannot be excused by low fees, as a professional you should always be putting a quality product on the table". Other participants noted that professionalism reflects the attitude and commitment of those working on the project. Participants emphasised that resources working on projects should prioritise delivering a professional service with a sense of responsibility to the client, rather than taking the easiest or most convenient approach when producing PSOs. Table 33 shows selected verbatim data extracts from participants.

Table 33: Selected verbatim data extracts for "professionalism" (Total pieces of coded text relating to this theme = 86)

Participant ID	Occupation	Employer	Verbatim data extract
P24	Civil/Structural Engineer	Consultant	*"Individual professionalism."*
P55	Architect	Consultant	*"Level of professionalism."*
P232	Civil/Structural Engineer	Consultant	*"Professional's attitude toward quality and accuracy."*
P247	Architect	Other	*"Act with integrity and be professional."*
P305	Architect	Client	*"Professional ethics."*
P518	Civil/Structural Engineer	Consultant	*"Professional attitude of the individual towards their work."*

- Project understanding

Project understanding was cited by several participants as a key factor influencing the quality of PSOs. Participants mentioned that understanding the scope and end-user requirements were important aspects of developing project understanding and improving the quality of PSOs. Participants viewed project understanding as an important precursor to producing quality PSOs. That is, without a good understanding of the project, it is very difficult to produce quality PSOs. Table 34 shows selected verbatim data extracts from participants.

Table 34: Selected verbatim data extracts for "project understanding" (Total pieces of coded text relating to this theme = 50)

Participant ID	Occupation	Employer	Verbatim data extract
P82	Architect	Consultant	*"Understanding the requirements and client. Understanding the environment where the design is to be – adapt to the existing surrounds."*
P117	Quantity Surveyor	Other	*"1. Understanding the scope from the Client (Debriefing). 2. Understanding end-user requirements."*
P168	Civil/Structural Engineer	Consultant	*"Understand the limitation of some contractors to interpret drawings – they need 3-dimensional views."*
P397	Civil/Structural Engineer	Consultant	*"Clear understanding of the scope."*
P493	Architect	Consultant	*"A good understanding of construction methodologies to be incorporated in the design of the building."*

- Personality

A few participants mentioned that the personality of built environment professionals was a key factor influencing the quality of PSOs. Participants highlighted important aspects related to an individual's personality, such as self-motivation, attention to detail and taking pride in work, which can impact the quality of PSOs. Table 35 shows selected verbatim data extracts from participants.

Table 35: Selected verbatim data extracts for "personality" (Total pieces of coded text relating to this theme = 20)

Participant ID	Occupation	Employer	Verbatim data extract
P111	Architect	Other	*"Self-discipline. Pride in own work."*
P370	Civil/Structural Engineer	Consultant	*"Pride in products."*

Participant ID	Occupation	Employer	Verbatim data extract
P483	Architect	Consultant	*"Enthusiasm to deliver."*

- Leadership

Leadership within project teams was highlighted as a key factor influencing the quality of PSOs. One participant asserted that the team leader should be "a good organiser and 'shepherd' to create the necessary environment and allow space for each member of the professional team to perform to its optimum". Other participants asserted that leaders in the team should motivate their resources and help them address key issues to ensure quality PSOs. One of the participants mentioned the importance of having a project manager with leadership abilities who can manage clients and their needs, which allows the rest of the team to focus on producing quality PSOs. Table 36 shows selected verbatim data extracts from participants for this sub-theme.

Table 36: Selected verbatim data extracts for "leadership" (Total pieces of coded text relating to this theme = 16)

Participant ID	Occupation	Employer	Verbatim data extract
P44	Architect	Consultant	*"Good leadership within the professional team."*
P60	Architect	Client	*"Leadership qualities of project manager or principal agent."*
P175	Civil/Structural Engineer	Consultant	*"Quality of the project leader and design leads."*
P447	Architect	Client	*"The quality of staff and in particular leadership. Great leaders manage the client to allow the team time to produce quality documentation."*

Industry Factors

Factors associated with the industry in which built environment professionals operate were included as part of industry factors. The key industry factors included fees, project capital cost, procurement system and the quality of graduates.

- Fees

The level of fees on projects was highlighted as a key factor influencing the quality of PSOs. Many participants indicated that it was difficult to deliver quality PSOs if the fee level was not appropriate as this impacted the amount of time, level of effort and resources (especially senior expertise) allocated to projects. Participants stated that reduced fees placed pressure on consultants to produce PSOs with low margins for error.

Participants indicated that reduced or low fees limited the amount of time that could be spent on projects, which may impact design development and rigour in the process of producing PSOs. The reduced time can impact the level of quality control and review that can be undertaken, which impacts the quality of PSOs. Other participants mentioned that reductions in rates and large fee discounts due to competition were making the industry unsustainable, with critical skills being lost overseas. One participant mentioned that "the ridiculous discounts offered for tendered projects has a huge knock-on effect to hire competent technical staff that would in normal operations execute most of the designs and documentation".

Participants indicated that reductions in fees result in leaner services being rendered. A few participants highlighted a lack of training of junior staff on projects due to fee levels being insufficient to accommodate training. Table 37 shows selected verbatim data extracts from participants.

Table 37: Selected verbatim data extracts for "fees" (Total pieces of coded text relating to this theme = 297)

Participant ID	Occupation	Employer	Verbatim data extract
P03	Civil/Structural Engineer	Consultant	*"Engineering fees - even with integrity it becomes difficult to deliver quality PSOs because of the amount of work taken on to be profitable and keep people employed. The excessive discounts which have become the norm lead to poorer quality PSOs and the client ends up paying for it because in many cases the design*

Participant ID	Occupation	Employer	Verbatim data extract
			optimisation is not what it should/could be."
P96	Architect	Client	*"Professional fees (fees are often insufficient to allocate enough time)."*
P136	Civil/Structural Engineer	Consultant	*"Large fee discounts being offered during tender processes. Reduced fees equate to reduced time and expertise being allocated in the preparation of PSOs."*
P183	Civil/Structural Engineer	Consultant	*"Budget (fees) compared to time available: if the fees are not sufficient, then enough time cannot be assigned to the work, then the quality of the output suffers. The same is true concerning business expenses of salaries and running costs, compared to the income derived from projects. Comment: for the past few years there has been increasing pressure on fees vs. costs, with quality of output suffering the most. Consultants are undercutting each other in order to gain work, but the fees are not sufficient to do quality work anymore."*
P260	Architect	Consultant	*"Fees charged by the professional."*
P353	Electrical Engineer	Consultant	*"Income hourly rates and percentage fees determine how much time and effort can be spent on a particular task, which includes transfer of skill to junior employees. Government and private sector demand unrealistic discounts, which then prevents one from spending the correct amount of time and effort on outputs.*

Participant ID	Occupation	Employer	Verbatim data extract
			Further reduction in rates due to massive discounts because of survival, is making the industry unsustainable and critical skills are being lost to overseas because of this issue."
P447	Architect	Client	*"The single most important determinant of PSOs is the fees paid to the consultant. If the fees are too low, too much pressure is put on the production team. Sufficient fees assist proper resourcing of teams to produce adequate documentation and attending to other duties."*
P474	Architect	Consultant	*"Every Client including the Government is forever asking for a discount on Gazetted fees. Due to these massive discounts that are offered just to secure the work, the time and quality get compromised. In general, many PSPs are competent when it comes to the work but due to these massive discounts, you cannot afford to get the number of personnel required to successfully achieve the required quality of work with limited resources."*
P505	Architect	Consultant	*"The amount of money that the client is prepared to pay, more time means that you can prepare proper details for the contractor that will save him time in the end. Time=Money."*
P594	Architect	Consultant	*"A major factor is being remunerated with a decent fee so that the resources and time are available to prepare documentation.*

Participant ID	Occupation	Employer	Verbatim data extract
			The widespread practice of risk work and undercutting fees is problematic."

- Project capital cost

Project capital cost was cited by participants as a key factor influencing the quality of PSOs. Many participants linked project capital cost with time, fees and level of effort required to produce PSOs; that is, the higher the capital cost the more effort required to produce PSOs. Participants stated that cost constraints impacted the flexibility to look at different design options. Table 38 shows selected verbatim data extracts from participants.

Table 38: Selected verbatim data extracts for "project capital cost" (Total pieces of coded text relating to this theme = 96)

Participant ID	Occupation	Employer	Verbatim data extract
P245	Civil/Structural Engineer	Consultant	*"Cost."*
P296	Architect	Other	
P306	Architect	Other	
P399	Architect	Client	*"Understand the cost parameters and try your utmost to stick to these."*

- Procurement system

The procurement system used to appoint built environment consulting companies was highlighted as a key factor influencing the quality of PSOs. Participants mentioned that appropriate systems were required to procure built environment professional services and balance value for money with ensuring competent teams were appointed to deliver projects. Many participants stated that the current public sector procurement system did not always appoint appropriately qualified and competent professionals to deliver projects.

Participants raised concerns about projects being awarded based on price and preference under current public sector procurement regulations in South Africa. Other participants stated that

fierce competition in the industry was causing unsustainably low fees, which made it challenging to deliver quality PSOs. Several participants decried the tendering system, asserting that clients falsely believed they were saving money by appointing the lowest-priced tenderer. However, the final design solution and overall lifecycle cost were usually not economical. Table 39 shows selected verbatim data extracts from participants.

Table 39: Selected verbatim data extracts for "procurement system" (Total pieces of coded text relating to this theme = 36)

Participant ID	Occupation	Employer	Verbatim data extract
P190	Civil Engineer	Consultant	*"Mechanism of procurement of professional services - appropriate for the stage of professional input. Mechanism of procurement of professional services - ensuring that there is appropriate balance between cost competitiveness and minimum skills and deliverables required."*
P242	Civil/Structural Engineer	Consultant	*"Tender-based design making it uneconomical to produce high-quality documents or outputs."*
P253	Civil/Structural Engineer	Consultant	*"Tendering for professional services and not being able to deliver based on under-priced services, the corollary being the unintended consequences of clients thinking the saving achieved by accepting low PSP pricing is significant in the overall lifecycle of a project."*
P571	Architect	Client	*"Weak Procurement processes."*

- The quality of graduates

The quality of graduates was raised as a key factor influencing the quality of PSOs by two participants, both architects. Table 40 shows selected verbatim data extracts from participants.

Table 40: Selected verbatim data extracts for "quality of graduates" (Total pieces of coded text relating to this theme = 2)

Participant ID	Occupation	Employer	Verbatim data extract
P85	Architect	Client	*"Poor-quality graduates."*

4.2.2.2 Word tree of key concepts

A text search of common phrases used by built environment professionals in Section 1 of the survey was conducted. Common phrases were used to produce word trees to develop an understanding of issues raised by participants. The word trees are related to the following common phrases:

- Available information
- Competence
- Cost
- Experience
- Fee
- Knowledge
- Project brief
- Team composition
- Time
- Tools

Figure 16 provides a word tree related to information available on a project. The amount and quality of information available on a project was highlighted by several participants as a key factor influencing the quality of PSOs. Information included designs, drawings, surveys and other reference information on projects. A few participants mentioned that the quality of information was particularly important for quantity surveyors as they use information produced by others for PSOs, such as BoQ.

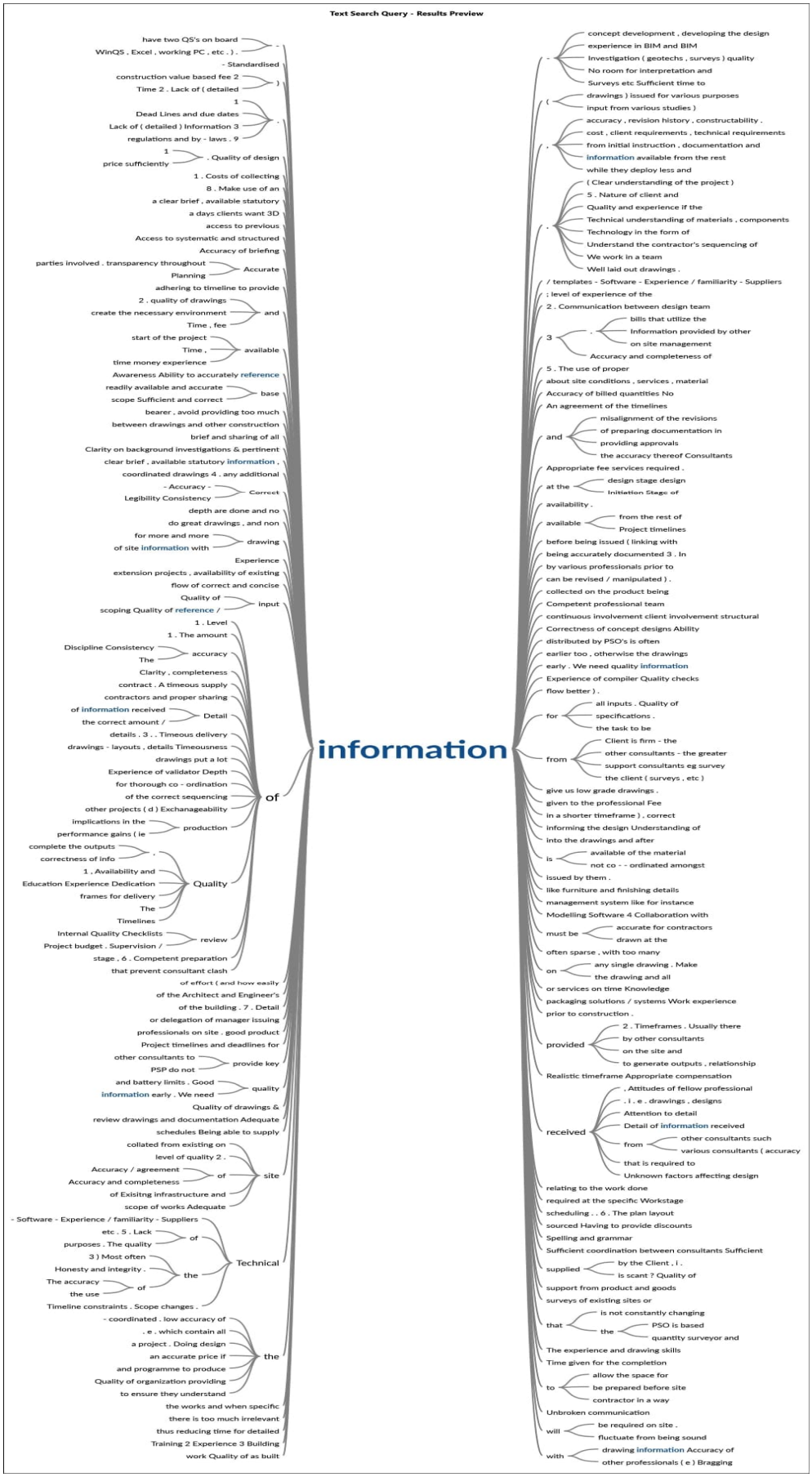


Figure 16: NVivo word tree related to available information

Figure 17 illustrates the NVivo word tree related to competence. Participants linked competence to various parties within infrastructure projects (e.g., designers, the professional team and clients). Participants stressed the importance of appointing competent people and ensuring that PSO production is adequately checked and supervised by competent people.

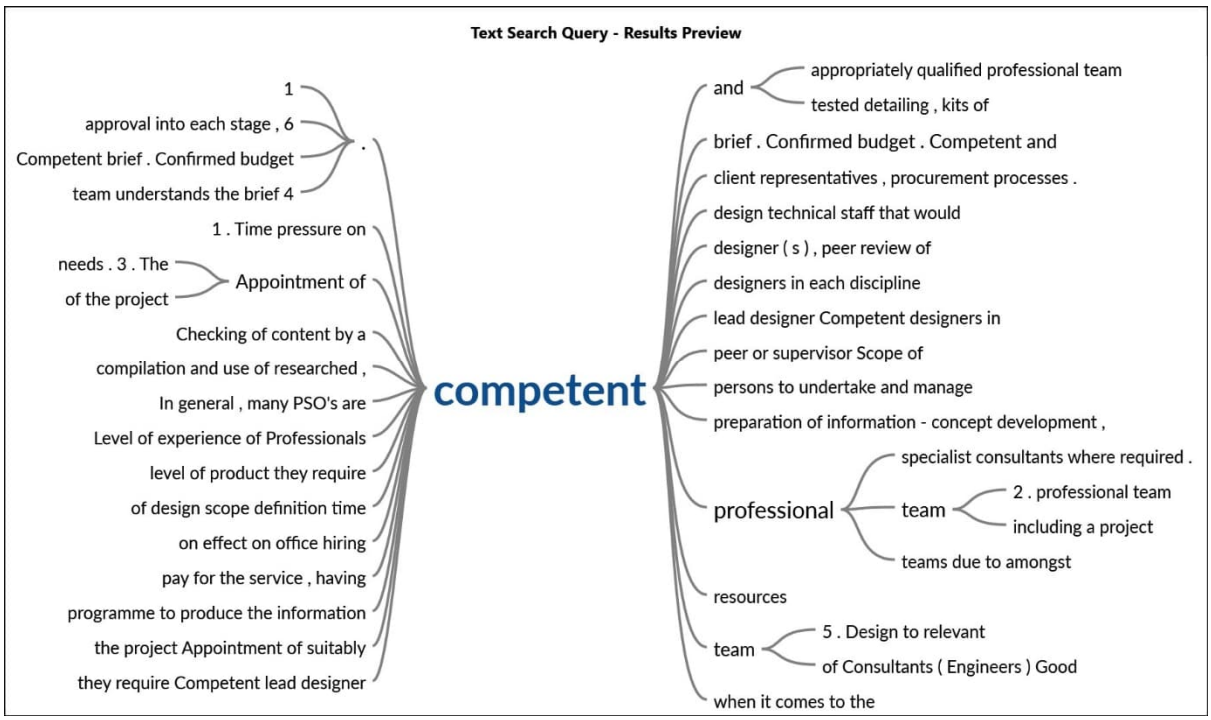


Figure 17: NVivo word tree related to competence

Figure 18 illustrates the NVivo word tree related to cost. Costs included project costs, lifecycle costs and professional fees associated with the production of PSOs. Concepts mentioned by participants included allocating project time based on low costs, balancing cost and competitiveness and seeking cheaper costs on projects.

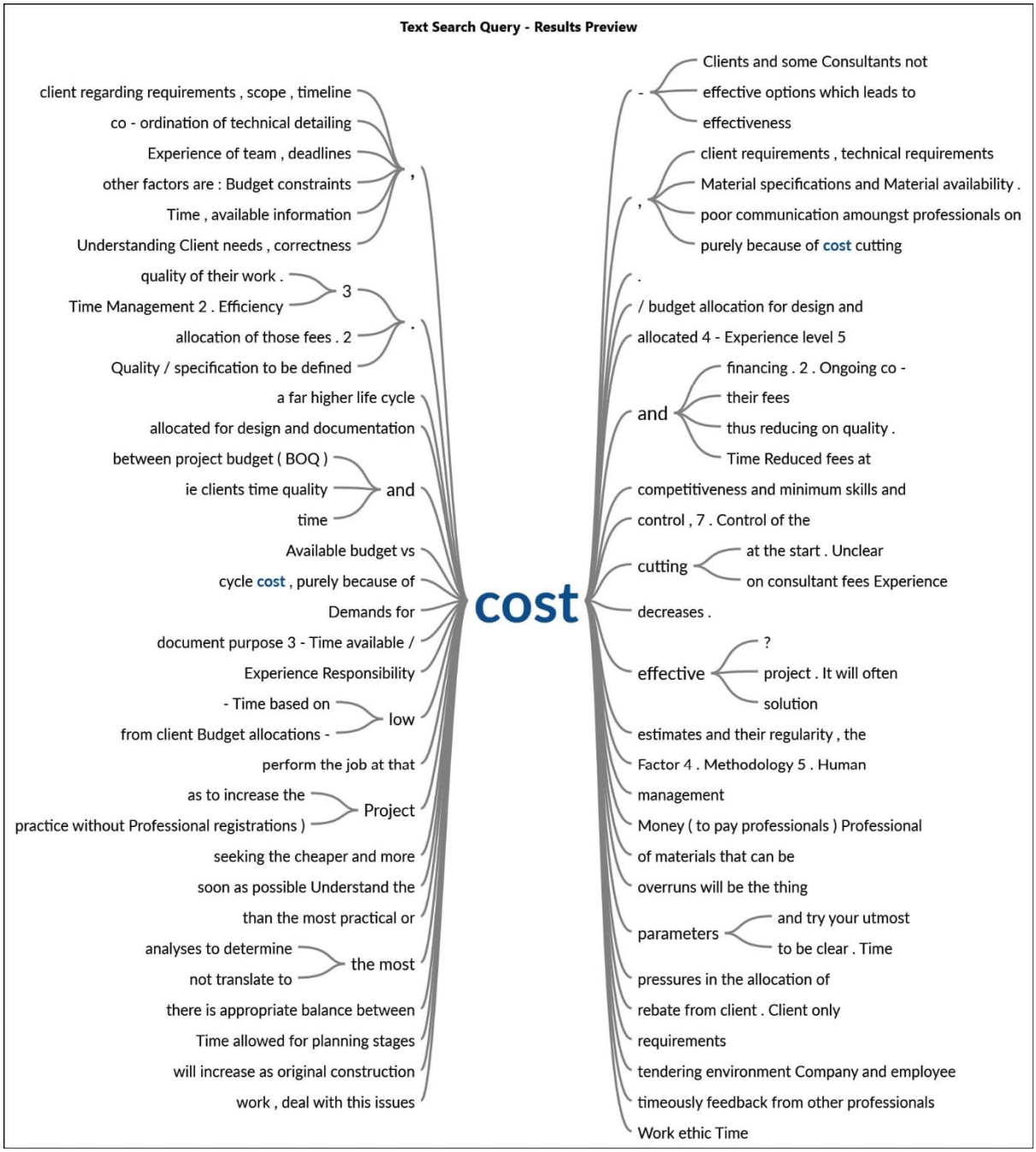


Figure 18: NVivo word tree related to cost

Figure 19 illustrates the NVivo word tree related to experience. Experience includes experience of professionals, staff or personnel, designers and clients. Participants mentioned that having an inadequate fee or budget to afford experienced resources was one of the key factors influencing the quality of PSOs. Supervision, review and mentorship by experienced professionals were also mentioned by several participants as a key factor influencing the quality of PSOs. The current “brain drain” in South Arica due to many professionals emigrating in search of opportunities in other countries was highlighted as one of the causes for the loss of experienced professionals in the industry.

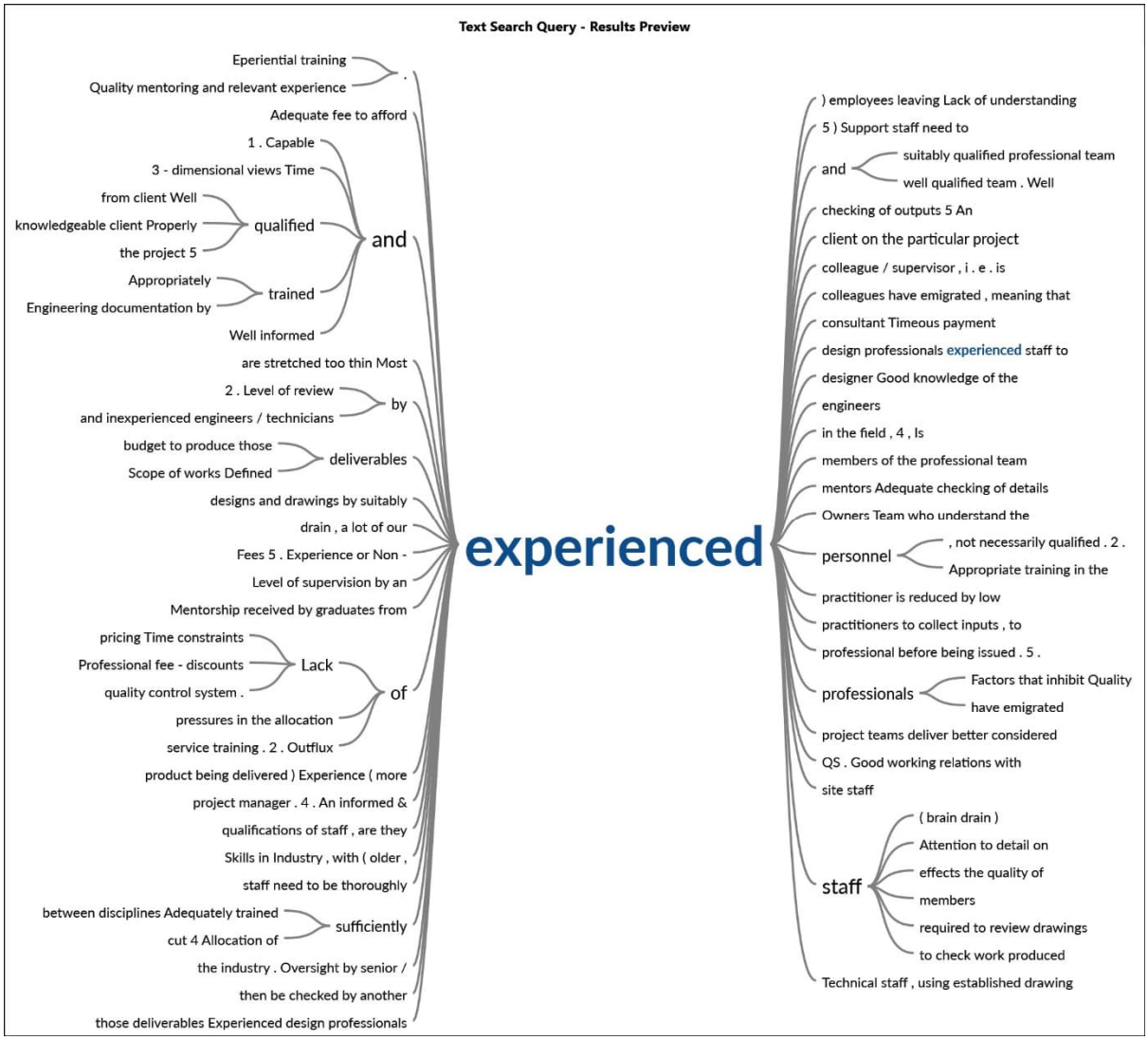


Figure 19: NVivo word tree related to experience

Figure 20 illustrates the NVivo word tree related to fees. Participants mentioned that the appointment of consultants and the fees associated with those appointments were key factors influencing the quality of PSOs. Some participants viewed fees on projects as rewards. Inadequate fees were stated as adversely impacting morale. There was a perception amongst participants that higher fees were often achieved on complex projects, and hence those projects received more time and attention from companies. Participants also drew comparisons between the level of fees and the amount of time and resources that could be allocated to projects.



Figure 20: NVivo word tree related to fee

Figure 21 illustrates the NVivo word tree related to knowledge. Several participants highlighted a lack of knowledge in the industry as one of the key factors influencing the quality of PSOs. Participants mentioned that it was important for both clients and consultants to have requisite knowledge on projects, which included technical and commercial knowledge. Institutional knowledge obtained from past projects and experience in the industry was also highlighted by participants. This is where knowledge and experience go hand in hand and why a blend of the

two is required. Lastly, knowledge retention in the industry was raised among participants as a concern and one of the key factors for poor-quality PSOs.

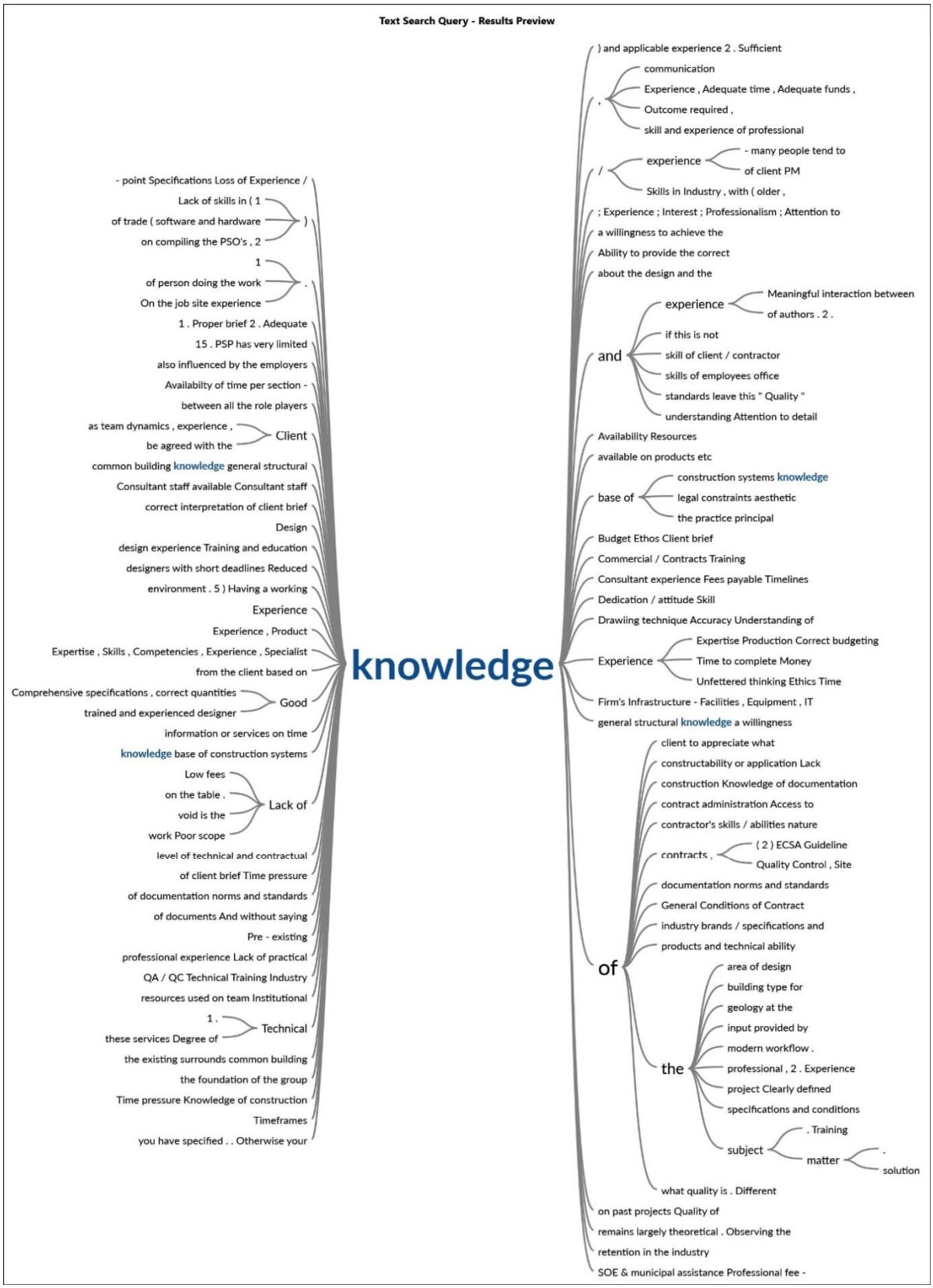


Figure 21: NVivo word tree related to knowledge

Figure 22 illustrates the NVivo word tree related to the project brief. Several participants highlighted that the quality of the project brief produced by the client influences the quality of PSOs. Participants mentioned that the project brief provided by the client should be clear, accurate, realistic and contain adequate detail to allow the project team to understand the client's requirements and efficiently deliver projects.

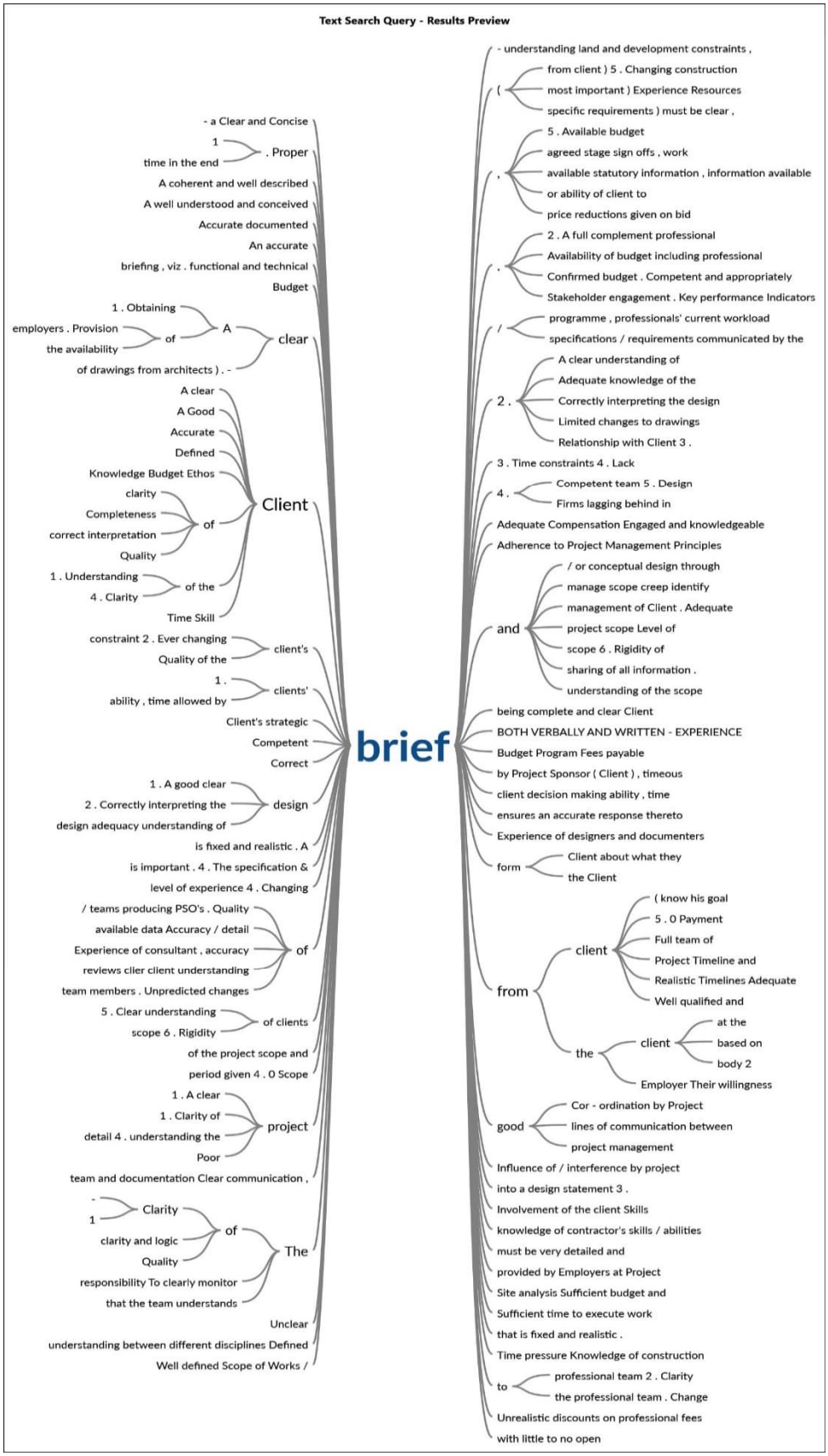


Figure 22: NVivo word tree related to project briefs

Figure 23 illustrates the NVivo word tree related to the project team. Participants mentioned having a strong and capable project team as a key factor influencing the quality of PSOs. Participants highlighted the importance of the entire team having an understanding of the project and its requirements. Management and leadership within the team were cited by participants as being important. Participants mentioned that aspects such as coordination, communication and motivation within the team were key factors in delivering quality PSOs. Participants also drew links with the composition of the team, time and level of fees on a project. According to several participants, time and fees impact resource allocation to projects.

Although much of the focus was on the professional team, a few participants also indicated the importance of having a competent and knowledgeable client team, which was a key factor influencing the quality of PSOs.

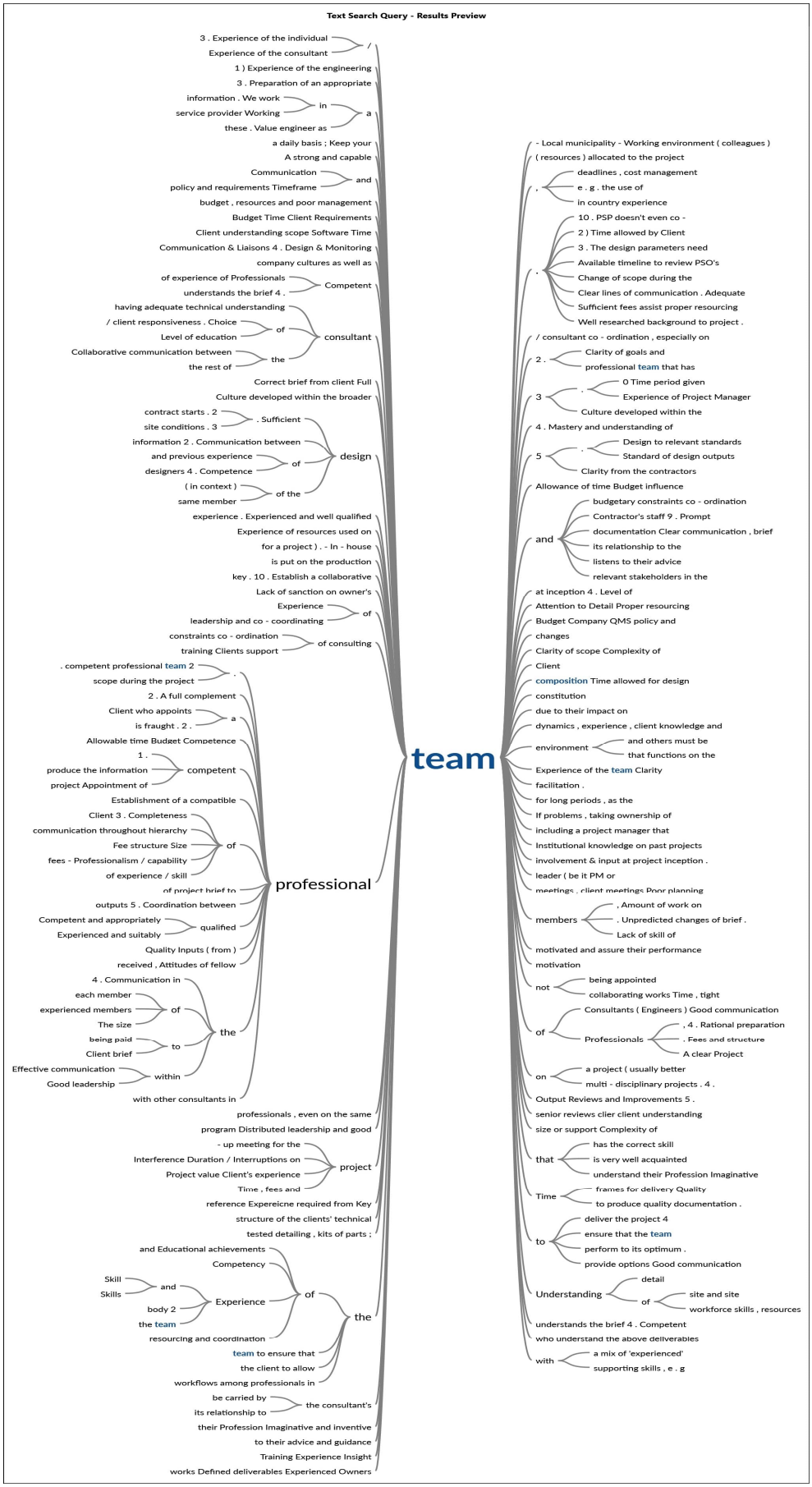


Figure 23: NVivo word tree related to team composition

Figure 24 illustrates the NVivo word tree related to time available on projects. Participants mentioned that time available on projects was a key factor influencing the quality of PSOs. Participants stated that resources on projects were allocated according to the amount of time available for different project tasks. Several participants mentioned that quality takes time, with participants asserting that they simply did not have sufficient time to produce quality PSOs on projects. Participants mentioned that insufficient time on projects limited training opportunities and resulted in less comprehensive reviews of PSOs being undertaken. Participants stated that fees on a project dictated the amount of time available for project tasks. Participants opined that even if professional teams were competent, time pressures create challenges on projects, which can adversely impact the quality of PSOs.

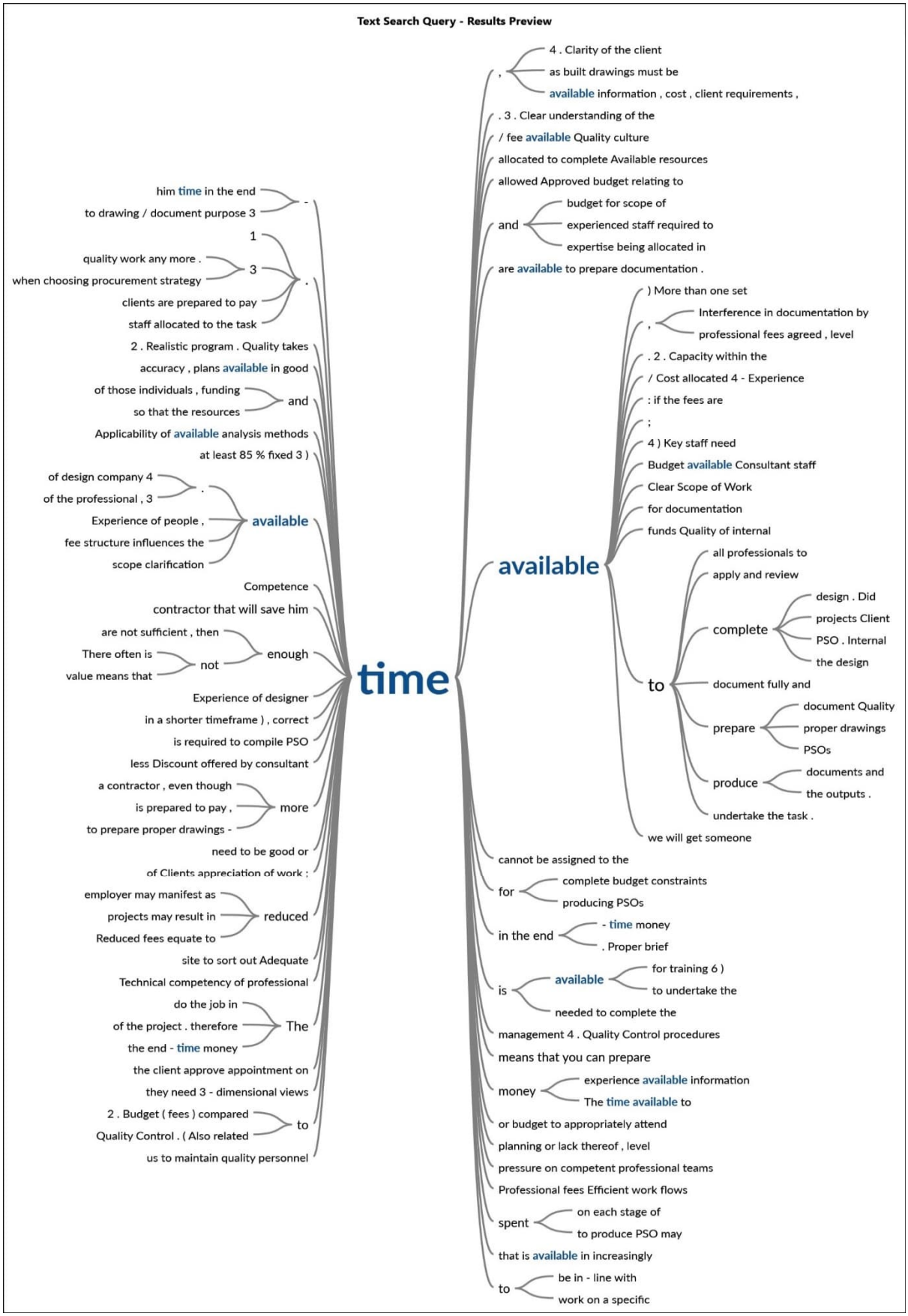


Figure 24: NVivo word tree related to available time

Figure 25 illustrates the NVivo word tree related to tools, primarily hardware and software, that are needed by professionals to deliver projects. Participants mentioned that the hardware or software available on projects influences the quality of PSOs. In addition to having the necessary software, participants stated that it was important for those using the software to have appropriate skills and mastery of the software to ensure that it was being used suitably. Participants mentioned that using appropriate software improved precision and minimised revisions of PSOs.

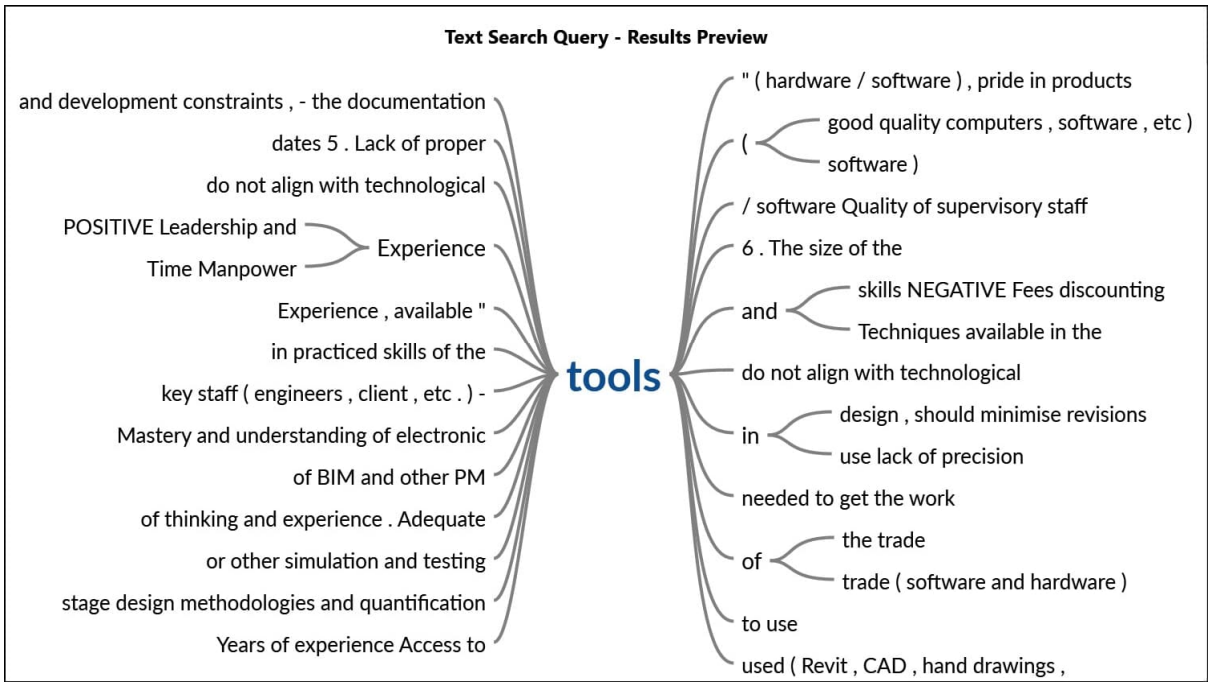


Figure 25: NVivo word tree related to tools and equipment

4.2.2.3 Architects

Figure 26 provides a word cloud illustrating high-frequency words among architectural participants in Section 1 of the survey.



Figure 26: Word cloud illustrating high-frequency words among architects

Table 41 and Figure 27 illustrate that overwhelmingly the top two key factors influencing the quality of PSOs according to architects were fees and time being cited by 50% and 45% of participants, respectively. The top five factors were cited by 20% or more of the participants. Tools and equipment, available information, project capital cost, and team composition were the remaining key factors in the top ten and were cited by fewer than 20% of participants.

Table 41: Key factors influencing the quality of PSOs as cited by architects

Rank	Factor	Frequency	Percentage of participants (%)
1	Fees**	137	50%
2	Time*	123	45%
3	Experience*	95	35%
4	Project brief	61	22%
5	Competence	55	20%
6	Tools and equipment	48	18%
7	Available information	46	17%
8	Project capital cost	45	17%
9	Team composition	43	16%
10	Knowledge	40	15%
		Total participants	**272**

*Cited by 25% or more of the participants
**Cited by 50% or more of the participants

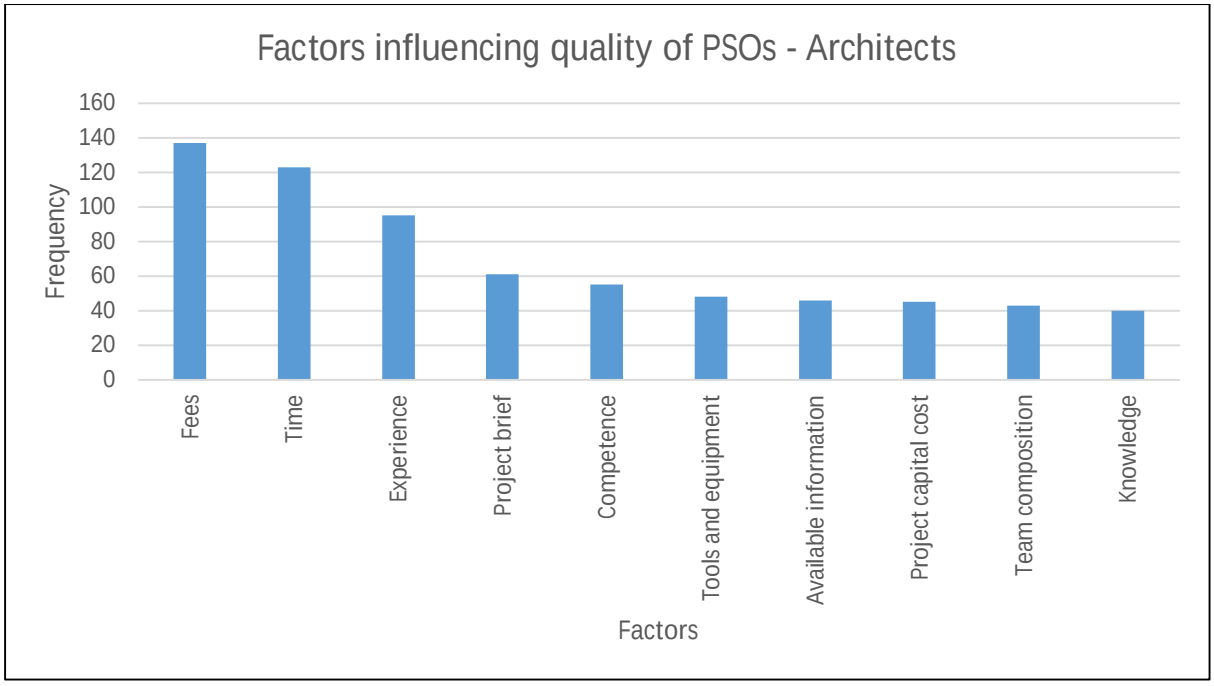


Figure 27: Bar chart illustrating key factors influencing the quality of PSOs as cited by architects

Figure 28 shows key factors influencing the quality of PSOs according to architects. The figure illustrates factors that were cited by at least 25% of architectural participants. The key factors were fees (50%), time (45%) and experience (35%).

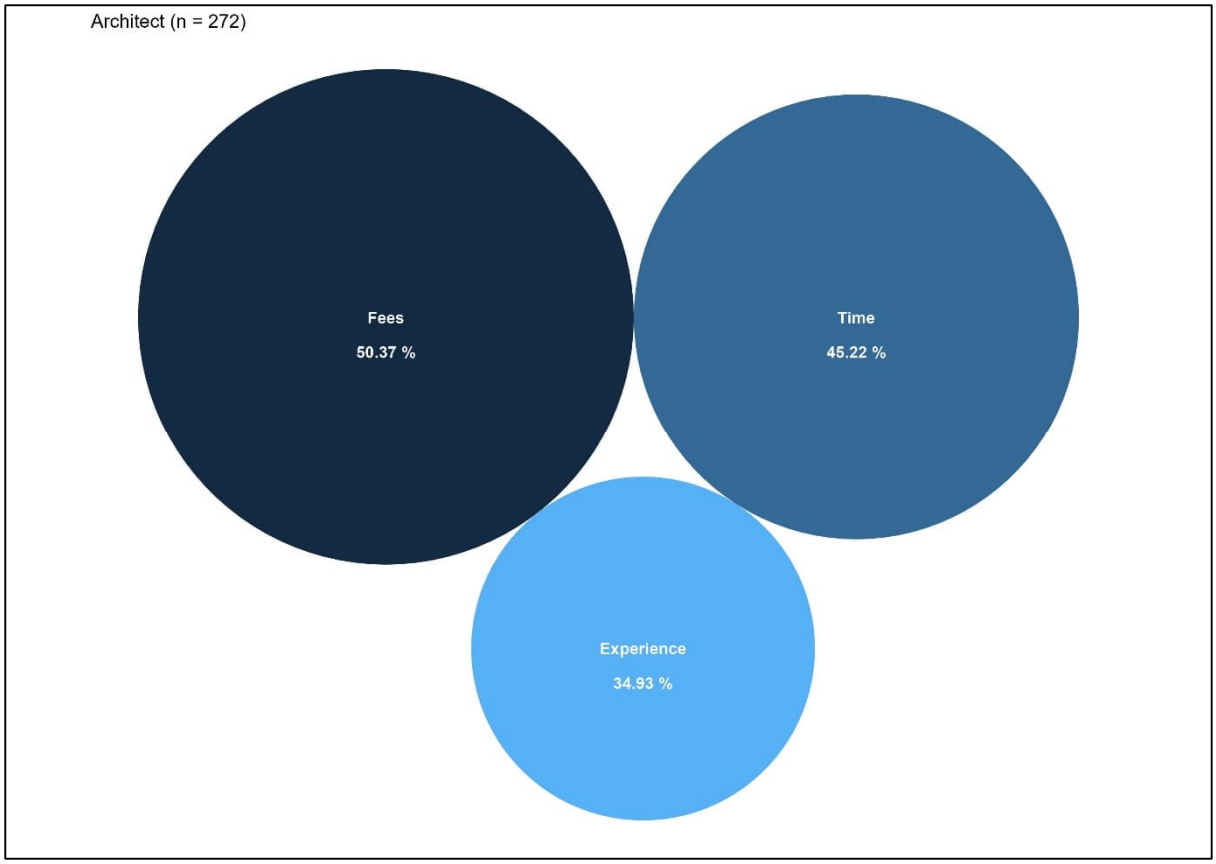


Figure 28: Key factors influencing the quality of PSOs (cited by 25% or more of the architectural participants)

4.2.2.4 Civil/Structural engineers

Figure 29 provides a word cloud illustrating high-frequency words among civil/structural engineering participants in Section 1 of the survey.



Figure 29: Word cloud illustrating high-frequency words among civil/structural engineers

Table 42 and Figure 30 show the key factors influencing the quality of PSOs as cited by civil/structural engineers. The top five factors were cited by 20% or more of the participants.

Interestingly, the key factor overwhelmingly cited by civil/structural engineers was experience, which is different compared to the other built environment disciplines in the study. The remaining key factors included knowledge, available information, team composition, project capital cost, review and tools and equipment, with each factor being cited by between 11% and 19% of participants.

Table 42: Key factors influencing the quality of PSOs as cited by civil/structural engineers

Rank	Factor	Frequency	Percentage of participants (%)
1	Experience**	146	56%
2	Fees*	121	46%
3	Time*	117	45%
4	Project brief*	74	28%
5	Competence	53	20%
5	Knowledge	53	20%
6	Available information	51	19%
7	Team composition	41	16%
7	Project capital cost	41	16%
8	Review	32	12%
9	Tools and equipment	28	11%
		Total participants	**262**

*Cited by 25% or more of the participants
**Cited by 50% or more of the participants

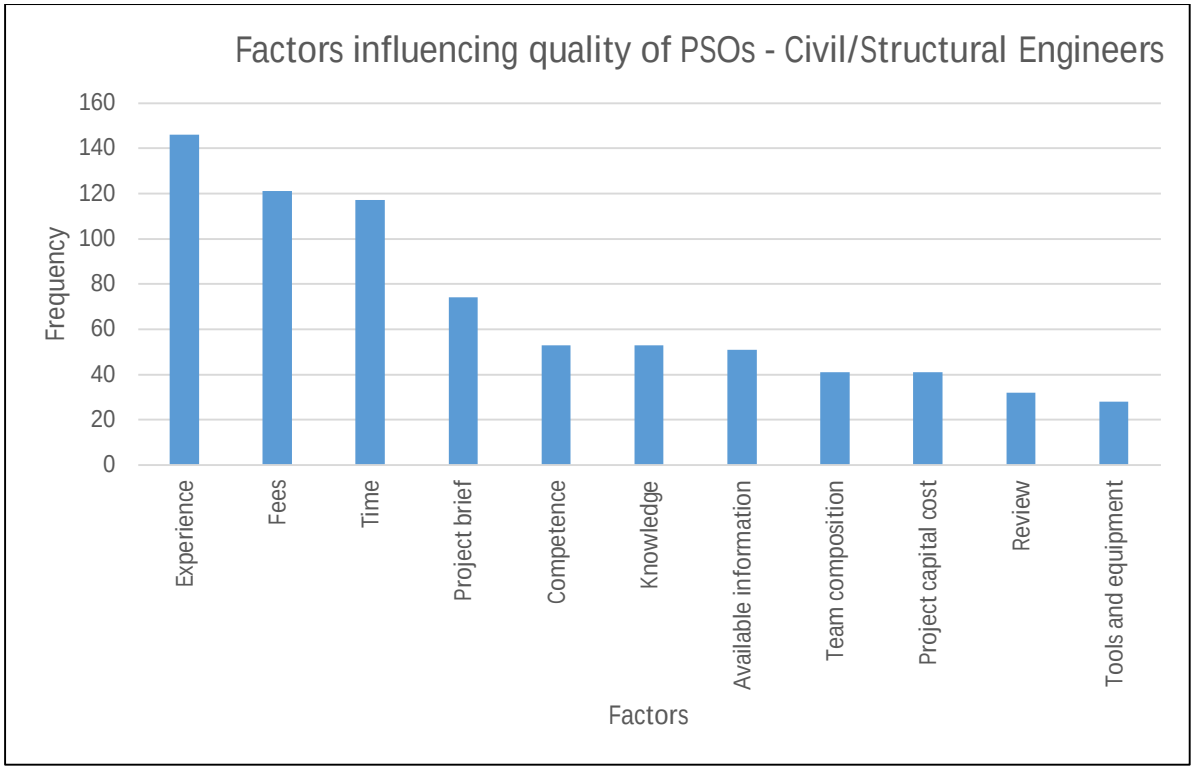


Figure 30: Bar chart illustrating key factors influencing the quality of PSOs as cited by civil/structural engineers

Figure 31 shows key factors influencing the quality of PSOs according to civil/structural engineers. The figure illustrates factors that were cited by at least 25% of civil/structural engineering participants. The key factors were experience (56%), fees (46%), time (45%) and project brief (28%).

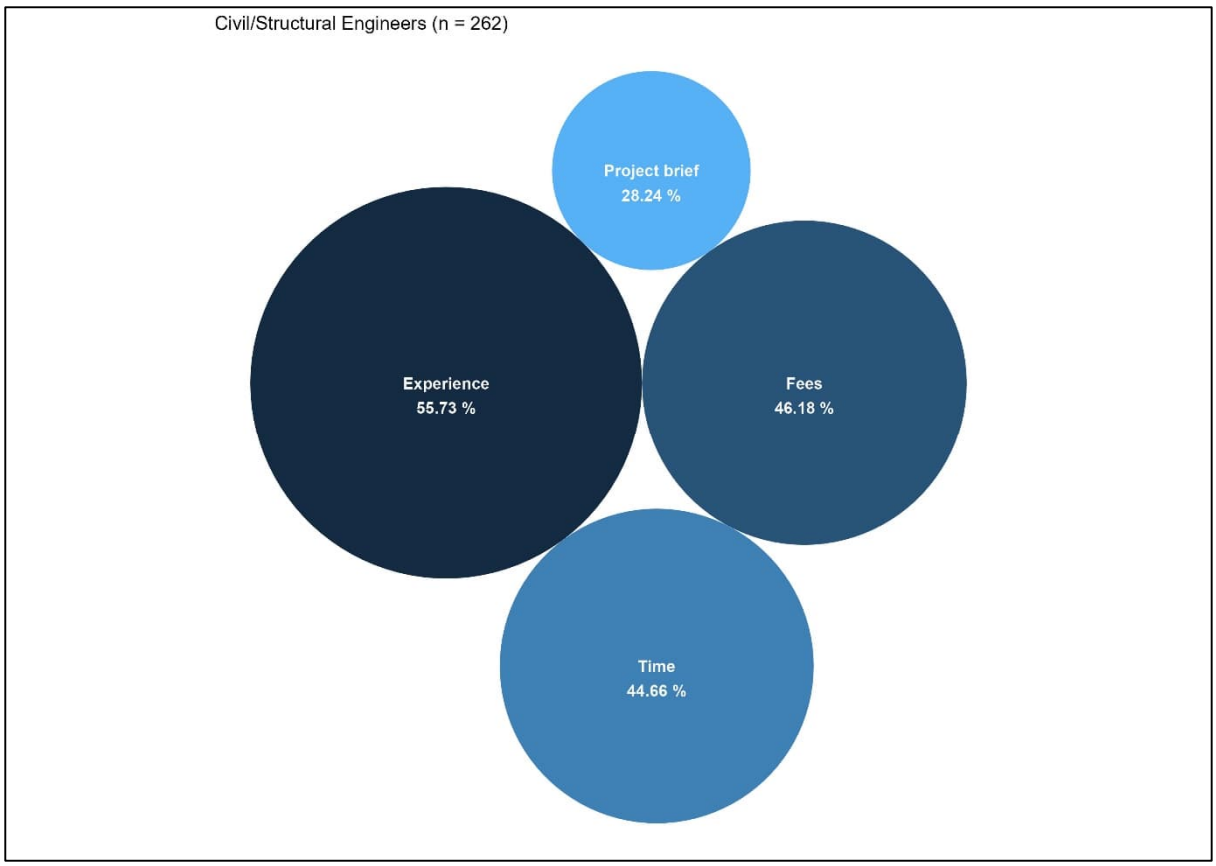


Figure 31: Key factors influencing the quality of PSOs (cited by 25% or more of the civil engineering participants)

4.2.2.5 Electrical engineers

Figure 32 provides a word cloud illustrating high-frequency words among electrical engineering participants in Section 1 of the survey.



Figure 32: Word cloud illustrating high-frequency words among electrical engineers

Table 43 and Figure 33 show the key factors influencing the quality of PSOs based on feedback from electrical engineers. Notably, the sample of electrical engineers only consisted of 16

participants. The top four factors, namely, time, fees, experience and the project brief are all consistent with feedback from other built environment disciplines analysed up to this point. Interestingly, fees and time were jointly the highest-ranked factor, with both being cited by more than 50% of participants. Another interesting observation is that scope creep made the list of top factors, being cited by 19% of participants. Scope creep was not listed as a key factor by any other built environment discipline up to this point in the study.

Table 43: Key factors influencing the quality of PSOs as cited by electrical engineers

Rank	Factor	Frequency	Percentage of participants (%)
1	Time**	9	56%
1	Fees**	9	56%
2	Experience*	6	38%
3	Project brief*	5	31%
4	Available information*	4	25%
5	Scope creep	3	19%
		Total participants	**16**

*Cited by 25% or more of the participants
**Cited by 50% or more of the participants

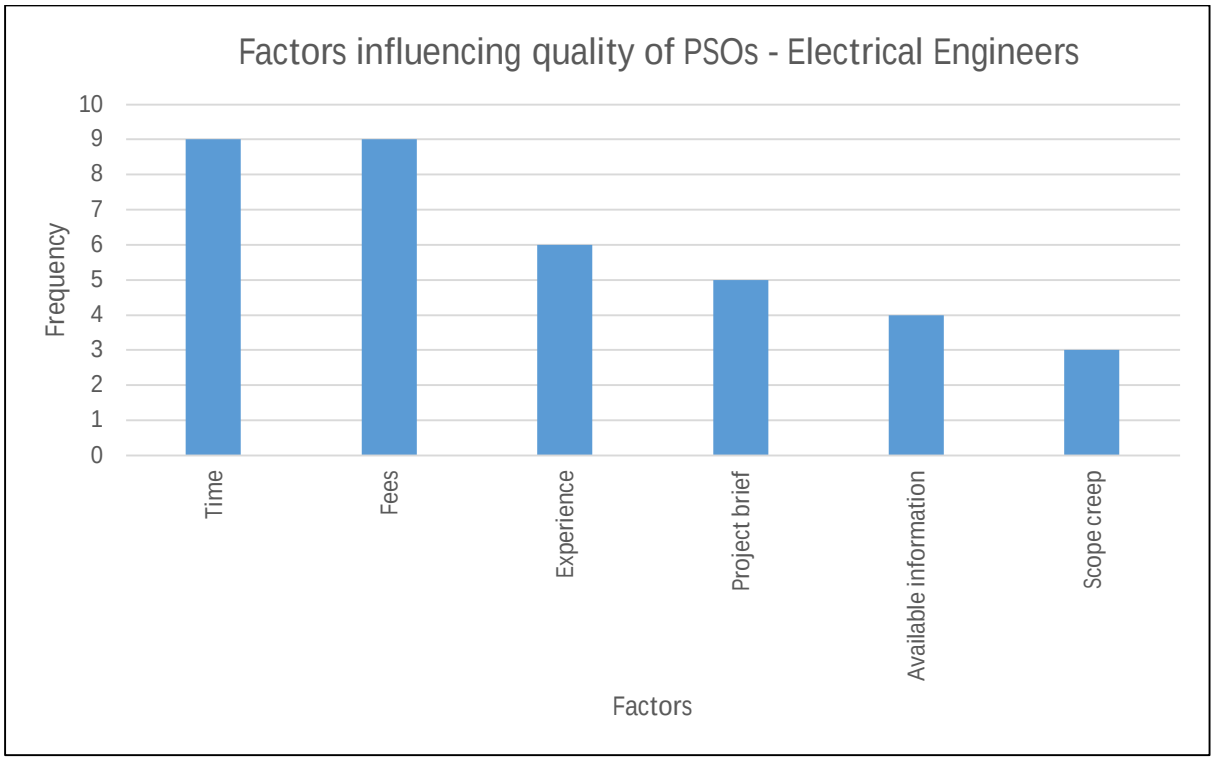


Figure 33: Bar chart illustrating key factors influencing the quality of PSOs as cited by electrical engineers

Figure 34 shows key factors influencing the quality of PSOs according to electrical engineers. The figure illustrates factors that were cited by at least 25% of electrical engineering participants. The key factors were time (56%), fees (56%), experience (38%), project brief (31%) and available information (25%).

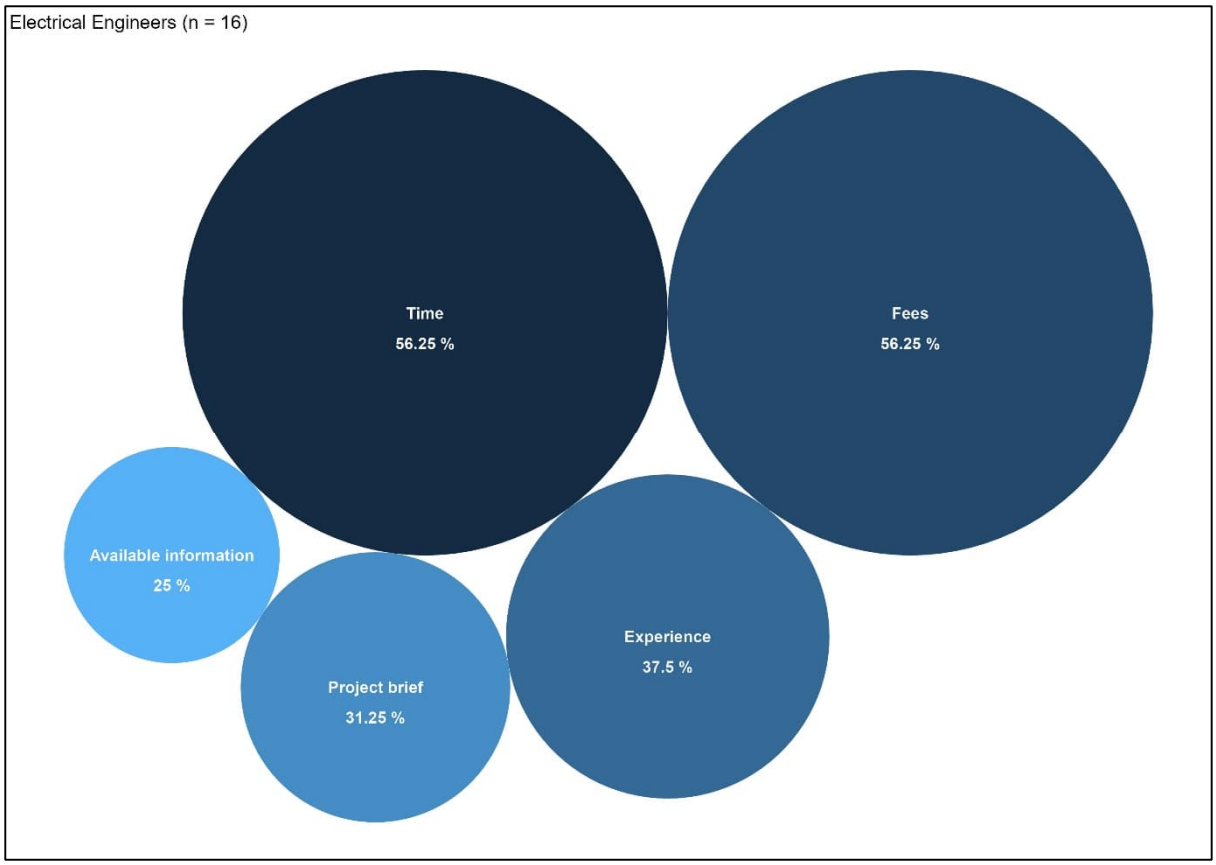


Figure 34: Key factors influencing the quality of PSOs (cited by 25% or more of the electrical engineering participants)

4.2.2.6 Mechanical engineers

Figure 35 provides a word cloud illustrating high-frequency words among mechanical engineering participants in Section 1 of the survey.



Figure 35: Word cloud illustrating high-frequency words among mechanical engineers

Table 44 and Figure 36 show the top-ranked factors based on the feedback of mechanical engineers. Notably, the sample of mechanical engineers was the lowest among all built environment disciplines and only consisted of eight participants. The top-ranked factors are identical to those cited by built environment disciplines up to this point in the study, although in a different order. Interestingly, the project brief was ranked as the highest factor (63%). Linked to the project brief is project understanding, which has been listed as a factor and was not among the top ten ranked factors of any of the previous built environment disciplines analysed up to this point. Unlike most of the other participant groups, time and fees were not the top two ranked factors.

Table 44: Key factors influencing the quality of PSOs as cited by mechanical engineers

Rank	Factor	Frequency	Percentage of participants (%)
1	Project brief**	5	63%
2	Experience**	4	50%
3	Time*	2	25%
3	Fees*	2	25%
3	Project understanding*	2	25%
	Total participants		**8**

*Cited by 25% or more of the participants
**Cited by 50% or more of the participants

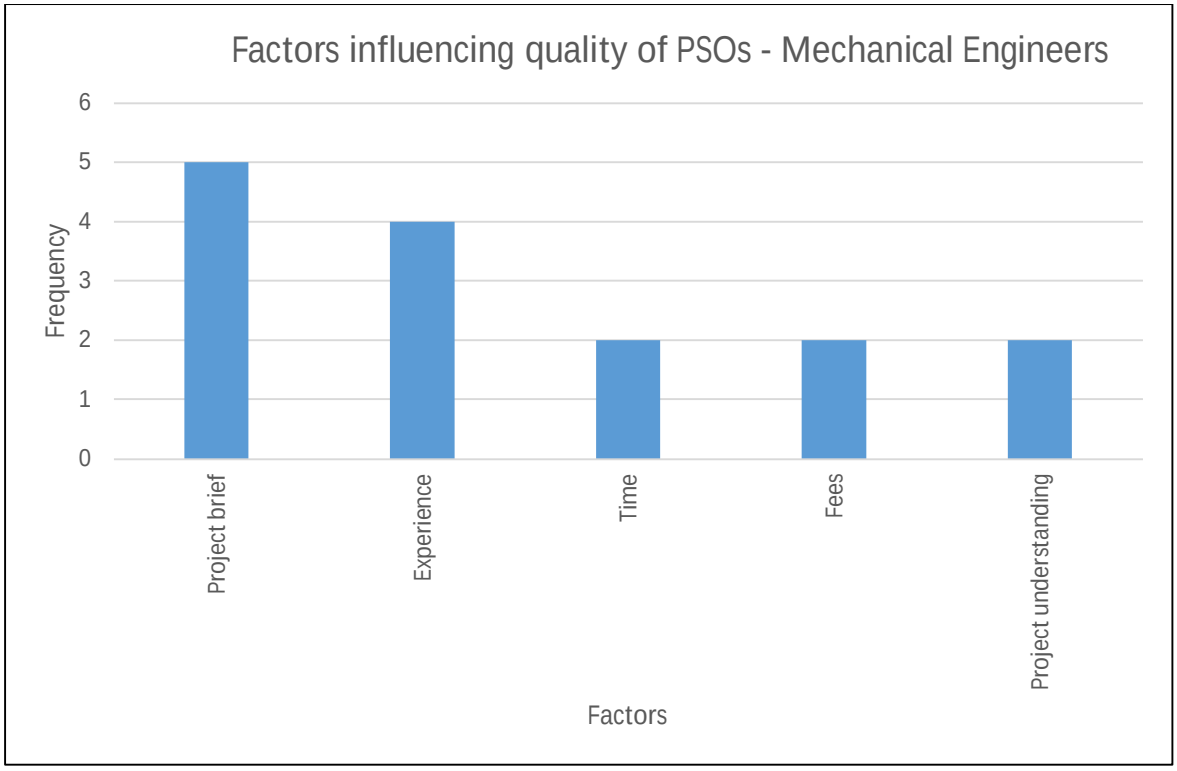


Figure 36: Bar chart illustrating key factors influencing the quality of PSOs as cited by mechanical engineers

Figure 37 provides shows key factors influencing the quality of PSOs according to mechanical engineers. The figure illustrates factors that were cited by at least 25% of mechanical engineering participants. The key factors were project brief (63%), experience (50%), time (25%), fees (25%), and project understanding (25%).

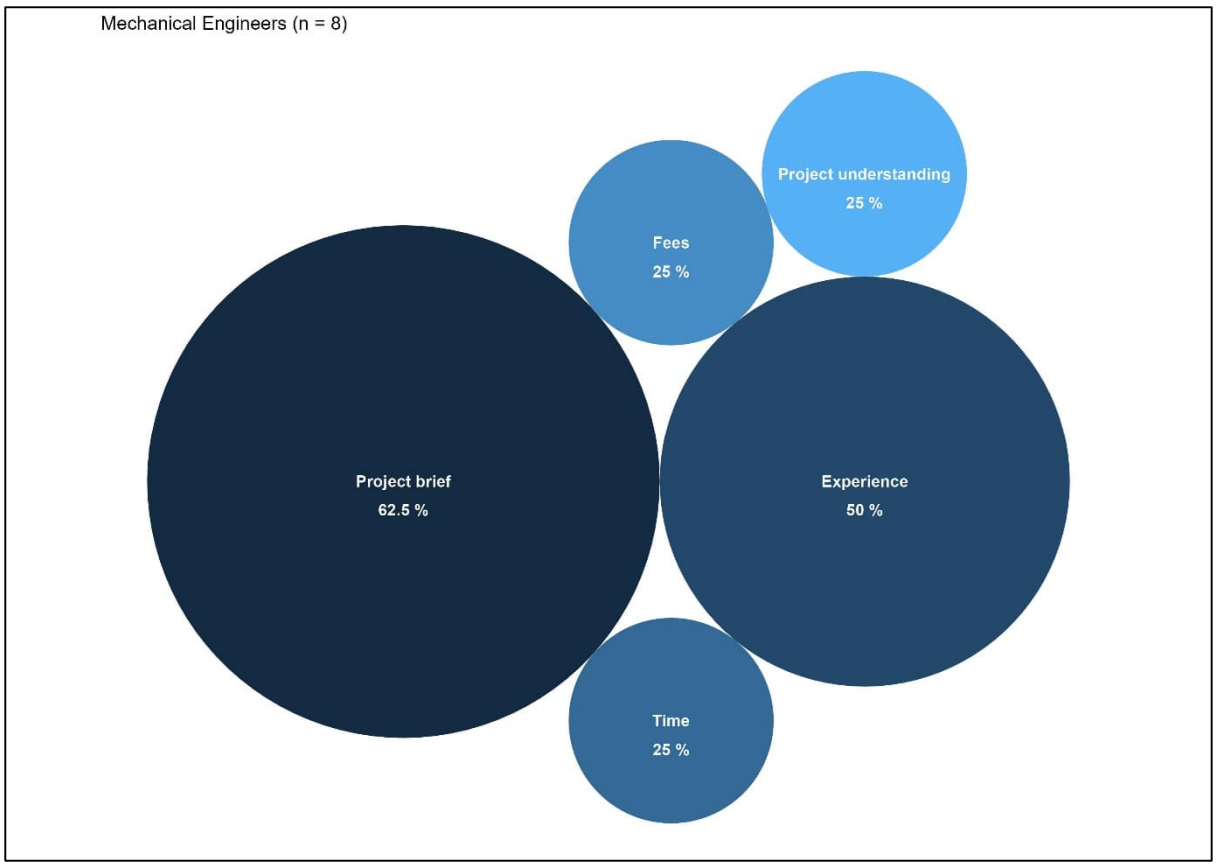


Figure 37: Key factors influencing the quality of PSOs (cited by 25% or more of the mechanical engineering participants)

4.2.2.7 Quantity surveyors

Figure 38 provides a word cloud illustrating high-frequency words among quantity surveying participants in Section 1 of the survey.



Figure 38: Word cloud illustrating high-frequency words among quantity surveyors

Table 45 and Figure 39 show the top factors that influence the quality of PSOs based on the feedback of quantity surveyors in the survey. The top four ranked factors are similar to those highlighted by other built environment disciplines. However, an additional factor, namely, additional information, has been ranked as the second-highest factor. Interestingly, time, available information, fees, project brief and experience were all cited by more than 25% of participants in the study. Team composition was the only other factor that was cited by more than 20% of participants. Interestingly, the accuracy of design information and coordination were cited among the top ten key factors. This did not occur among other built environment disciplines. Communication, the accuracy of design information, coordination, and tools and equipment were cited by between 11% and 17% of quantity surveyors.

Table 45: Key factors influencing the quality of PSOs as cited by quantity surveyors

Rank	**Factor**	**Frequency**	**Percentage of participants (%)**
1	Time**	31	67%
2	Available information*	22	48%
3	Fees*	15	33%
4	Project brief*	12	26%
4	Experience*	12	26%
5	Team composition	11	24%
6	Communication	8	17%
7	Accuracy of design information	6	13%
7	Coordination	6	13%
8	Tools and equipment	5	11%
		Total participants	46

*Cited by 25% or more of the participants
**Cited by 50% or more of the participants

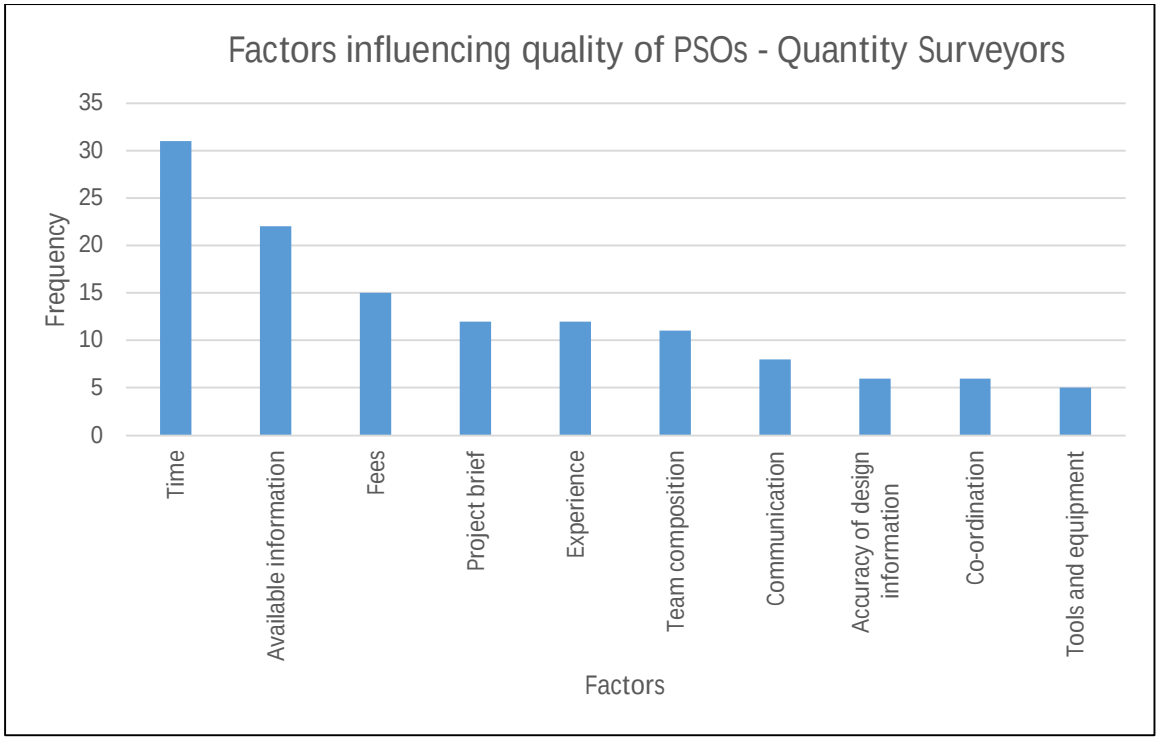


Figure 39: Bar chart illustrating key factors influencing the quality of PSOs as cited by quantity surveyors

Figure 40 shows key factors influencing the quality of PSOs according to quantity surveyors. The figure illustrates factors that were cited by at least 25% of quantity surveying participants. The key factors were time (67%), available information (48%), fees (33%), project brief (26%) and experience (26%).

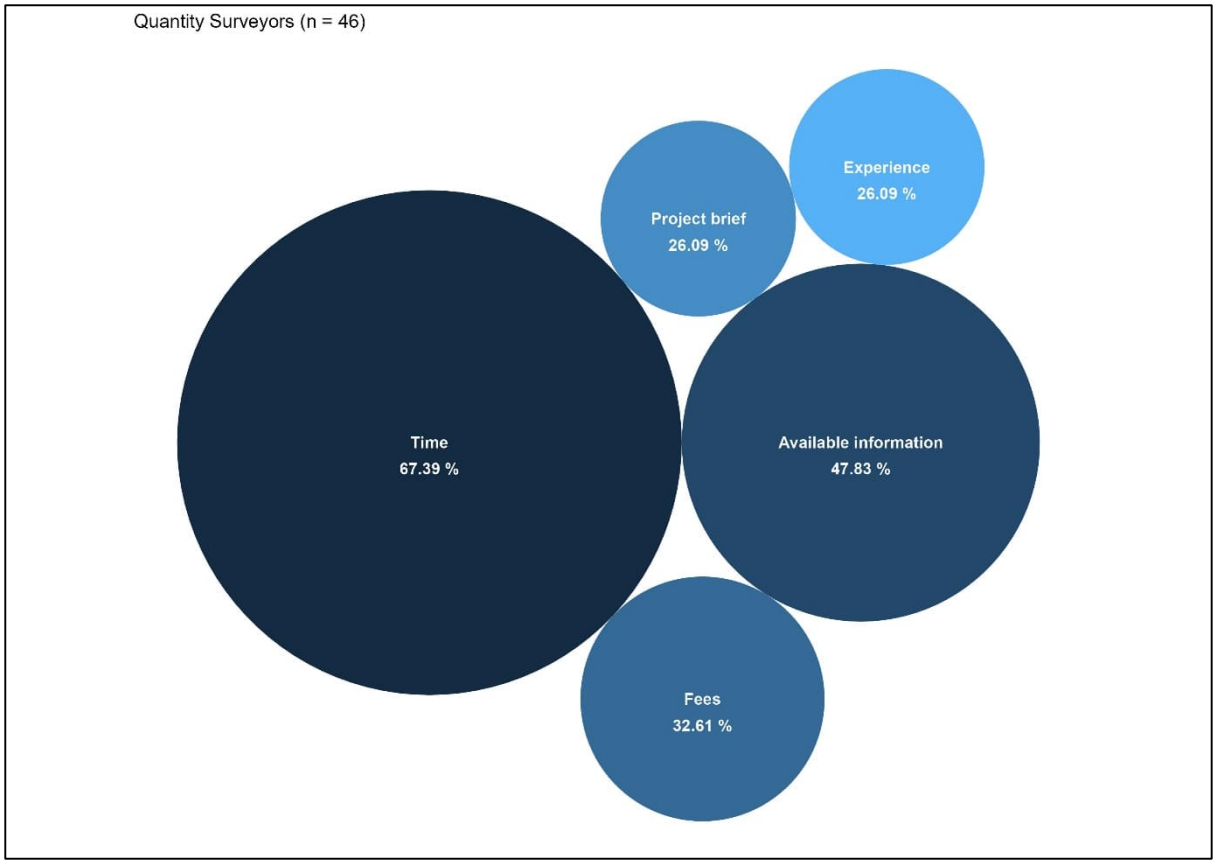


Figure 40: Key factors influencing the quality of PSOs (cited by 25% or more of the quantity surveying participants)

4.2.2.8 Cross-discipline analysis

Six key factors across disciplines were cited by a minimum of 25% of participants, namely:

- Available information
- Experience
- Fees
- Project brief
- Project understanding
- Time

Table 46 provides key factors that were cited by 25% or more of the participants in the various built environment disciplines. “Experience”, “fees” and “time” were key factors across all built environment disciplines. Additionally, "project brief" appears to be a key factor for all disciplines except architects. Interestingly, "available information" and "project understanding" were not overwhelmingly selected by participants, with "available information" being more important for electrical engineering and quantity surveying participants, while "project understanding" was more important for mechanical engineering participants.

Table 46: Key factors cited by 25% or more of the participants in specific built environment disciplines

Factors	Discipline				
	Architect	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
Available information			✓		✓
Experience	✓	✓	✓	✓	✓
Fees	✓	✓	✓	✓	✓
Project brief		✓	✓	✓	✓
Project understanding				✓	
Time	✓	✓	✓	✓	✓

Table 47 provides key factors that were cited by 50% or more of the participants in the various built environment disciplines. “Experience”, “fees” and “time” were key factors across two built environment disciplines. “Experience” was a key factor for civil/structural engineers and mechanical engineers. A key factor for architects and electrical engineers was “fees”. Lastly, “time” was a key factor for electrical engineers and quantity surveyors. Interestingly, “project brief” was only cited as a key factor by 50% or more of mechanical engineering participants. “Available information” and “project understanding” were previously selected as key factors by more than 25% of participants in a few disciplines but failed to receive 50% or more citations from any of the built environment disciplines. This suggests that they may not be as significant as other factors presented below.

Table 47: Key factors cited by 50% or more of the participants in specific built environment disciplines

Factors	Discipline				
	Architect	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
Available information					
Experience		✓		✓	
Fees	✓		✓		
Project brief				✓	
Project understanding					
Time			✓		✓

4.2.3 Section 2: Client Factors

This section provides a breakdown of the level of agreement among built environment professionals with client factors influencing the quality of PSOs.

4.2.3.1 Architects

Figure 41 provides a heatmap with client factors influencing the quality of PSOs and the distribution of agreement among architectural participants. Only a handful of factors received a "strongly agree" response from more than 50% of participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. ARCH F5 (59.7%), ARCH F8 (59.3%) and ARCH F17 (58.4%) generated the three highest "strongly agree" responses while ARCH F18 (18.9%), ARCH F14 (20.7%) and ARCH F4 (21.1%) generated the three least "strongly agree" responses. On the other hand, ARCH F16 (9.6%), ARCH F4 (7%) and ARCH F14 (6.1%) generated the three highest "strongly disagree" responses while ARCH F1 (1.4%) and ARCH F5 (1.4%) contained the lowest number of "strongly disagree" responses.

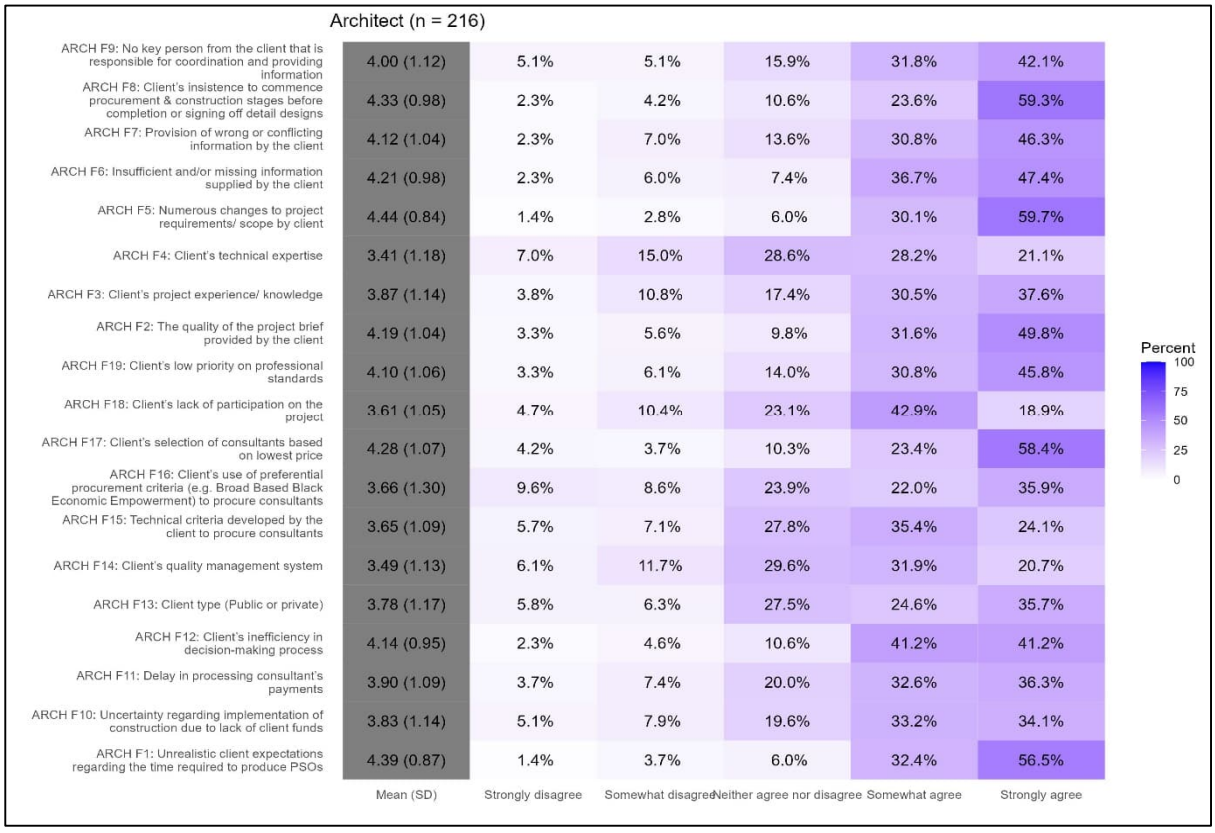


Figure 41: Heat map showing architects' distribution of agreement with client factors

Figure 42 contains a stacked bar chart showing architects' distribution of agreement with client factors. ARCH F5 (90%), ARCH F1 (89%) and ARCH F6 (84%) were the top three factors with the highest level of agreement among participants. On the other hand, ARCH F4 (49%), ARCH F14 (53%) and ARCH F16 (58%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, only ARCH F4 contained a level of agreement of under 50%. Interestingly, the last two factors (ARCH F4 and ARCH F14) had the highest and second-highest percentage of participants selecting "neither agree nor disagree". Two factors with the highest levels of agreement ARCH F5 and ARCH F1 both had the lowest levels of disagreement, with 4% and 5%, respectively. Furthermore, the three factors with the lowest levels of agreement, ARCH F4, ARCH F14 and ARCH F16, had the three highest levels of disagreement, with 22%, 18% and 18%, respectively.

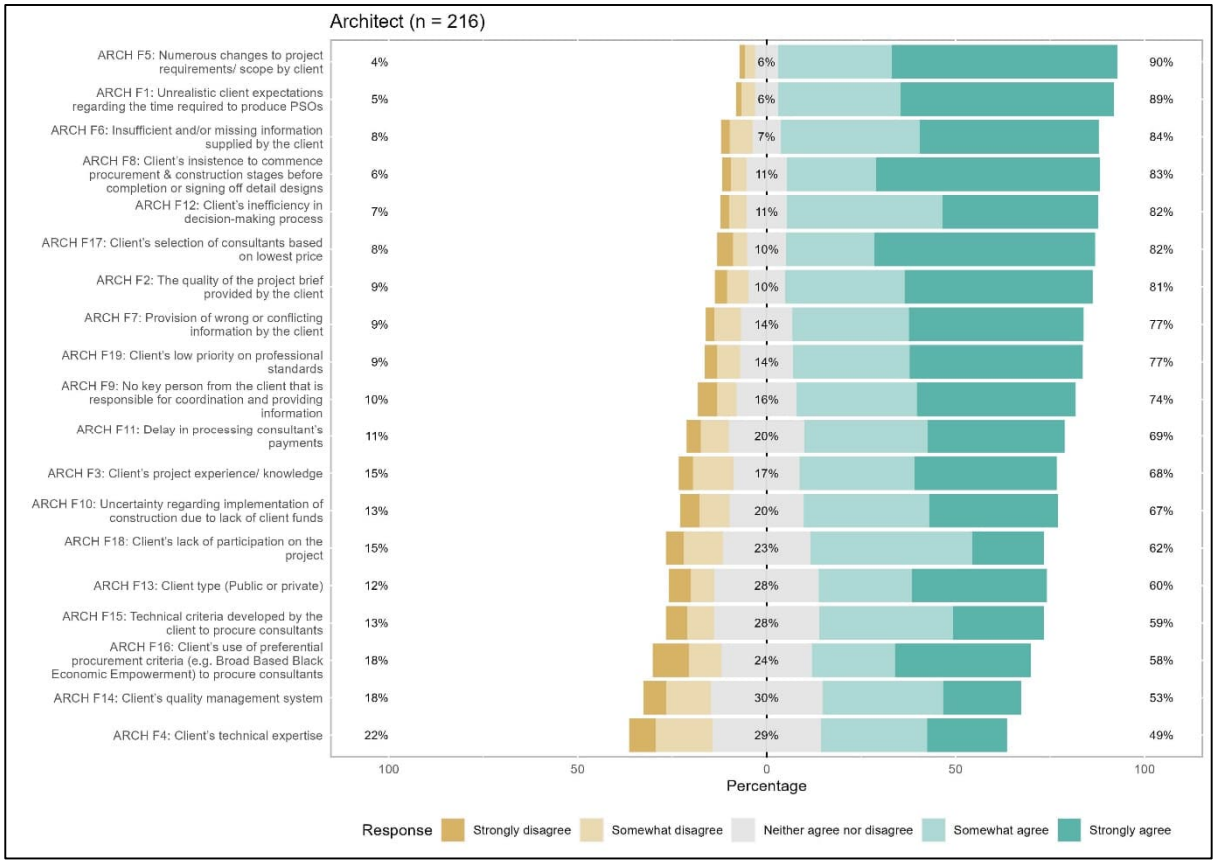


Figure 42: Bar chart showing architects' level of agreement with client factors

The figures below provide insight into client factors that were most important to architects, based on their level of agreement. Figure 43 illustrates client factors cited by architects where "strongly agree" was selected by 50% or more of the participants. From a total of 19 client factors, only ARCH F1 (56.48%), ARCH F17 (58.41%), ARCH F8 (59.26%) and ARCH F5 (59.72%) satisfied this criterion.

Figure 44 shows client factors cited by architects where a combination of “strongly agree” and “agree” was selected by 80% or more of the participants. Seven factors satisfied this criterion including ARCH F5 (89.81%), ARCH F1 (88.89%), ARCH F6 (84.19%), ARCH F8 (82.87%), ARCH F12 (82.41%), ARCH F17 (81.78%) and ARCH F2 (81.4%).

Notably, ARCH F1, ARCH F17, ARCH F8 and ARCH F5 were the only factors appearing in both figures, indicating they were considered the most important factors.

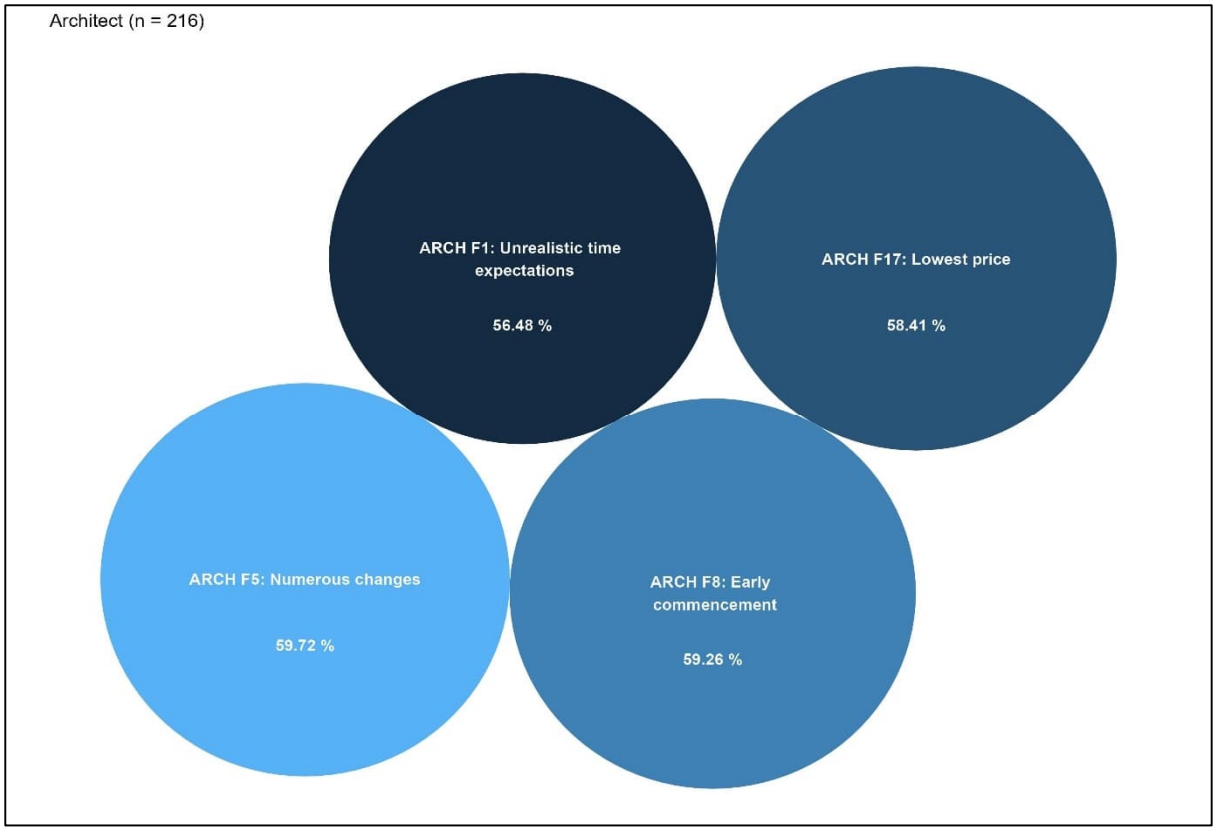


Figure 43: Client factors where "strongly agree" was selected by 50% or more of the architects

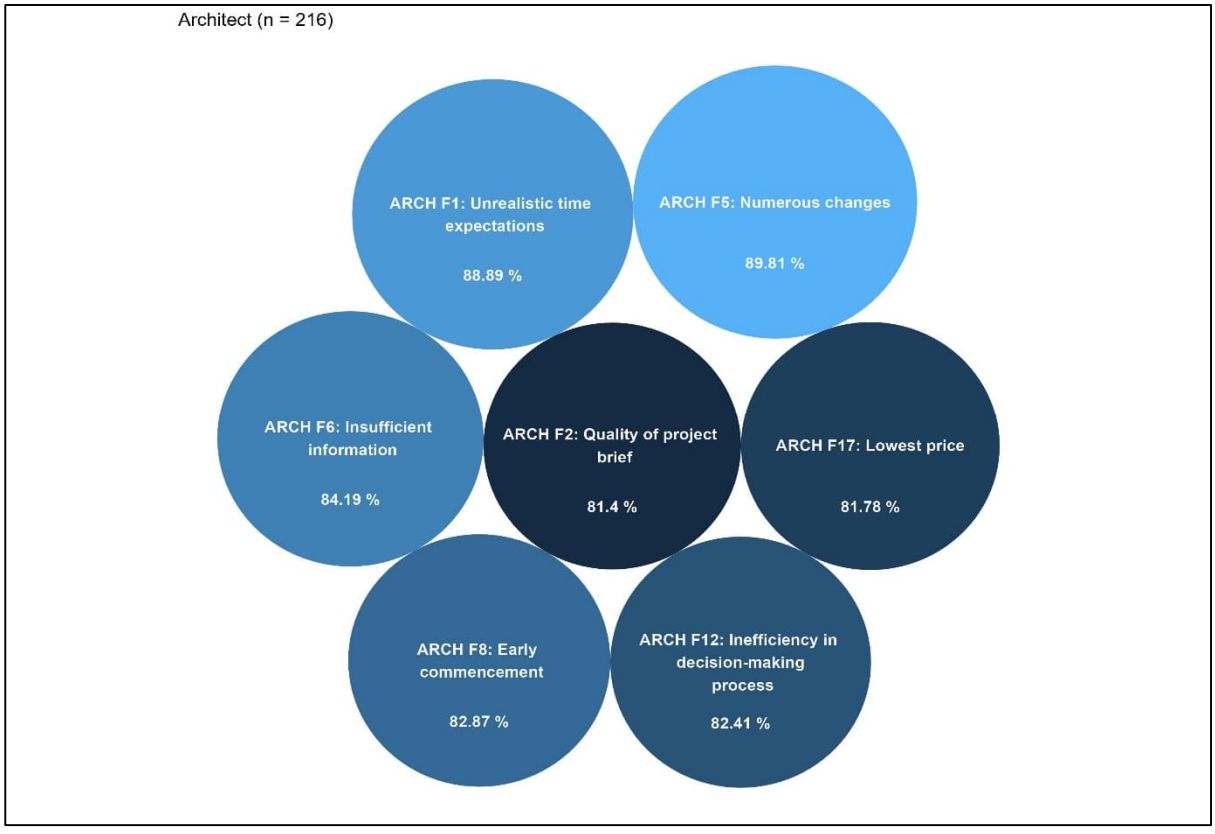


Figure 44: Client factors where "strongly agree" and "agree" was selected by 80% or more of the architects

4.2.3.2 Civil/Structural engineers

Figure 45 provides a heatmap with client factors influencing the quality of PSOs and the distribution of agreement among civil/structural engineering participants. Six factors received a "strongly agree" response by more than 50% of the participants with CSENG F17 receiving 73.48% of "strongly agree" responses. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. CSENG F17 (73.48%), CSENG F5 (61.90%) and CSENG F1 (56.71%) generated the three highest "strongly agree" responses while CSENG F14 (20.26%), CSENG F18 (26.52%) and CSENG F11 (30.70%) generated the three lowest "strongly agree" responses. CSENG F17 generated approximately 11% more "strongly agree" responses than CSENG F5, which had the second-highest number of "strongly agree" responses. On the other hand, CSENG F16 (8.56%), CSENG F11 (8.33%) and CSENG F14 (7.05%) generated the three highest "strongly disagree" responses while CSENG F1 (0.87%) and CSENG F6 (0.87%) contained the lowest number of "strongly disagree" responses.

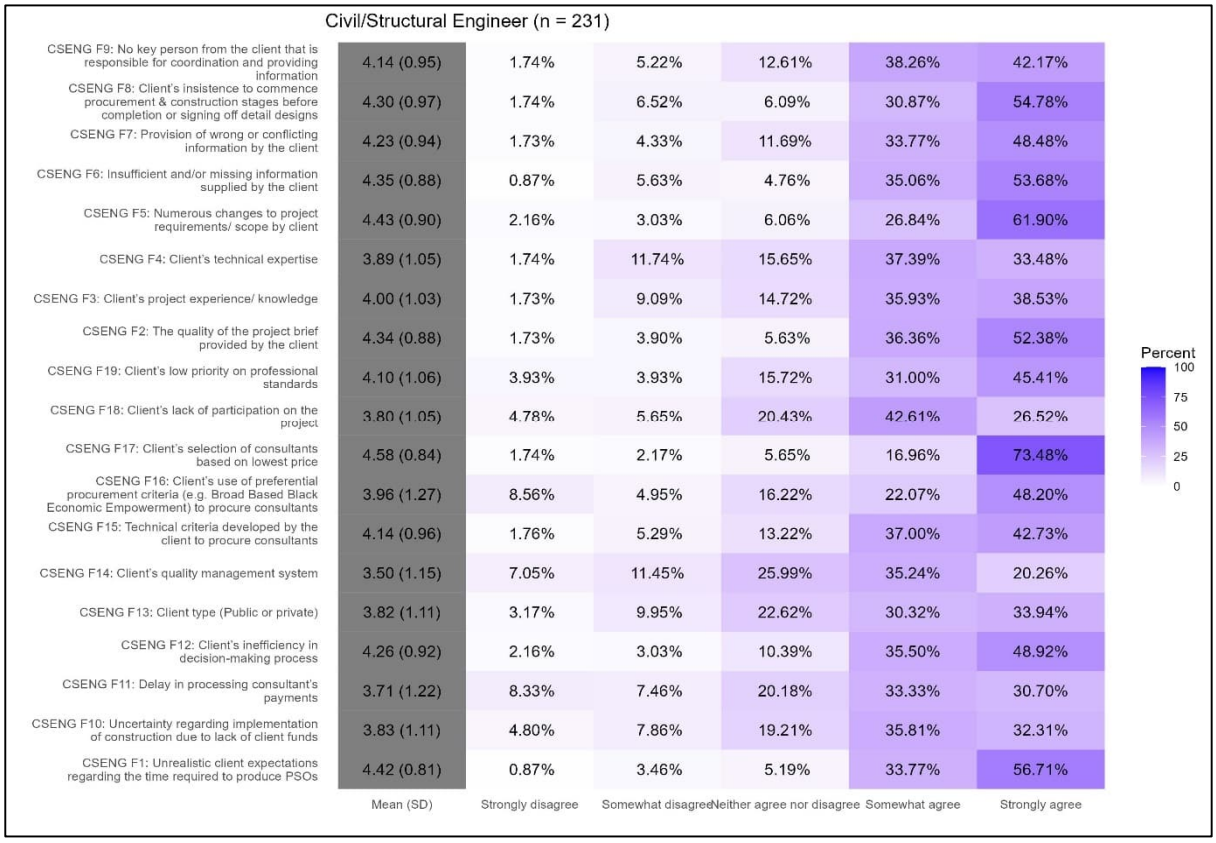


Figure 45: Heat map showing civil/structural engineers' distribution of agreement with client factors

Figure 46 illustrates a stacked bar chart showing civil/structural engineers' distribution of agreement with client factors. CSENG F1 (90%), CSENG F17 (90%), CSENG F6 (89%), CSENG F5 (89%), and CSENG F2 (89%) were the top five factors with the highest level of agreement among participants. On the other hand, CSENG F14 (56%), CSENG F11 (64%) and CSENG F13 (64%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, it is interesting to note that they all contained a level of agreement that exceeded 50%. The last two factors had the highest and second-highest percentage of participants selecting "neither agree nor disagree". Interestingly the two factors with the highest levels of agreement, CSENG F1 and CSENG F17, both have the lowest levels of disagreement of 4%. Furthermore, the two factors with the lowest levels of agreement, CSENG F14 and CSENG F11, also have the two highest levels of disagreement, with 19% and 16%, respectively.

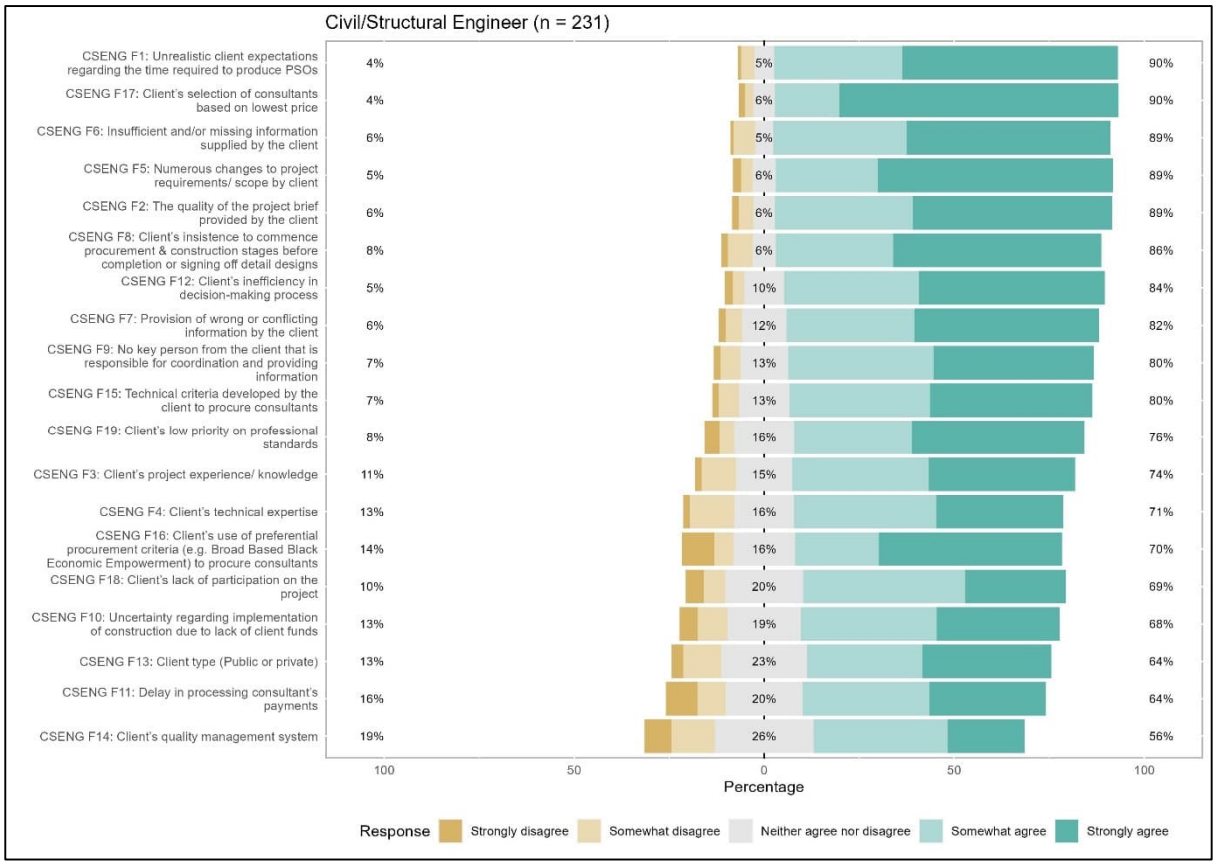


Figure 46: Bar chart showing civil/structural engineers' distribution of agreement with client factors

The figures below provide insight into the client factors that were most important to civil/structural engineers, based on their level of agreement. Figure 47 illustrates client factors cited by civil/structural engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 19 client factors, only CSENG F17 (73.48%), CSENG F5 (61.9%),

CSENG F1 (56.71%), CSENG F8 (54.78%), CSENG F6 (53.68%) and CSENG F2 (52.38%) satisfied this criterion.

Figure 48 shows client factors cited by civil/structural engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Nine factors satisfied this criterion, including CSENG F1 (90.48%), CSENG F17 (90.43%), CSENG F6 (88.74%), CSENG F5 (88.74%), CSENG F2 (88.74%), CSENG F8 (85.65%), CSENG F12 (84.42%), CSENG F7 (82.25%) and CSENG F9 (80.43%).

Notably, CSENG F17, CSENG F5, CSENG F1, CSENG F8, CSENG F6 and CSENG F2 were the only factors appearing in both figures, indicating they were considered the most important factors.

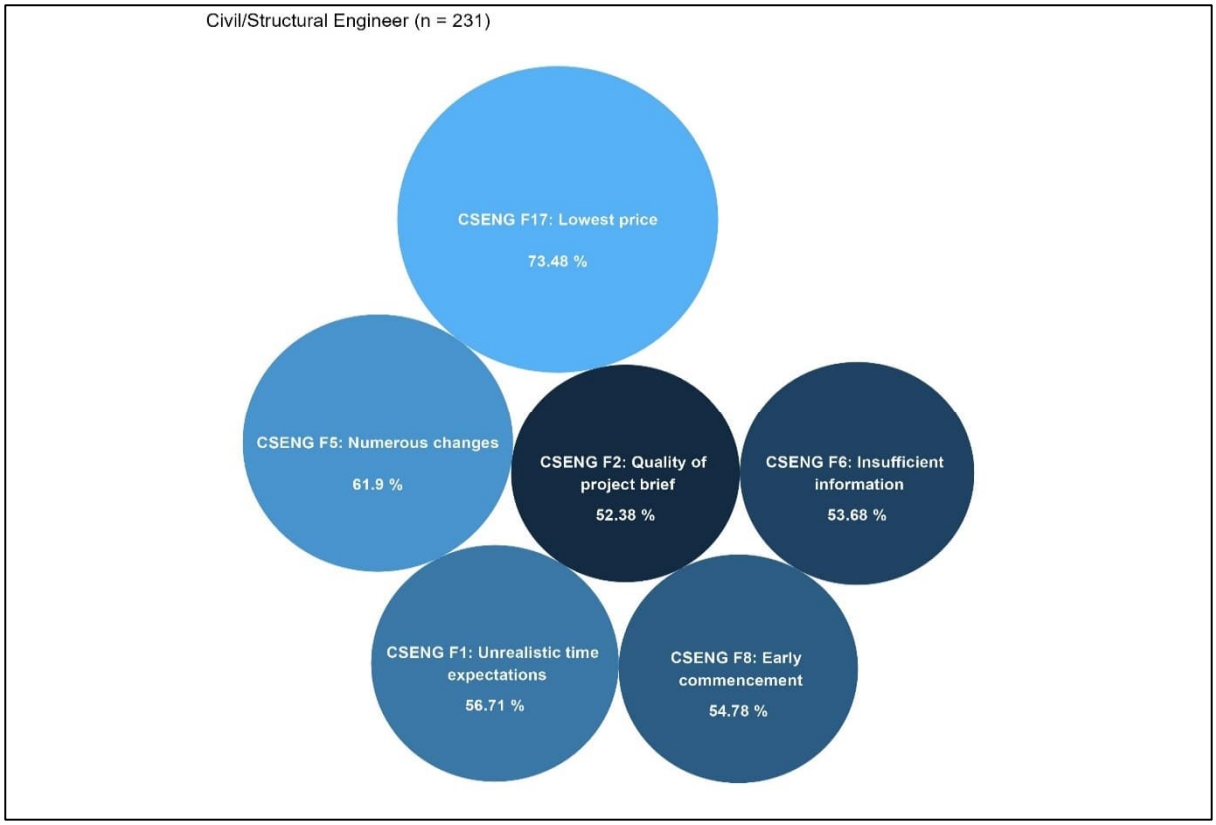


Figure 47: Client factors where "strongly agree" was selected by 50% or more of the civil/structural engineers

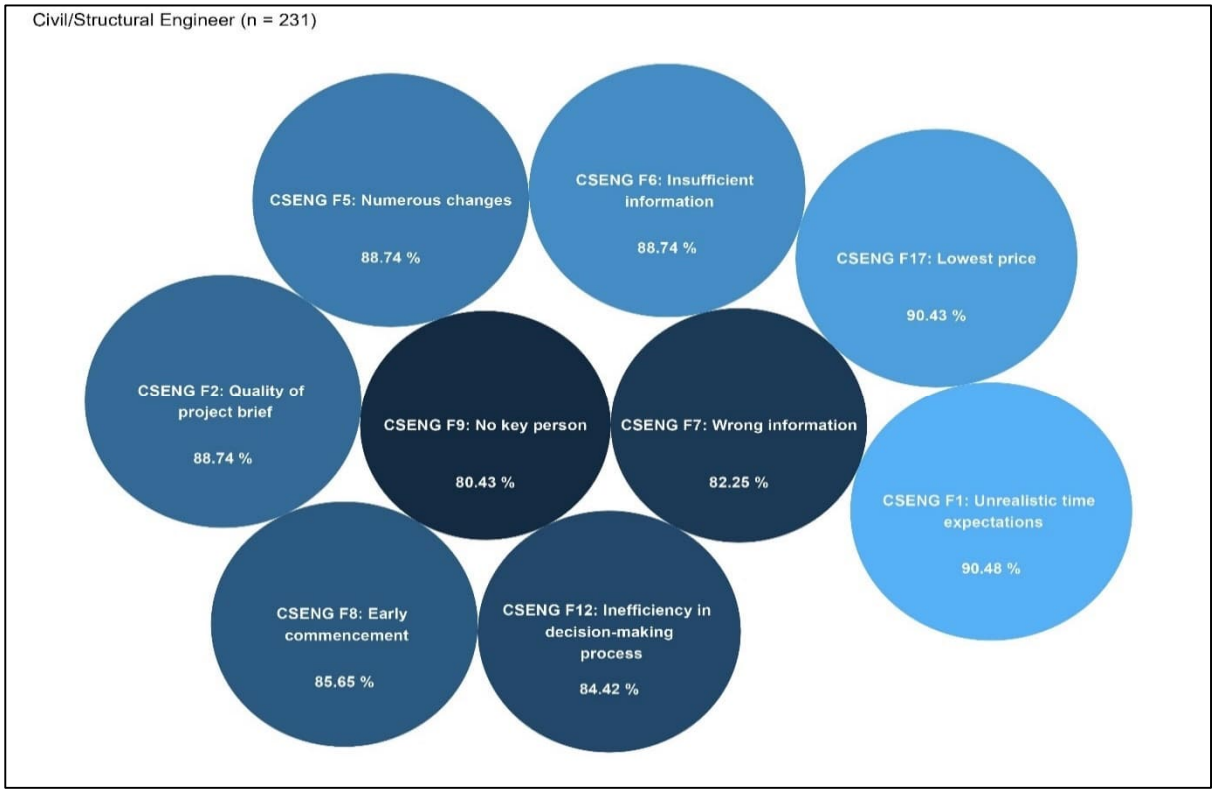


Figure 48: Client factors where "strongly agree" and "agree" was selected by 80% or more of the civil/structural engineers

4.2.3.3 Electrical engineers

Figure 49 provides a heatmap with client factors influencing the quality of PSOs and the distribution of agreement among electrical engineering participants. Five factors received a "strongly agree" response from more than 50% of participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". Interestingly, 12 factors did not receive any responses for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "agree" and "strongly agree". EENG F8 (64.3%), EENG F16 (58.30%) and EENG F17 (57.10%) generated the three highest "strongly agree" responses while EENG F14 (14.3%), EENG F11 (14.3%) and EENG F1 (21.4%) generated the three lowest "strongly agree" responses. On the other hand, EENG F4 (7.1%), EENG F2 (7.1%), EENG F15 (7.1%), EENG F14 (7.1%), EENG F12 (7.1%), EENG F11 (7.1%) and EENG F1 (7.1%) contained the highest "strongly disagree" responses.

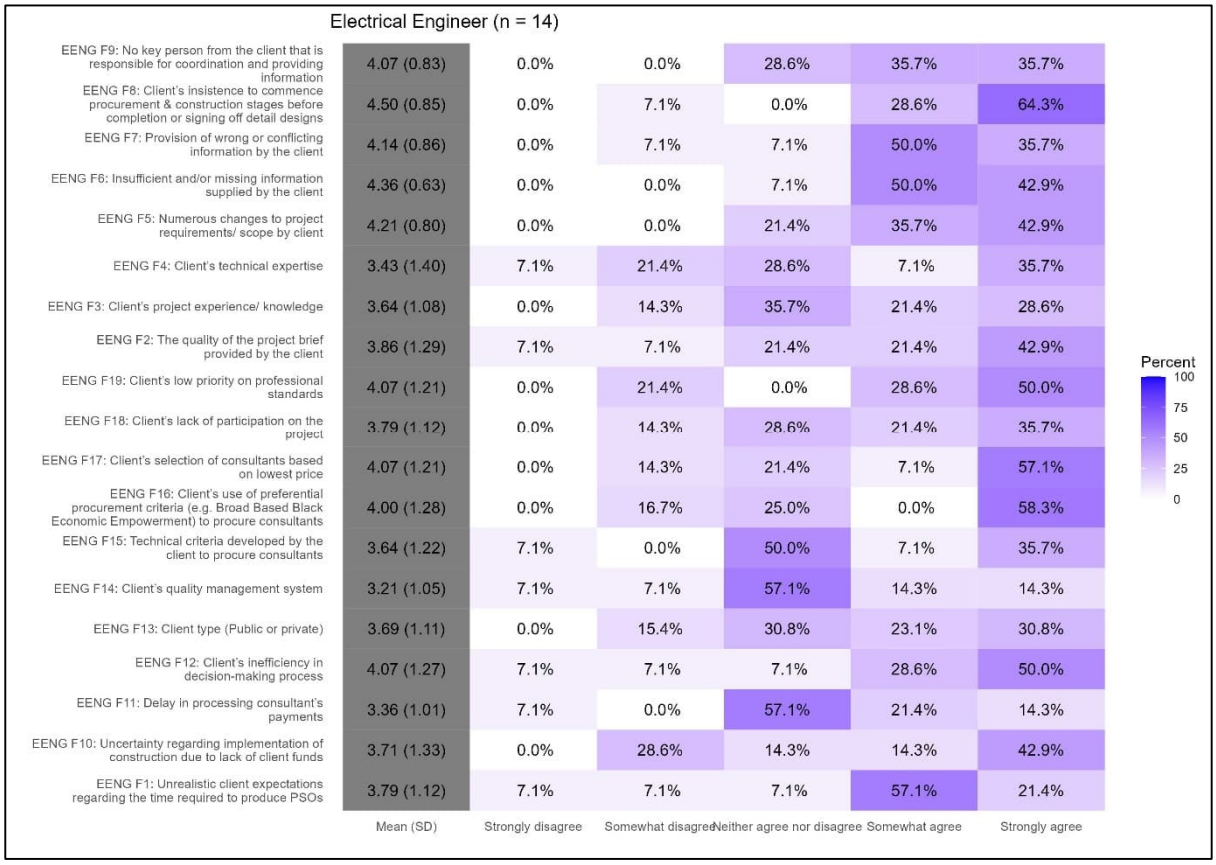


Figure 49: Heat map showing electrical engineers' distribution of agreement with client factors

Figure 50 contains a stacked bar chart showing electrical engineers' distribution of agreement with client factors. EENG F8 (93%), EENG F6 (93%) and EENG F7 (86%) were the top three factors with the highest level of agreement among participants. On the other hand, EENG F14 (29%), EENG F11 (36%), EENG F4 (43%) and EENG F15 (43%) contained the lowest level

of agreement. Interestingly, the level of agreement for the four aforementioned factors was under 50%, while all other factors had a level of agreement above 50%. The two factors with the lowest level of agreement, EENG F14 and EENG F11, had the highest percentage of participants selecting "neither agree nor disagree" (both 57%). EENG F6 (93%), which jointly had the highest level of agreement, also had the lowest level of disagreement of 0% with EENG F9. EENG F4 had the highest level of disagreement at 29%.

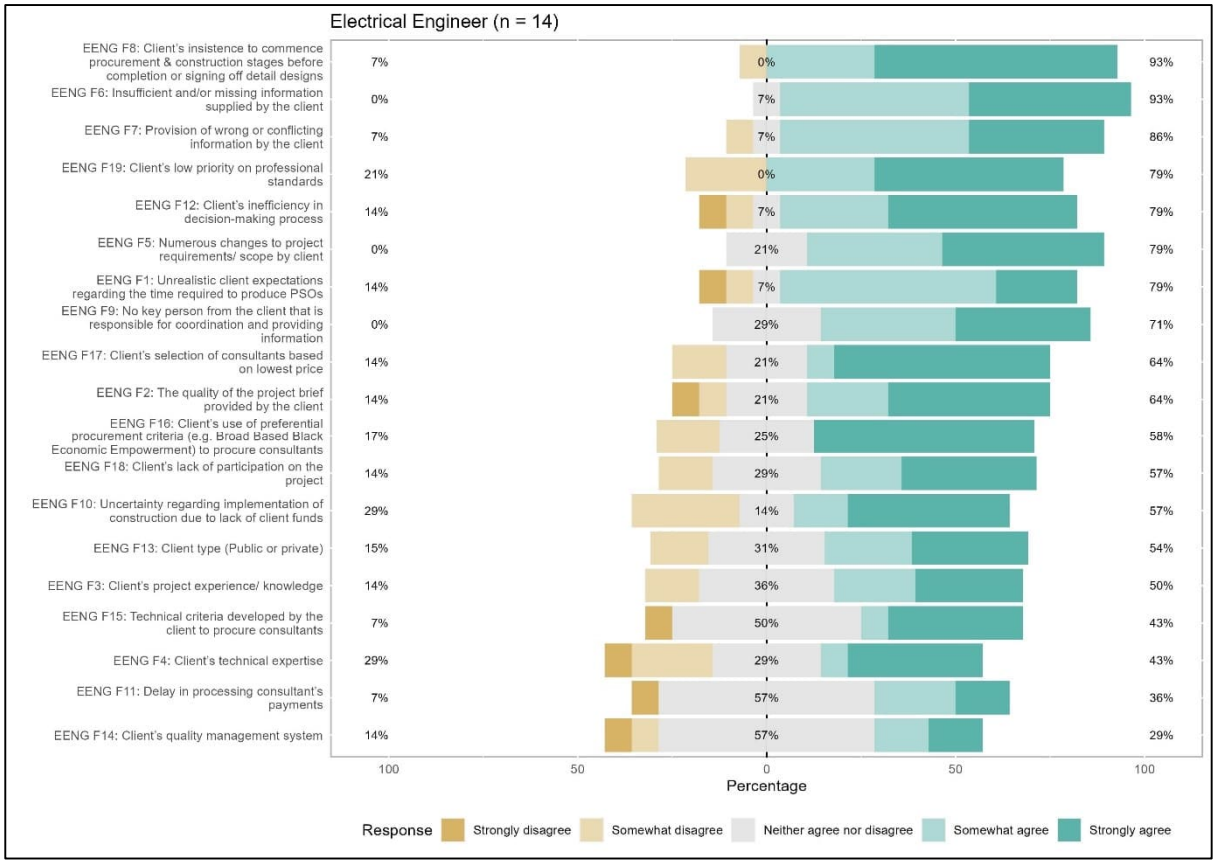


Figure 50: Bar chart showing electrical engineers' distribution of agreement with client factors

The figures below provide insight into client factors that were most important to electrical engineers, based on their level of agreement. Figure 51 illustrates client factors cited by electrical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 19 client factors, only EENG F8 (64.29%), EENG F16 (58.33%), EENG F17 (57.14%), EENG F19 (50%) and EENG F12 (50%) satisfied this criterion.

Figure 52 shows client factors cited by electrical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Three factors satisfied this criterion: EENG F8 (92.86%), EENG F6 (92.86%) and EENG F7 (85.71%).

Notably, only EENG F8 appeared in both figures, indicating it was considered one of the most important factors.

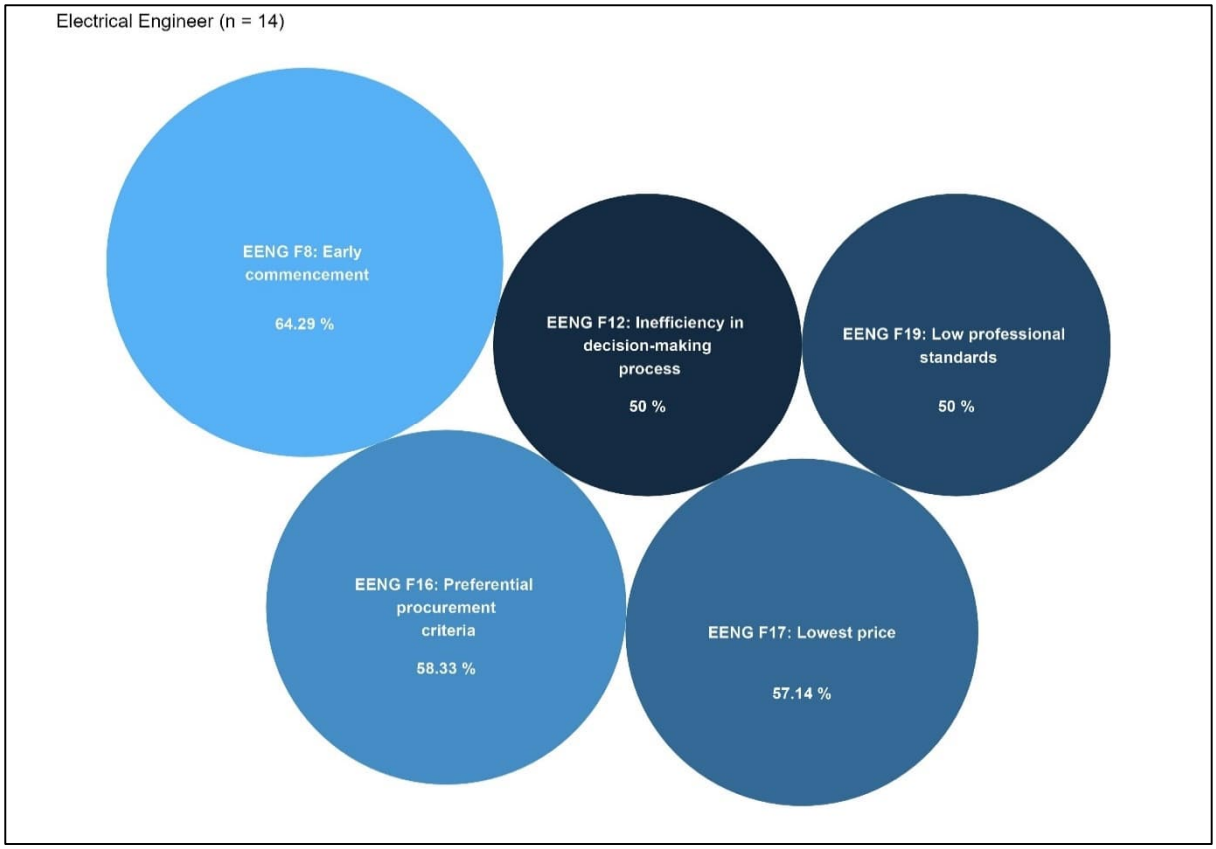


Figure 51: Client factors where "strongly agree" was selected by 50% or more of the electrical engineers

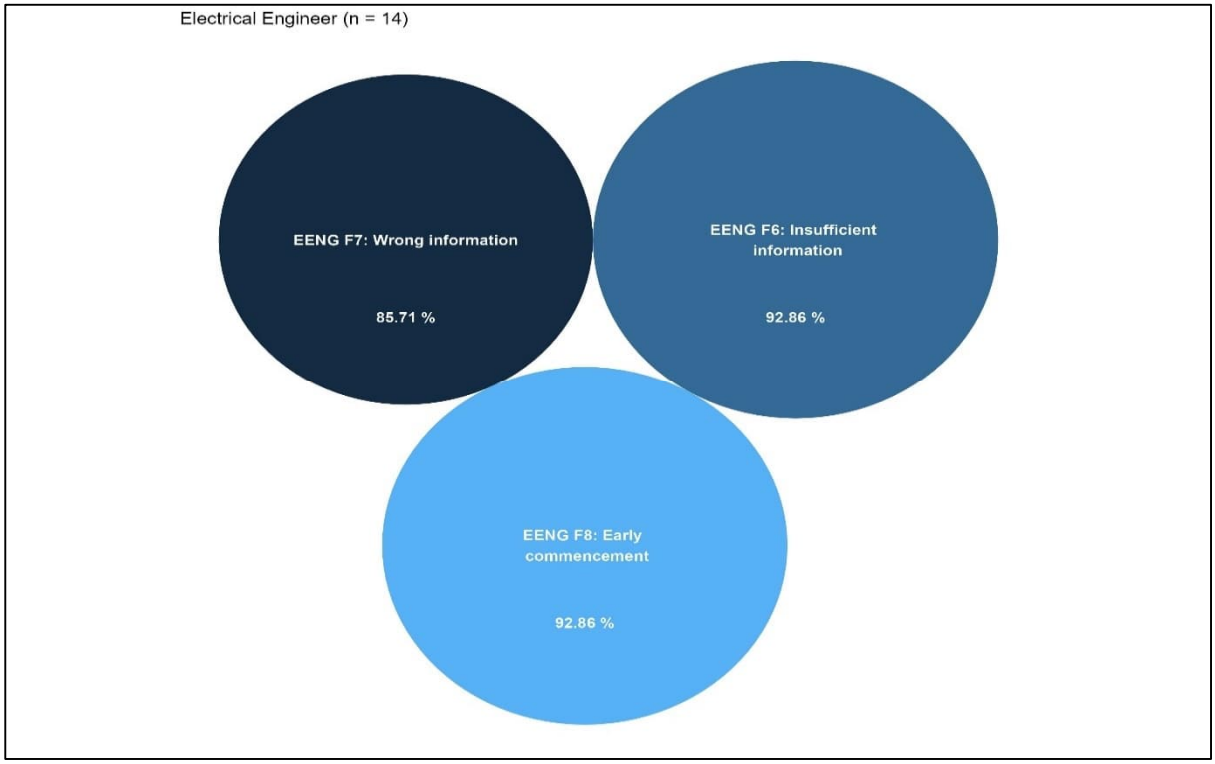


Figure 52: Client factors where "strongly agree" and "agree" was selected by 80% or more of the electrical engineers

4.2.3.4 Mechanical engineers

Figure 53 provides a heatmap with client factors influencing the quality of PSOs and the distribution of agreement among mechanical engineering participants. Seven factors received a "strongly agree" response by more than 50% of the participants with those factors jointly having the highest "strongly agree" responses. On the other hand, only MEENG F16 received a response for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". MEENG F8 (57%), MEENG F7 (57%), MEENG F2 (57%), MEENG F19 (57%), MEENG F17 (57%), MEENG F15 (57%) and MEENG F10 (57%) generated the most "strongly agree" responses. MEENG F16 (0%), MEENG F3 (14%), MEENG F18 (14%), MEENG F14 (14%) and MEENG F11 (14%) generated the lowest "strongly agree" responses. MENG F16 had the highest "strongly disagree" responses with 33%, the rest of the factors did not contain any responses for "strongly disagree".



Figure 53: Heat map showing mechanical engineers' distribution of agreement with client factors

Figure 54 contains a stacked bar chart showing mechanical engineers' distribution of agreement with client factors. MEENG F19 (100%), MEENG F15 (100%) and MEENG F2 (100%) had the highest level of agreement among participants. On the other hand, MEENG

F16 (17%) and MEENG F11 (43%) contained the lowest levels of agreement. The two aforementioned factors contained a level of agreement under 50%. MEENG F16 (50%), MEENG F11 (43%), MEENG F18 (43%) and MEENG F1 (43%) contained the most "neither agree nor disagree" responses. The factor with the lowest level of agreement, MEENG F16, also had the highest level of disagreement of 33%.

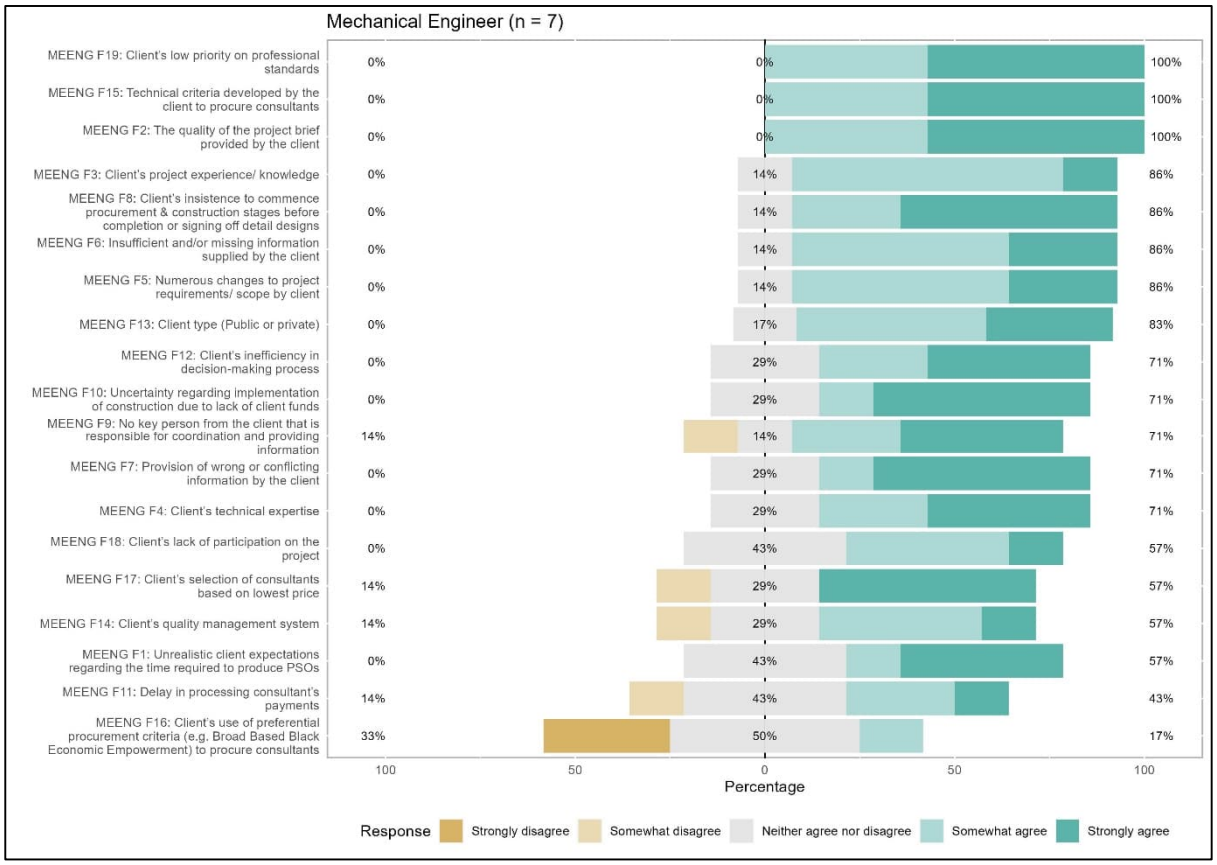


Figure 54: Bar chart showing mechanical engineers' distribution of agreement with client factors

The figures below provide insight into client factors that were most important to mechanical engineers, based on their level of agreement. Figure 55 illustrates client factors cited by mechanical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 19 client factors, only MEENG F8 (57%), MEENG F7 (57%), MEENG F2 (57%), MEENG F19 (57%), MEENG F17 (57%), MEENG F15 (57%) and MEENG F10 (57%) satisfied this criterion.

Figure 56 shows client factors cited by mechanical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Eight factors satisfied this criterion including MEENG F19 (100%), MEENG F15 (100%), MEENG F2 (100%), MEENG

F3 (85.71%), MEENG F8 (85.71%), MEENG F6 (85.71%), MEENG F5 (85.71%) and MEENG F13 (83.33%).

Notably, MEENG F19, MEENG F15, MEENG F2 and MEENG F8 were the only factors appearing in both figures, indicating they were considered the most important factors.

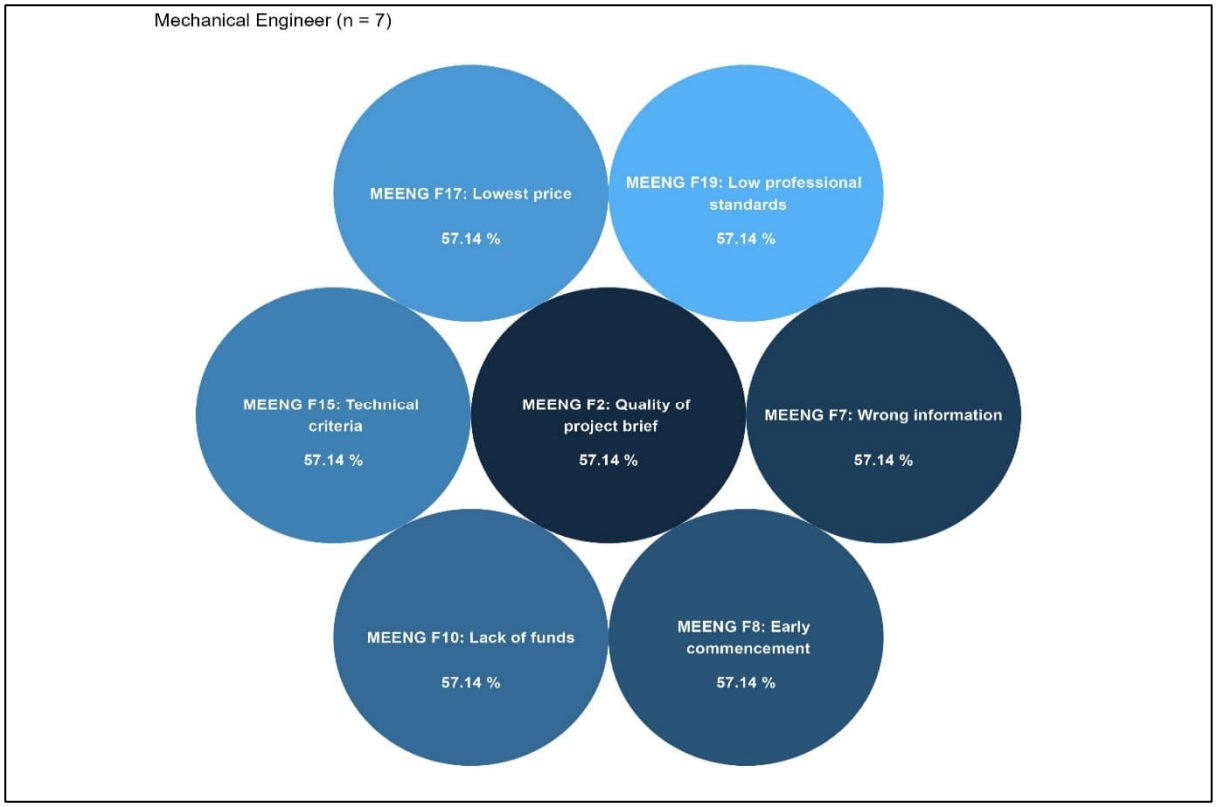


Figure 55: Client factors where "strongly agree" was selected by 50% or more of the mechanical engineers

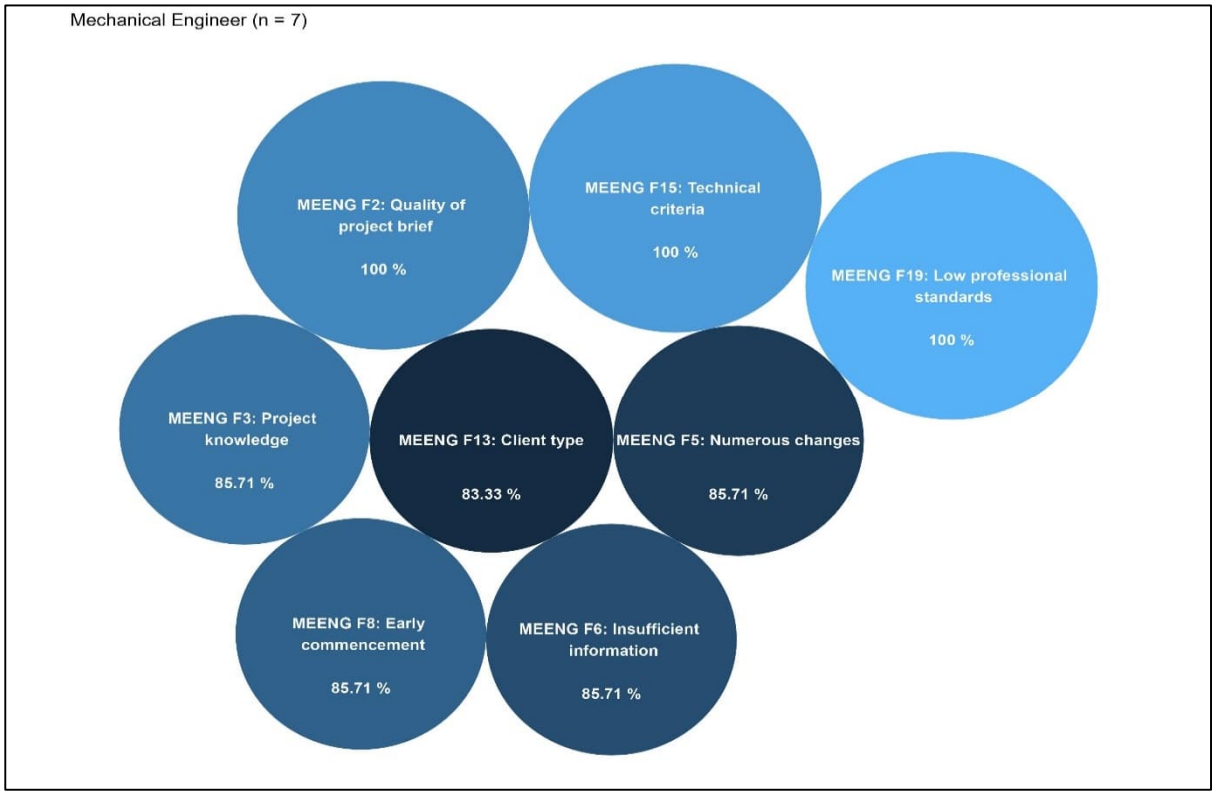


Figure 56: Client factors where "strongly agree" and "agree" was selected by 80% or more of the mechanical engineers

4.2.3.5 Quantity surveyors

Figure 57 provides a heatmap with client factors influencing the quality of PSOs and the distribution of agreement among quantity surveying participants. From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. QS F1 (66.67%), QS F8 (61.54%) and QS F5 (53.85%) generated the three highest "strongly agree" responses while QS F14 (10.3%), QS 4 (15.4%), QS F18 (15.8%) and QS F15 (15.8%) generated the lowest "strongly agree" responses. On the other hand, QS F14 (15.4%), QS F18 (13.2%), QS F13 (12.8%) and QS F4 (12.8%) generated the highest "strongly disagree" responses while QS F5 (0%), QS F6 (0%) and QS F7 (0%) had the lowest "strongly disagree" responses.



Figure 57: Heat map showing quantity surveyors' distribution of agreement with client factors

Figure 58 contains a stacked bar chart showing quantity surveyors' distribution of agreement with client factors. QS F6 (92%), QS F5 (90%), QS F1 (90%) and QS F8 (85%) had the highest level of agreement among participants. On the other hand, QS F14 (36%), QS F4 (46%) and QS F16 (47%) contained the lowest level of agreement. Interestingly, the aforementioned

factors contained a level of agreement of under 50%. The four factors with the lowest level of agreement had 26 – 36% of participants selecting "neither agree nor disagree". The two factors with the highest levels of agreement, QS F5 and QS F6, both had the lowest levels of disagreement of 3%. Furthermore, the two factors with the lowest levels of agreement, QS F14 and QS F4, had the highest levels of disagreement of 36% and 28%, respectively.

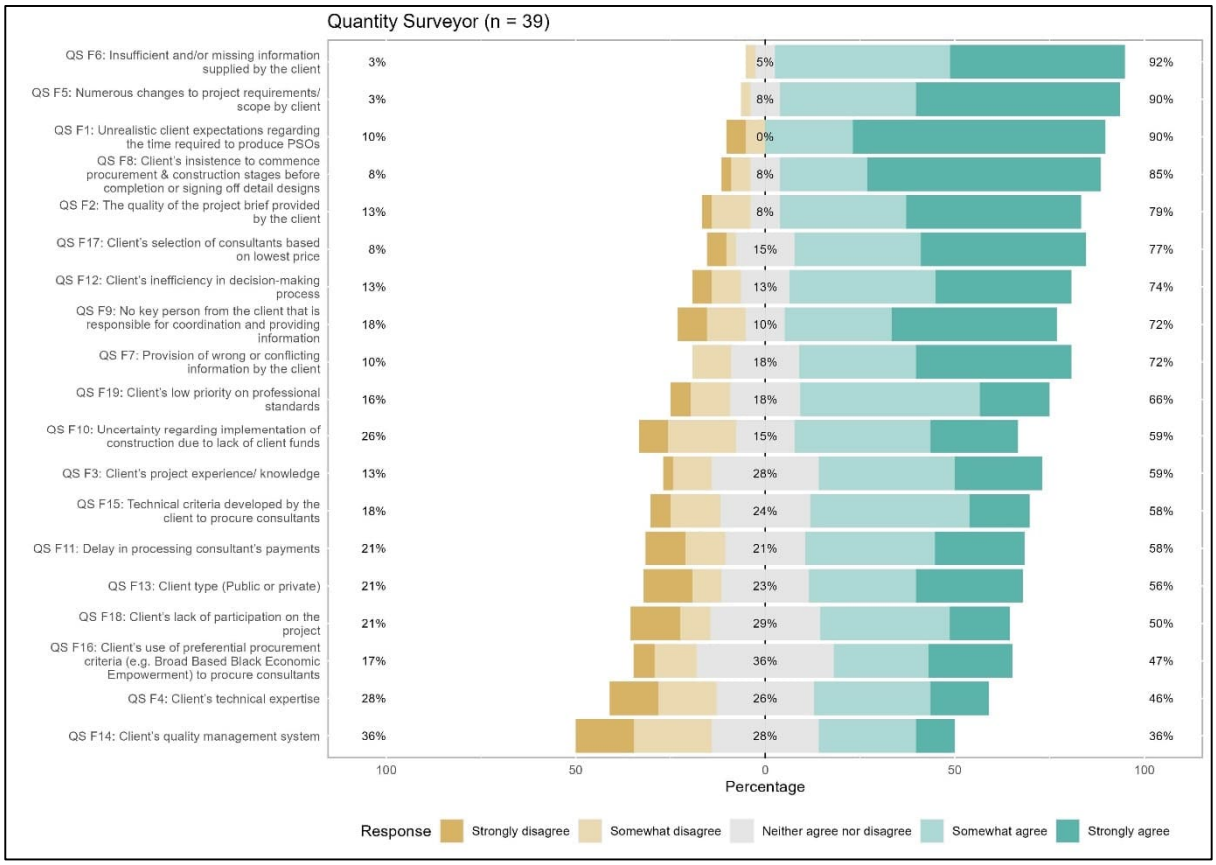


Figure 58: Bar chart showing quantity surveyors' distribution of agreement with client factors

The figures below provide insight into client factors that were most important to quantity surveyors, based on their level of agreement. Figure 59 illustrates client factors cited by quantity surveyors where "strongly agree" was selected by 50% or more of the participants. From a total of 19 client factors, only QS F1 (66.67%), QS F8 (61.54%) and QS F5 (53.85%) satisfied this criterion.

Figure 60 shows client factors cited by quantity surveyors where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Four factors satisfied this criterion including QS F6 (92.31%), QS F5 (89.74%), QS F1 (89.74%) and QS F8 (84.62%).

Notably, QS F1, QS F8 and QS F5 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

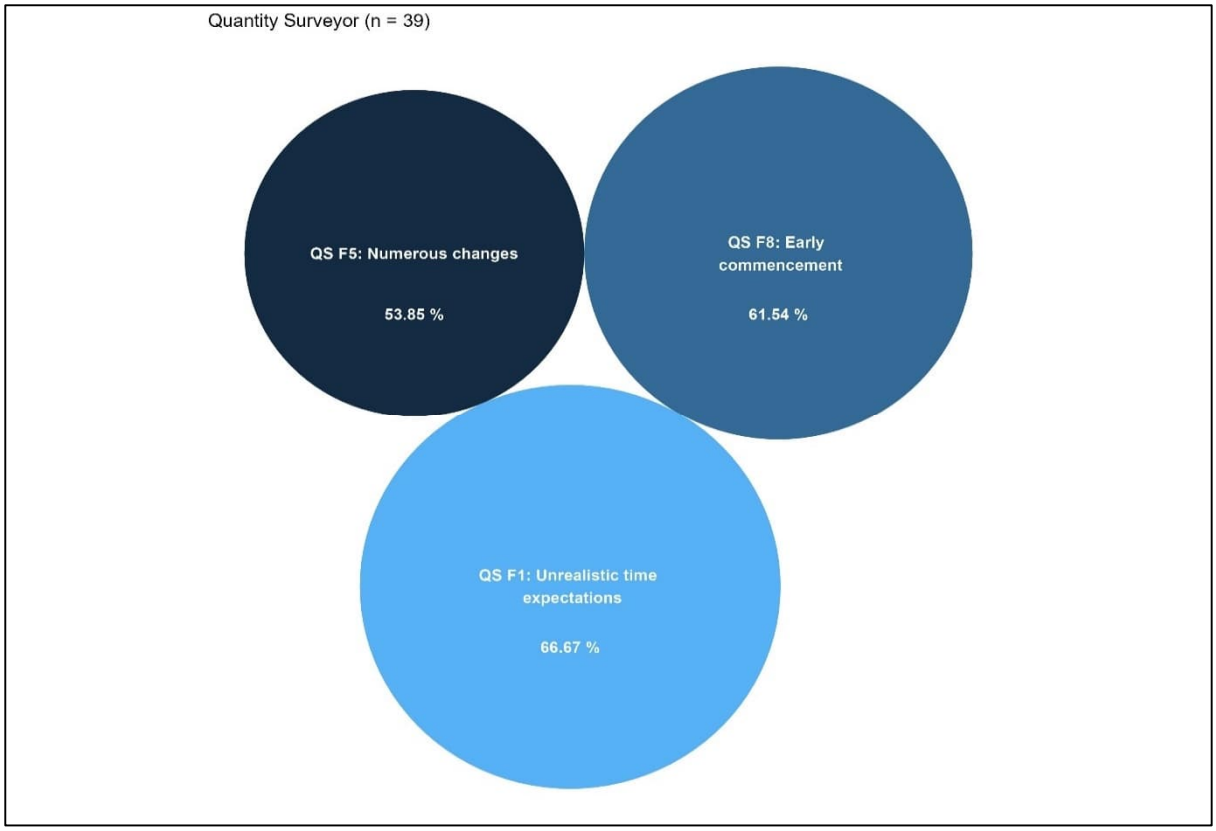


Figure 59: Client factors where "strongly agree" was selected by 50% or more of the quantity surveyors

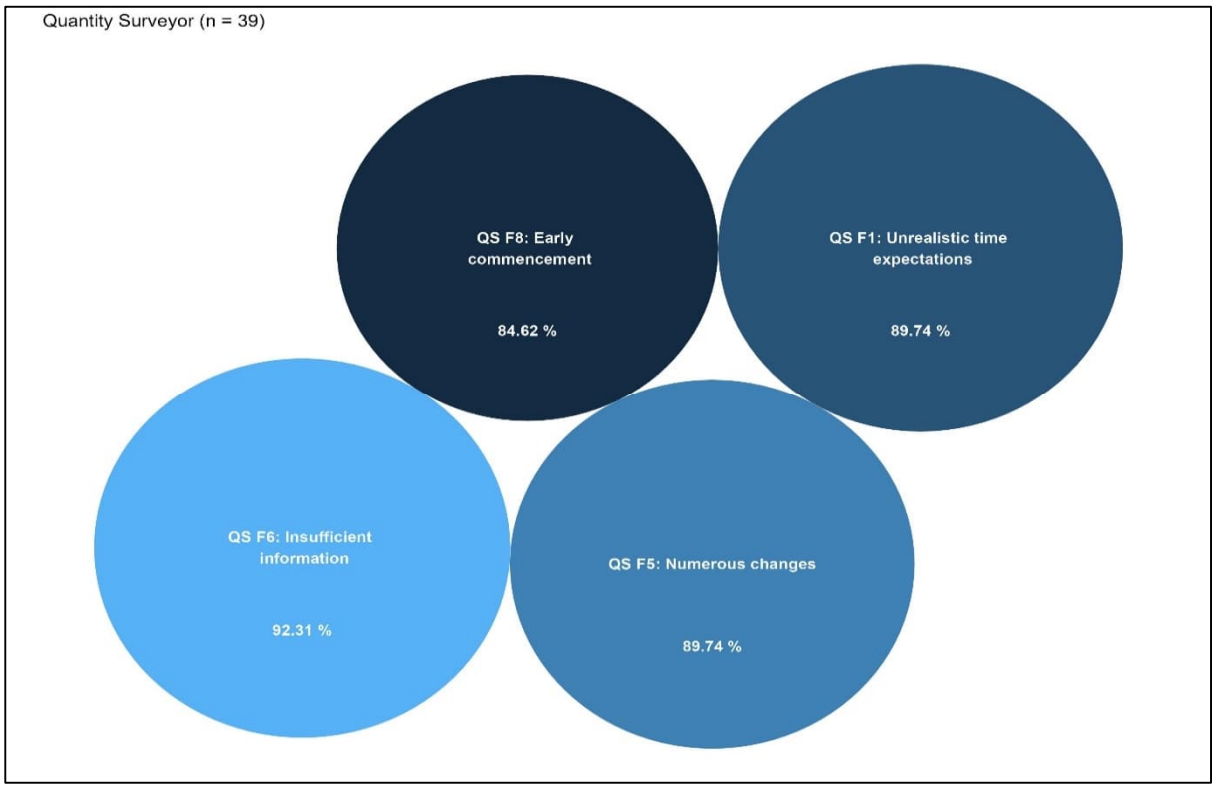


Figure 60: Client factors where "strongly agree" and "agree" was selected by 80% or more of the quantity surveyors

4.2.3.6 Cross-discipline analysis

Four client factors across disciplines had a high level of agreement, namely:

- F1: Unrealistic client expectations regarding time to produce PSOs.
- F5: Numerous changes to project requirements or scope by clients.
- F8: Client's insistence on commencing procurement and construction stages before completion or signing off on detailed designs.
- F17: Client's selection of consultants based on lowest price.

Interestingly, each discipline had the highest percentage of "strongly agree" responses for at least one of the aforementioned factors (i.e., F1: highest "strongly agree" responses among quantity surveyors, F5: highest "strongly agree" responses among architects, F8: highest "strongly agree" responses among electrical and mechanical engineers and F17: highest "strongly agree" responses among civil and mechanical engineers). F1 and F5 obtained fewer than 30% of "strongly agree" responses for electrical engineers and mechanical engineers, respectively. Table 48 provides a percentage distribution of "strongly agree" responses per discipline.

Table 48: Discipline-specific percentage of "strongly agree" responses for client factors

Factor	**Percentage of "strongly agree" responses per discipline**				
	Architect	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
F1	56.5%	56.7%	21.4%	43%	66.7%
F5	59.7%	61.9%	42.9%	29%	53.9%
F8	59.3%	54.8%	64.3%	57%	61.5%
F17	58.4%	73.48%	57.1%	57%	43.6%

Table 49 provides client factors with a level of agreement (percentage of "somewhat agree" and "strongly agree") of 80% or more of the participants (per discipline). Factor F8 was the only factor to obtain a level of agreement greater than 80% among all disciplines. Factor F5 obtained a level of agreement greater than 80% for all disciplines except electrical engineering. Architects and civil/structural engineers both had a level of agreement greater than 80% for F1 and F17. Quantity surveyors had a level of agreement greater than 80% for F1.

Table 49: Client factors with agreement of 80% or more of the participants

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F1	88.9%	90.5%	-	-	89.7%
F5	89.8%	88.7%	-	85.7%	89.7%
F8	82.9%	85.7%	92.9%	85.7%	84.6%
F17	81.8%	90.4%	-	-	-

Table 50 illustrates factors that obtained 50% or more "strongly agree" responses and a level of agreement of 80% or more of the participants (per discipline). F8 was the only factor to satisfy these criteria for all disciplines. While F1 and F5 satisfied these criteria for the architectural, civil engineering and quantity surveying disciplines.

Table 50: Client factors with 50% or more "strongly agree" responses and a level of agreement of 80% or more of the participants

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F1	✓	✓			✓
F5	✓	✓			✓
F8	✓	✓	✓	✓	✓
F17	✓	✓			

4.2.4 Section 3: Company Factors

This section provides a breakdown of the level of agreement among built environment professionals with company factors influencing the quality of PSOs.

4.2.4.1 Architects

Figure 61 provides a heatmap with company factors influencing the quality of PSOs and the distribution of agreement among architectural participants. Two factors received a "strongly agree" response by 50% or more of the participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". ARCH F28 (57.21%), ARCH F22 (50%) and ARCH F29 (49.07%) generated the three highest "strongly agree" responses while ARCH F23 (21.13%), ARCH F31 (22.07%) and ARCH F26 (28.50%) generated the three lowest "strongly agree" responses. On the other hand, ARCH F31 (8.45%), ARCH F23 (8.45%) and ARCH F24 (3.85%) generated the three

highest “strongly disagree” responses while ARCH F30 (0.47%) and ARCH F21 (0.48%) had the lowest “strongly disagree” responses.



Figure 61: Heat map showing architects' distribution of agreement with company factors

Figure 62 contains a stacked bar chart showing architects' distribution of agreement with company factors. ARCH F28 (91%), ARCH F34 (86%), ARCH F29 (84%), ARCH F21 (83%), and ARCH F25 (81%) were the top five factors with the highest level of agreement among participants. On the other hand, ARCH F31 (51%), ARCH F23 (54%) and ARCH F24 (63%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, they all contained a level of agreement that exceeded 50%. Interestingly, ARCH F31, which had the lowest level of agreement, also had the highest percentage of participants selecting “neither agree nor disagree” (27%). The factor with the highest level of agreement ARCH F28 had the lowest levels of disagreement of 2%. Furthermore, two factors with the lowest levels of agreement, ARCH F31 and ARCH F23, also had the highest levels of disagreement of 23%.

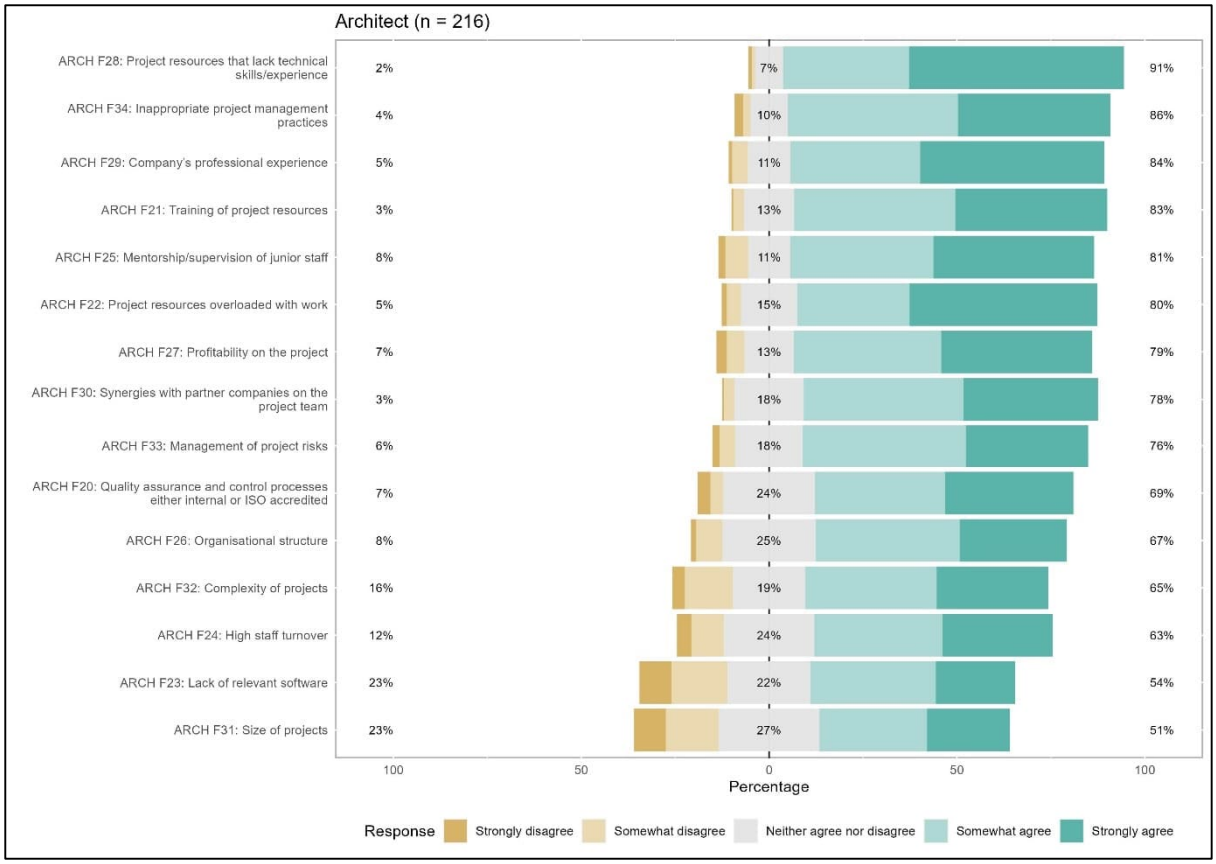


Figure 62: Bar chart showing architects' level of agreement with company factors

The figures below provide insights into company factors that were most important to architects, based on their level of agreement. Figure 63 illustrates company factors cited by architects where "strongly agree" was selected by 50% or more of the participants. From a total of 15 company factors, only ARCH F28 (57.21%) and ARCH F22 (50%) satisfied this criterion.

Figure 64 shows company factors cited by architects where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Five factors satisfied this criterion including ARCH F28 (90.7%), ARCH F34 (85.85%), ARCH F29 (83.64%), ARCH F21 (83.33%) and ARCH F25 (80.93%).

Notably, only ARCH F28 appeared in both figures, indicating that it was considered one of the most important factors by participants.

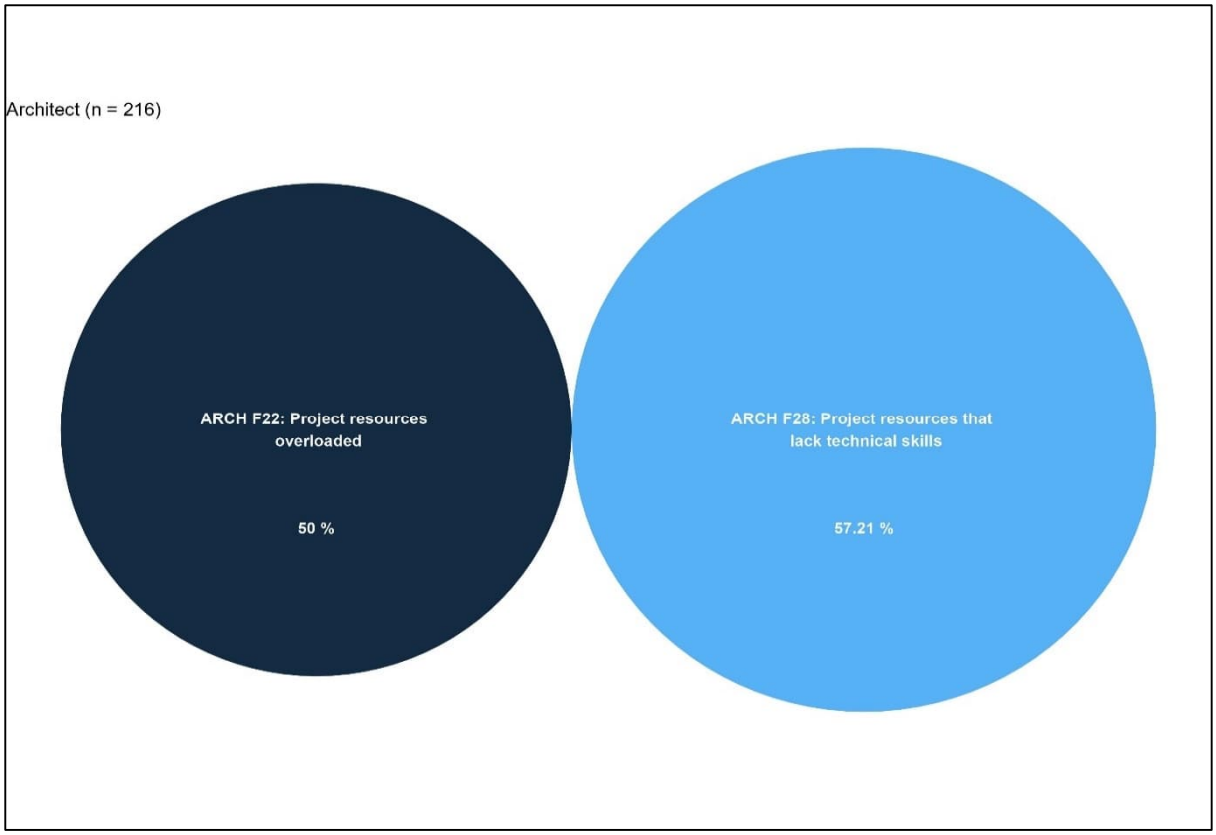


Figure 63: Company factors where "strongly agree" was selected by 50% or more of the architects

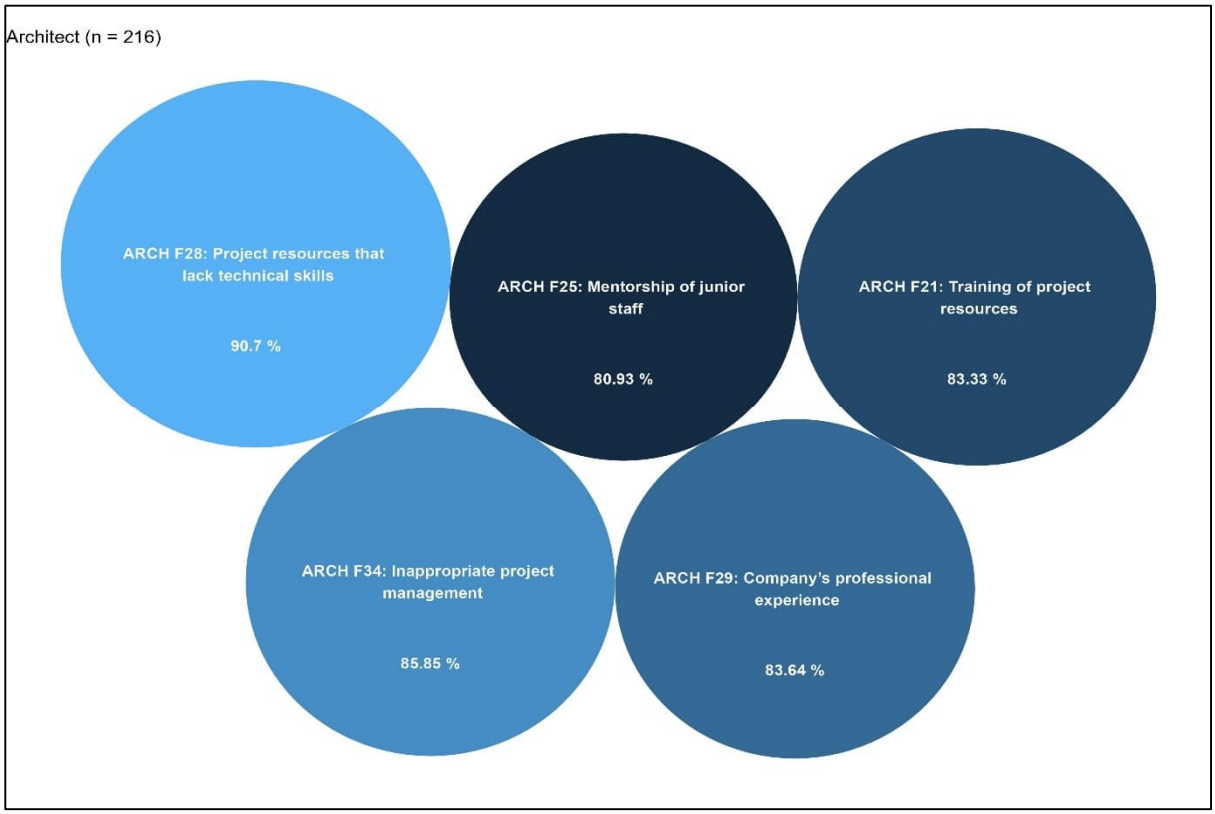


Figure 64: Company factors where "strongly agree" and "agree" was selected by 80% or more of the architects

4.2.4.2 Civil/Structural engineers

Figure 65 provides a heatmap with company factors influencing the quality of PSOs and the distribution of agreement among civil/structural engineering participants. Five factors received a "strongly agree" response by 50% or more of the participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". CSENG F28 (67.11%), CSENG F25 (52.63%) and CSENG F22 (52.17%) generated the three highest "strongly agree" responses while CSENG F31 (14.04%), CSENG F26 (14.60%) and CSENG F23 (18.34%) generated the three lowest "strongly agree" responses. On the other hand, CSENG F23 (8.73%), CSENG F31 (8.33%) and CSENG F32 (5.24%) generated the three highest "strongly disagree" responses while CSENG F21 (0%), CSENG F30 (0.87%) and CSENG F28 (0.88%) produced the lowest number of "strongly disagree" responses.

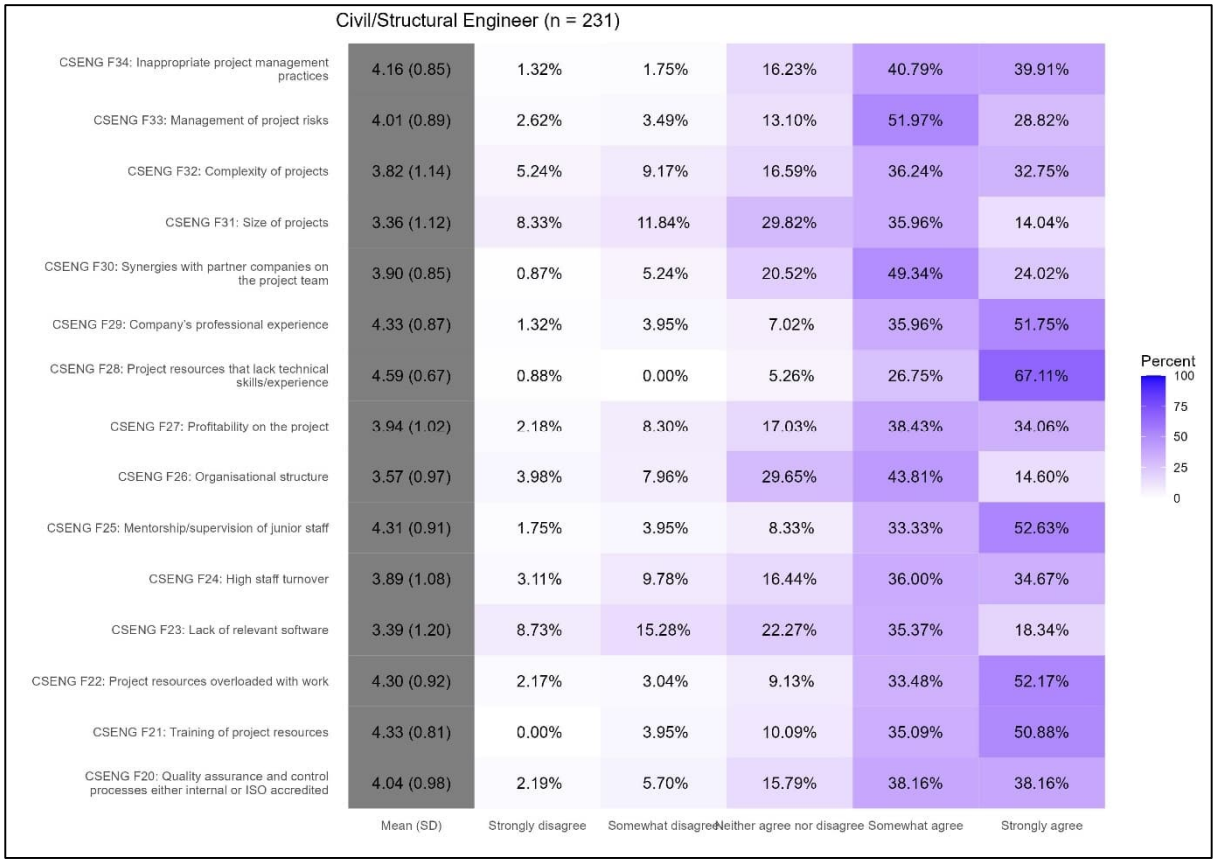


Figure 65: Heat map showing civil/structural engineers' distribution of agreement with company factors

Figure 66 contains a stacked bar chart showing civil/structural engineers' distribution of agreement with company factors. CSENG F28 (94%), CSENG F29 (88%), CSENG F25 (86%),

CSENG F21 (86%) and CSENG F22 (86%) were the top five factors with the highest level of agreement among participants. On the other hand, CSENG F31 (50%), CSENG F23 (54%) and CSENG F26 (58%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, they all contained a level of agreement that exceeded 50%. CSENG F31 (30%) and CSENG F26 (30%) had the highest percentage of participants selecting "neither agree nor disagree". The factor with the highest level of agreement (CSENG F28) had the lowest level of disagreement of 1%. Furthermore, the two factors with the lowest levels of agreement CSENG F31 and CSENG F23 also had the highest levels of disagreement of 20% and 24%, respectively.

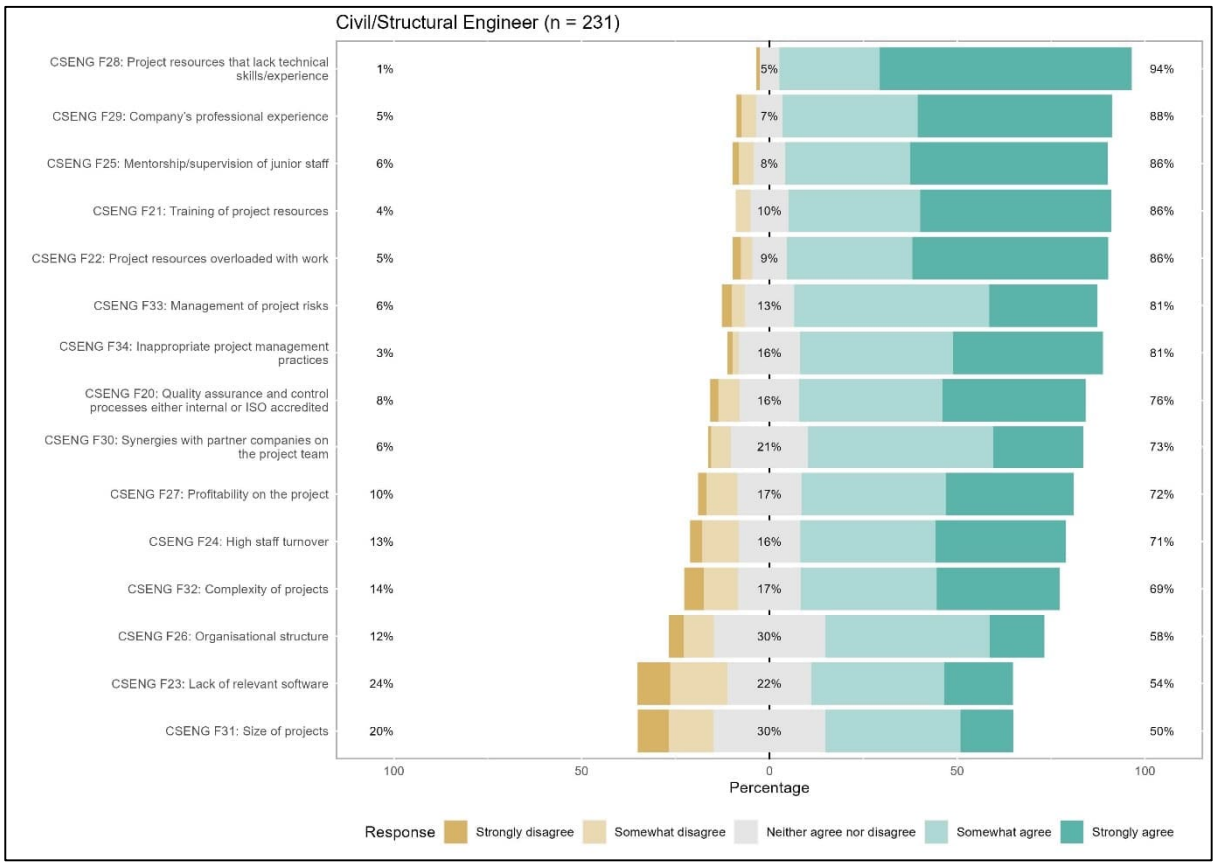


Figure 66: Bar chart showing civil/structural engineers' level of agreement with company factors

The figures below provide insights into company factors that were most important to civil/structural engineers, based on their level of agreement. Figure 67 illustrates company factors cited by civil/structural engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 15 company factors, CSENG F28 (67.11%), CSENG F25 (52.63%), CSENG F22 (52.63%), CSENG F29 (52.63%) and CSENG F21 (52.17%) satisfied this criterion.

Figure 68 shows company factors cited by civil/structural engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Seven factors satisfied this criterion including CSENG F28 (93.86%), CSENG F29 (87.72%), CSENG F25 (85.96%), CSENG F21 (85.96%), CSENG F22 (85.65%), CSENG F33 (80.79%) and CSENG F34 (80.7%).

Notably, CSENG F28, CSENG F25, CSENG F22, CSENG F29 and CSENG F21 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

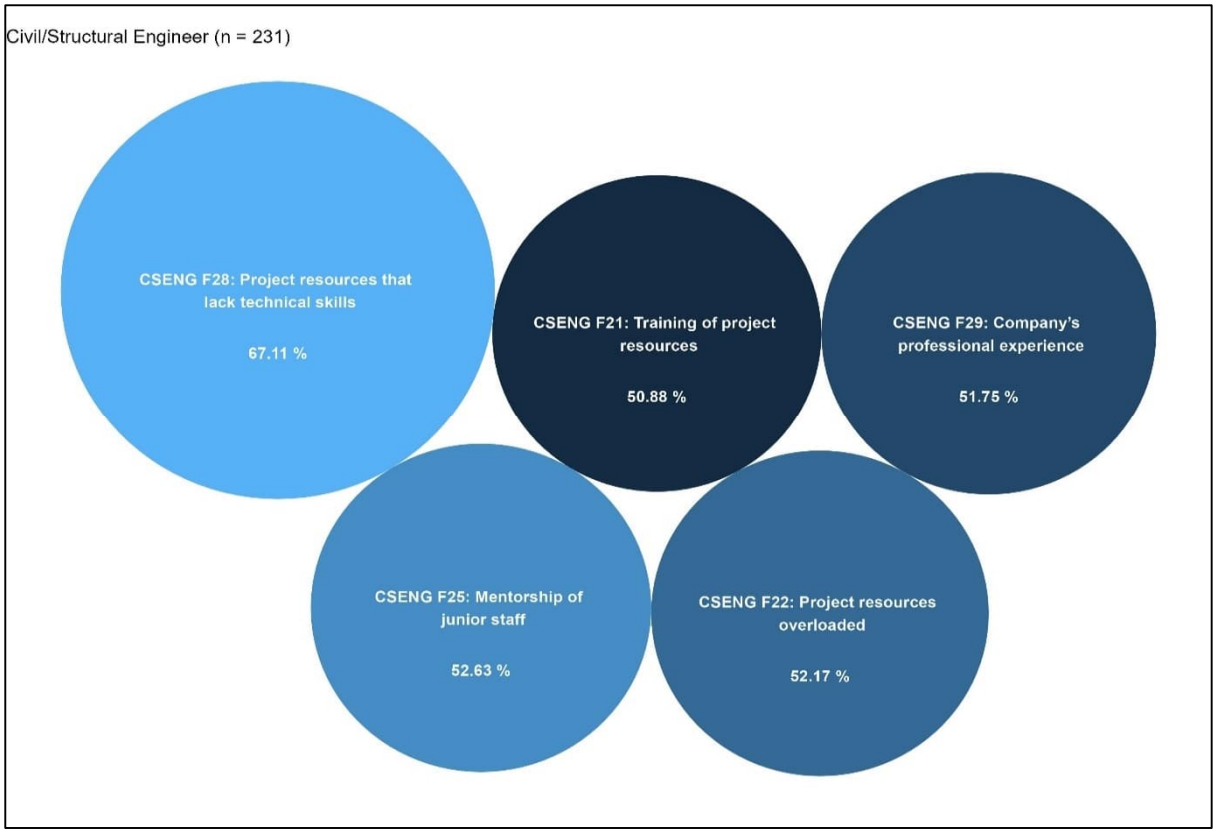


Figure 67: Company factors where "strongly agree" was selected by 50% or more of the civil/structural engineers

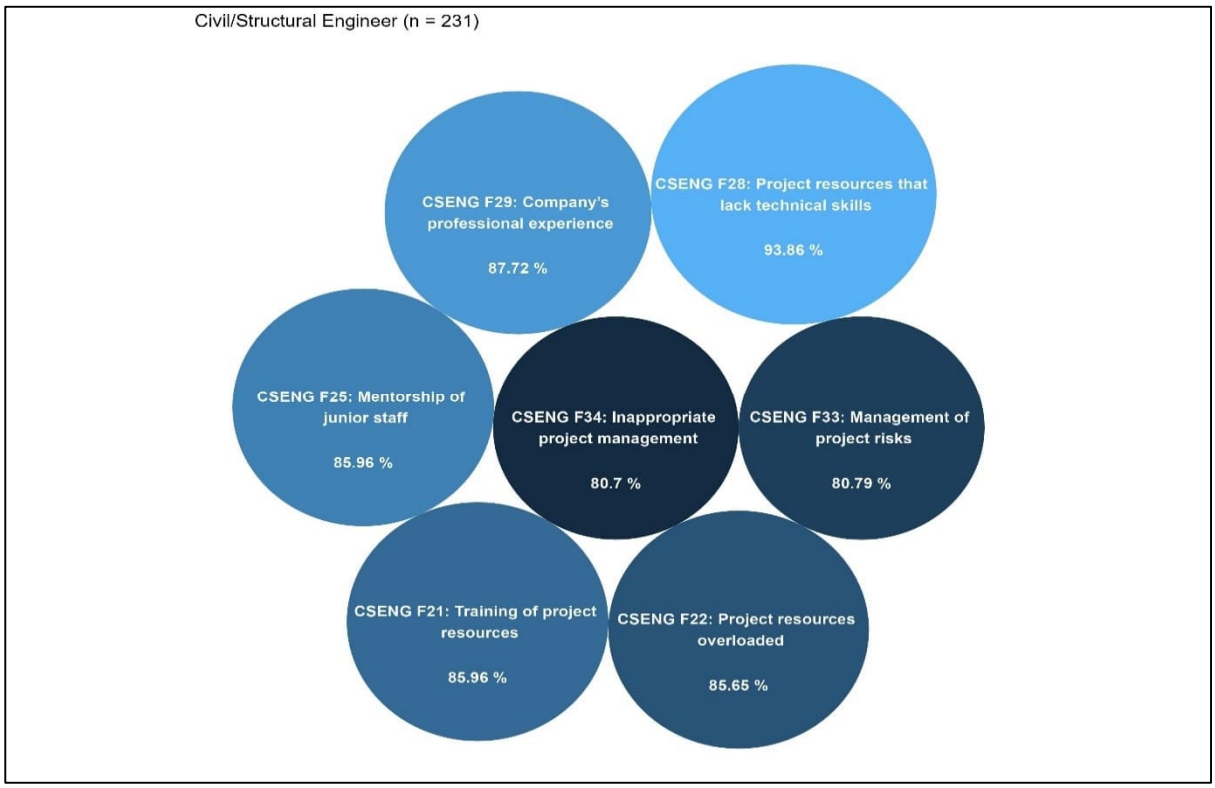


Figure 68: Company factors where "strongly agree" and "agree" was selected by 80% or more of the civil engineers

4.2.4.3 Electrical engineers

Figure 69 provides a heatmap with company factors influencing the quality of PSOs and the distribution of agreement among electrical engineering participants. Two factors received a "strongly agree" response by 50% or more of the participants. On the other hand, participants only selected "strongly disagree" for three factors, EENG F34 (7.1%), EENG F31 (7.1%) and EENG F23 (7.1%). From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". EENG F28 (57.1%), EENG F29 (50%) and EENG F22 (42.9%) generated the three highest "strongly agree" responses while EENG F26 (7.1%), EENG F33 (14.3%), EENG F31 (14.3%), EENG F23 (14.3%) and EENG F20 (14.3%) generated the lowest "strongly agree" responses.

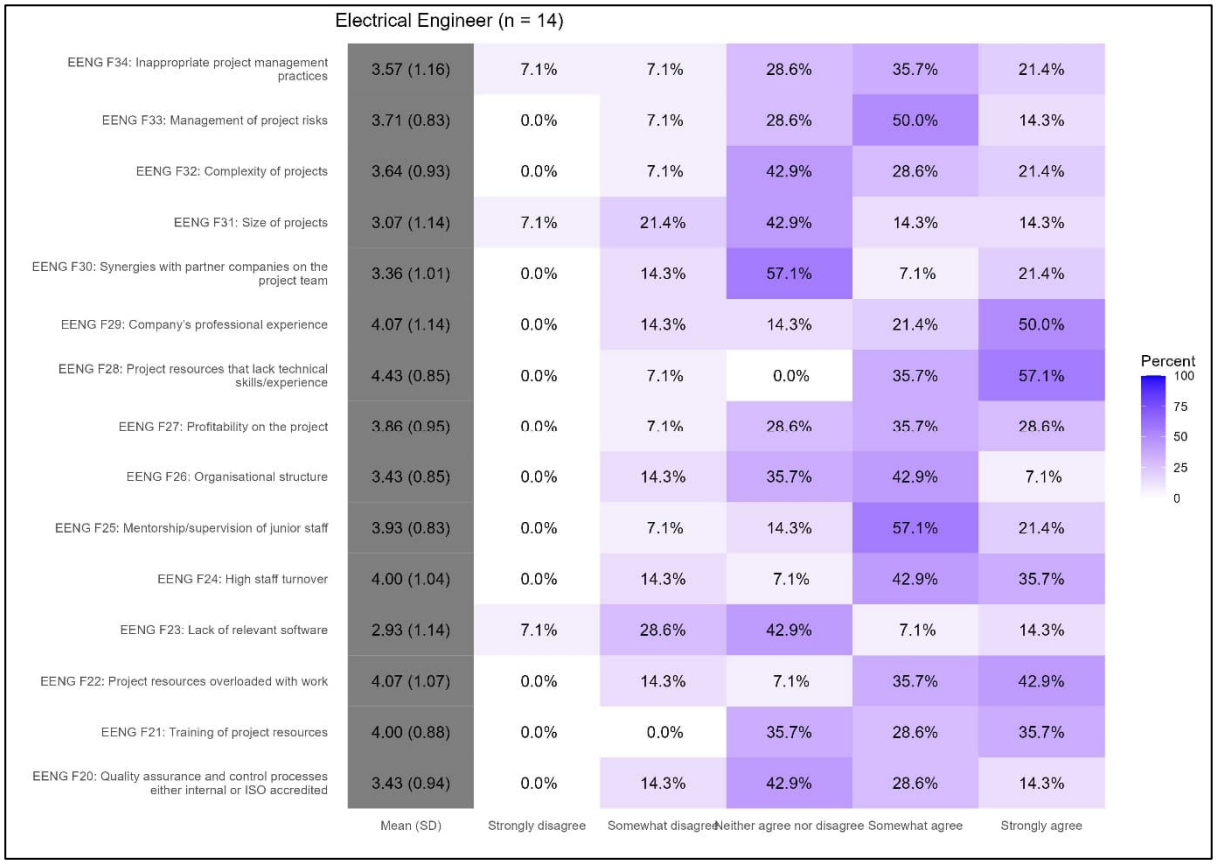


Figure 69: Heat map showing electrical engineers' distribution of agreement with company factors

Figure 70 contains a stacked bar chart showing electrical engineers' distribution of agreement with company factors. EENG F28 (93%), EENG F25 (79%), EENG F24 (79%) and EENG F22 (79%) were the top factors with the highest level of agreement among participants. On the other hand, EENG F23 (21%), EENG F30 (29%), EENG F31 (29%) and EENG F20 (43%) contained the lowest level of agreement. The aforementioned factors all contained levels of agreement under 50%. EENG F30 (57%) had the highest percentage of participants selecting "neither

agree nor disagree". Interestingly, EENG F21 had the lowest level of disagreement (0%) but did not contain the highest level of agreement. EENG F23 had the lowest level of agreement and the highest level of disagreement at 36%.

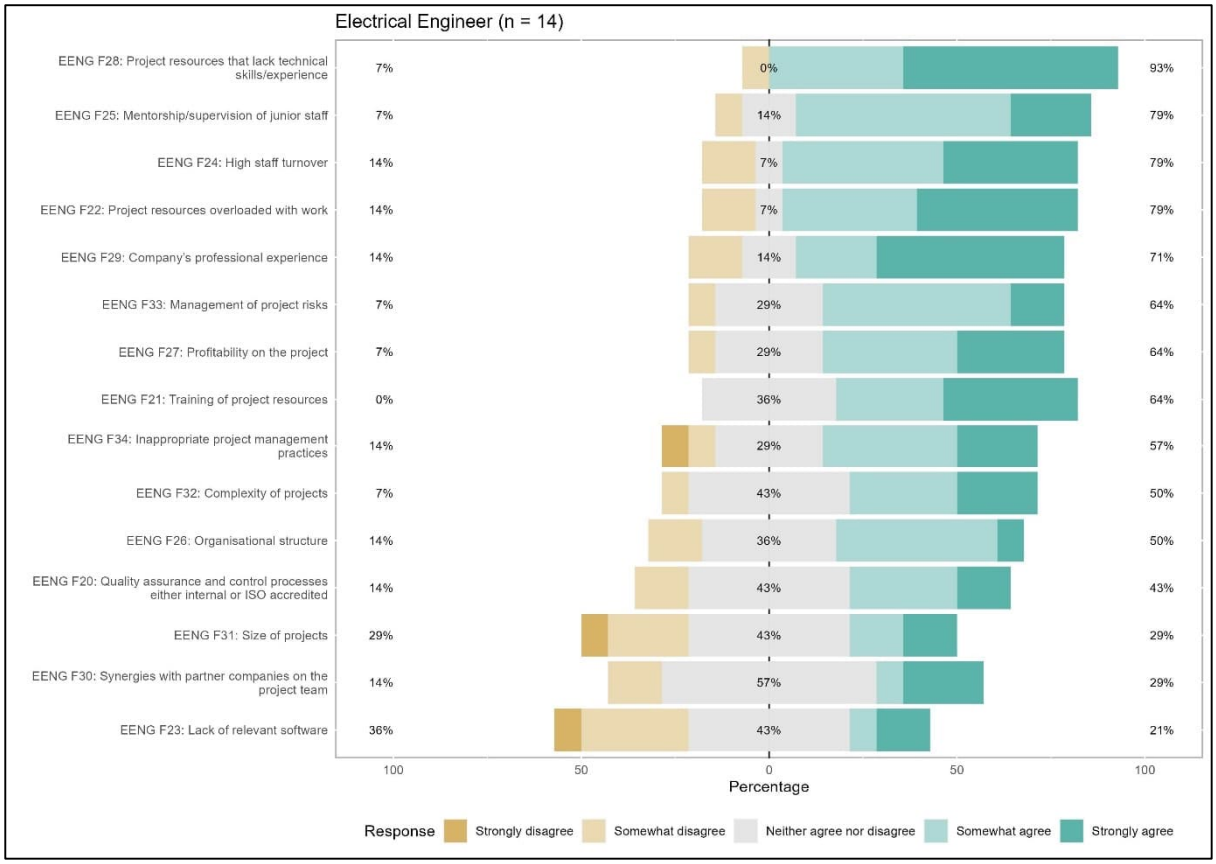


Figure 70: Bar chart showing electrical engineers' level of agreement with company factors

The figures below provide insights into company factors that were most important to electrical engineers, based on their level of agreement. Figure 71 illustrates company factors cited by electrical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 15 company factors, only EENG F28 (57.14%) and EENG F29 (50%) satisfied this criterion.

Figure 72 shows company factors cited by electrical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Only one factor satisfied this criterion, namely, EENG F28 (92.86).

Notably, only EENG F28 appeared in both figures, indicating it was considered one of the most important factors by participants.

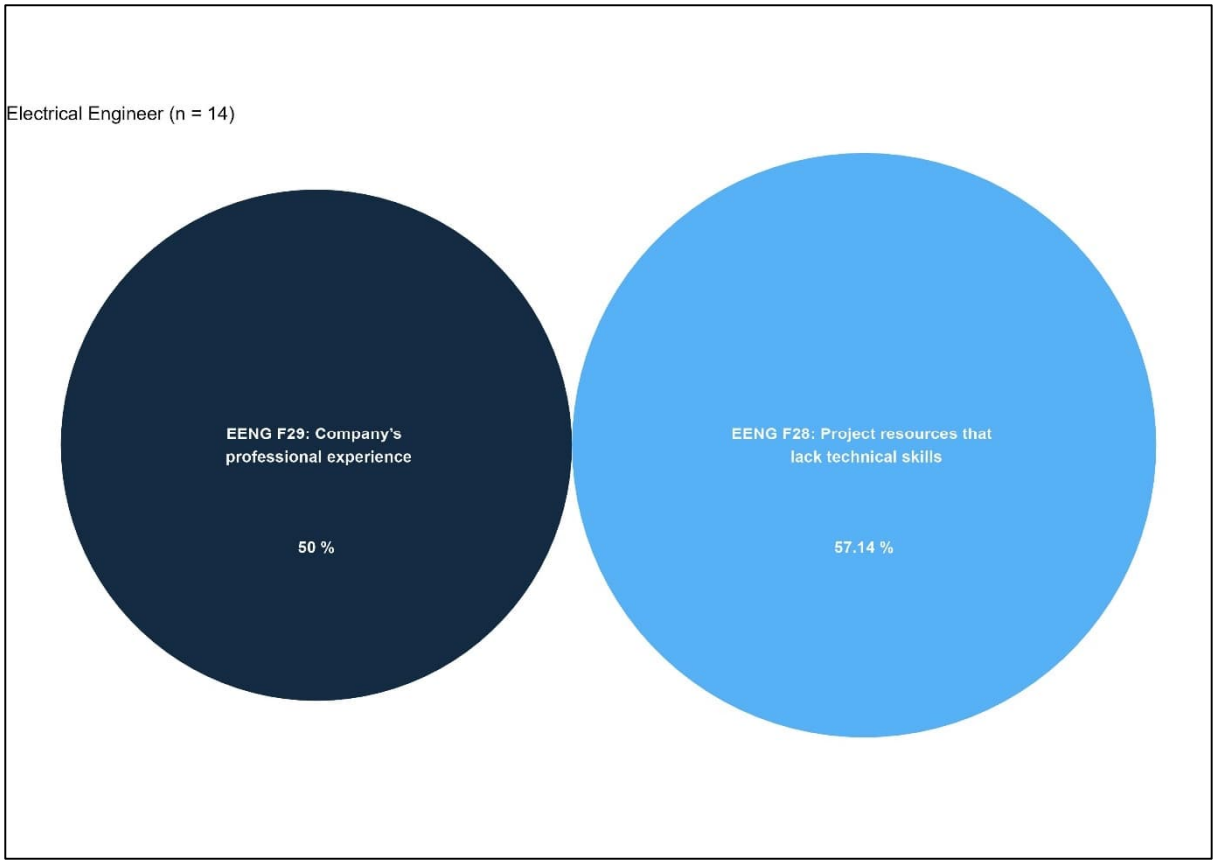


Figure 71: Company factors where "strongly agree" was selected by 50% or more of the electrical engineers

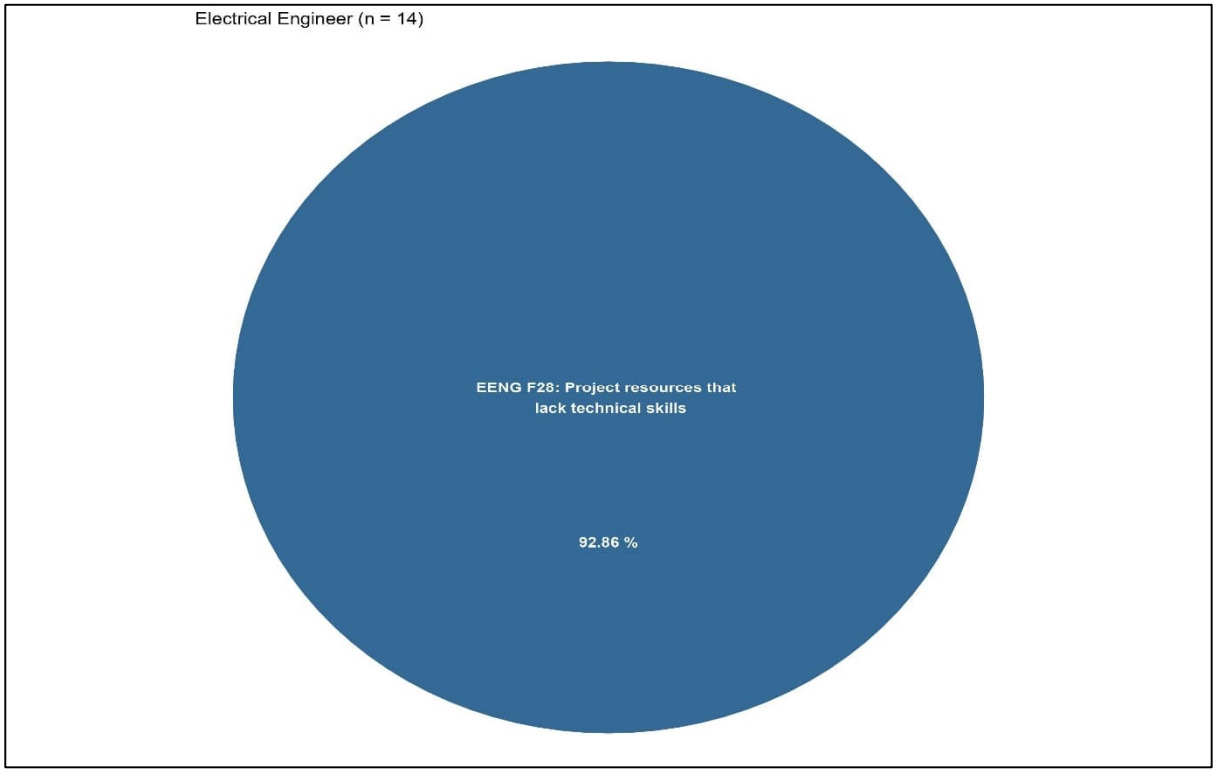


Figure 72: Company factors where "strongly agree" and "agree" was selected by 80% or more of the electrical engineers

4.2.4.4 Mechanical engineers

Figure 73 provides a heatmap with company factors influencing the quality of PSOs and the distribution of agreement among mechanical engineering participants. Four factors received a “strongly agree” response by 50% or more of the participants. The highest "strongly agree" response was for MEENG F29, which was selected by 86% of participants. This was significantly higher than the other three factors with the second-highest "strongly agree" responses, namely, MEENG F28 (57%), MEENG F32 (57%) and MEENG F33 (57%). On the other hand, none of the factors generated any “strongly disagree” responses. From the heatmap, it is evident that responses were mainly spread among “somewhat agree” and “strongly agree”. This suggests there is a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing on the importance of these factors. MEENG F26 (14%), MEENG F27 (14%) and MEENG F30 (14%) generated the three smallest numbers of “strongly agree” responses.

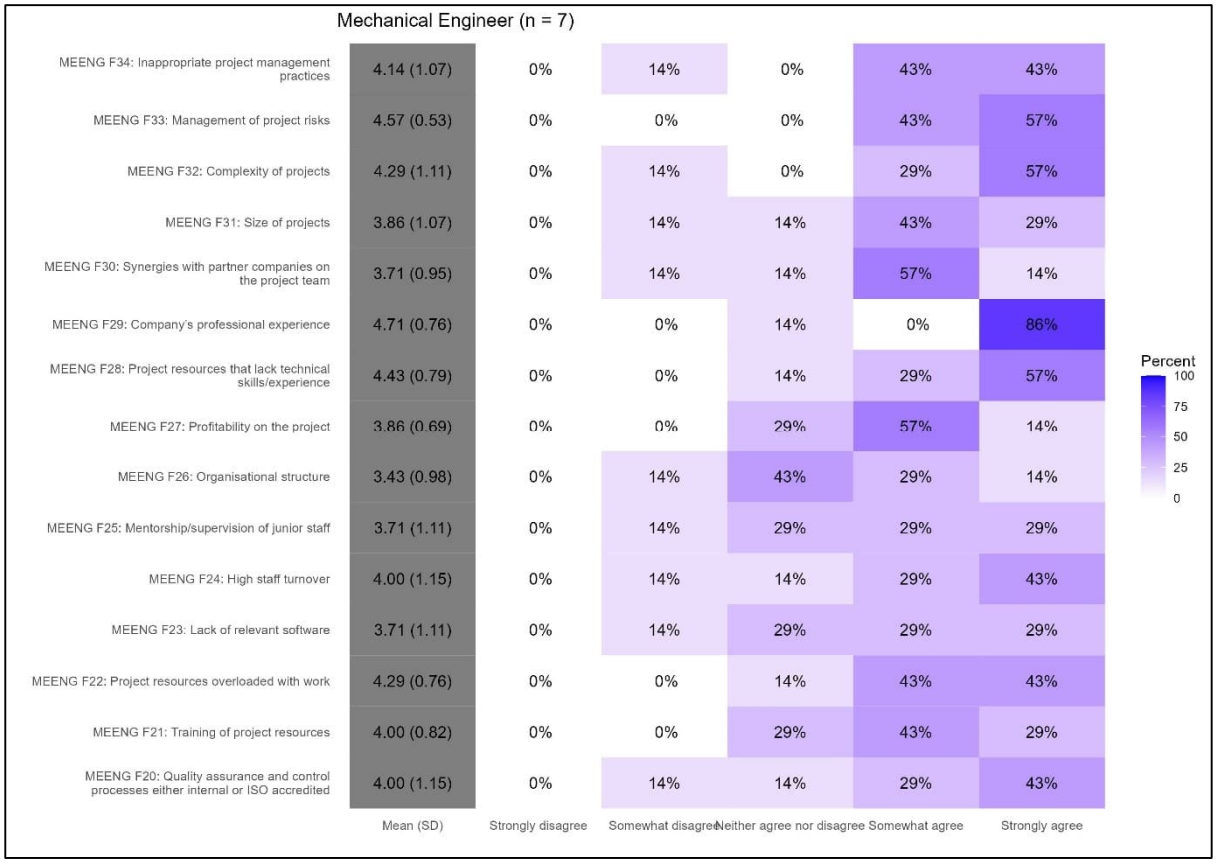


Figure 73: Heat map showing mechanical engineers’ distribution of agreement with company factors

Figure 74 contains a stacked bar chart showing mechanical engineers’ distribution of agreement with company factors. MEENG F33 (100%), MEENG F34 (86%), MEENG F32 (86%), MEENG F29 (86%), MEENG F28 (86%) and MEENG F22 (86%) were the top five

factors with the highest level of agreement among participants. On the other hand, MEENG F26 (43%), MEENG F23 (57%) and MEENG F25 (57%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, only MEENG F26 contained a level of agreement of under 50%. MEENG F26 (27%) had the highest percentage of participants selecting "neither agree nor disagree". The factor with the highest level of agreement (MEENG F33) jointly had the lowest levels of disagreement of 0% with MEENG F29, MEENG F28, MEENG F22, MEENG F27, and MEENG F21. Nine factors jointly had the highest levels of disagreement, namely, MEENG F34 (14%), MEENG F32 (14%), MEENG F31 (14%), MEENG F30 (14%), MEENG F24 (14%), MEENG F20 (14%), MEENG F25 (14%), MEENG F23 (14%) and MEENG F26 (14%).

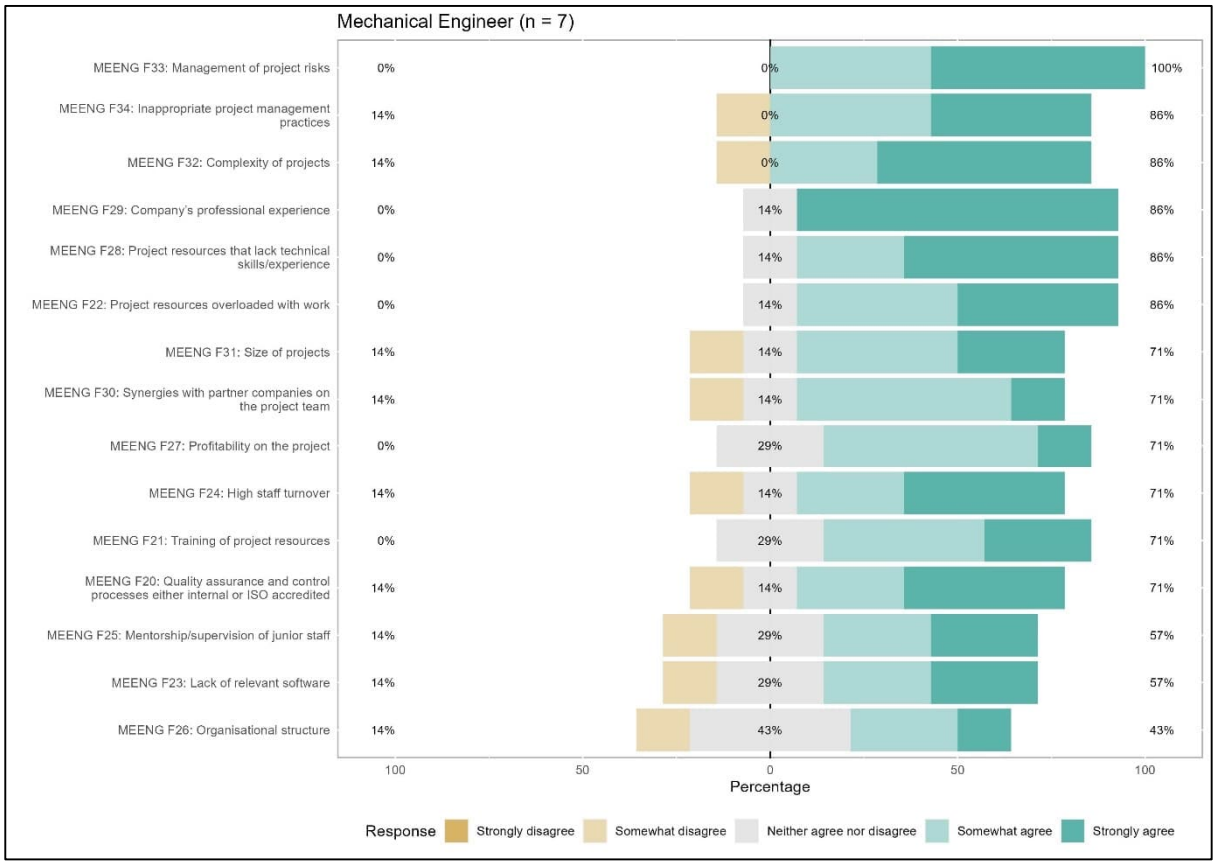


Figure 74: Bar chart showing mechanical engineers' level of agreement with company factors

The figures below provide insights into company factors that were most important to mechanical engineers, based on their level of agreement. Figure 75 illustrates company factors cited by mechanical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 15 company factors, MEENG F29 (85.71%), MEENG F28 (57.14%), MEENG F32 (57.14%) and MEENG F33 (57.14%) satisfied this criterion.

Figure 76 shows company factors cited by mechanical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Six factors satisfied this criterion including MEENG F33 (100%), MEENG F34 (85.71%), MEENG F32 (85.71%), MEENG F29 (85.71%), MEENG F28 (85.71%) and MEENG F22 (85.71%).

Notably, MEENG F29, MEENG F28, MEENG F32 and MEENG F33 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

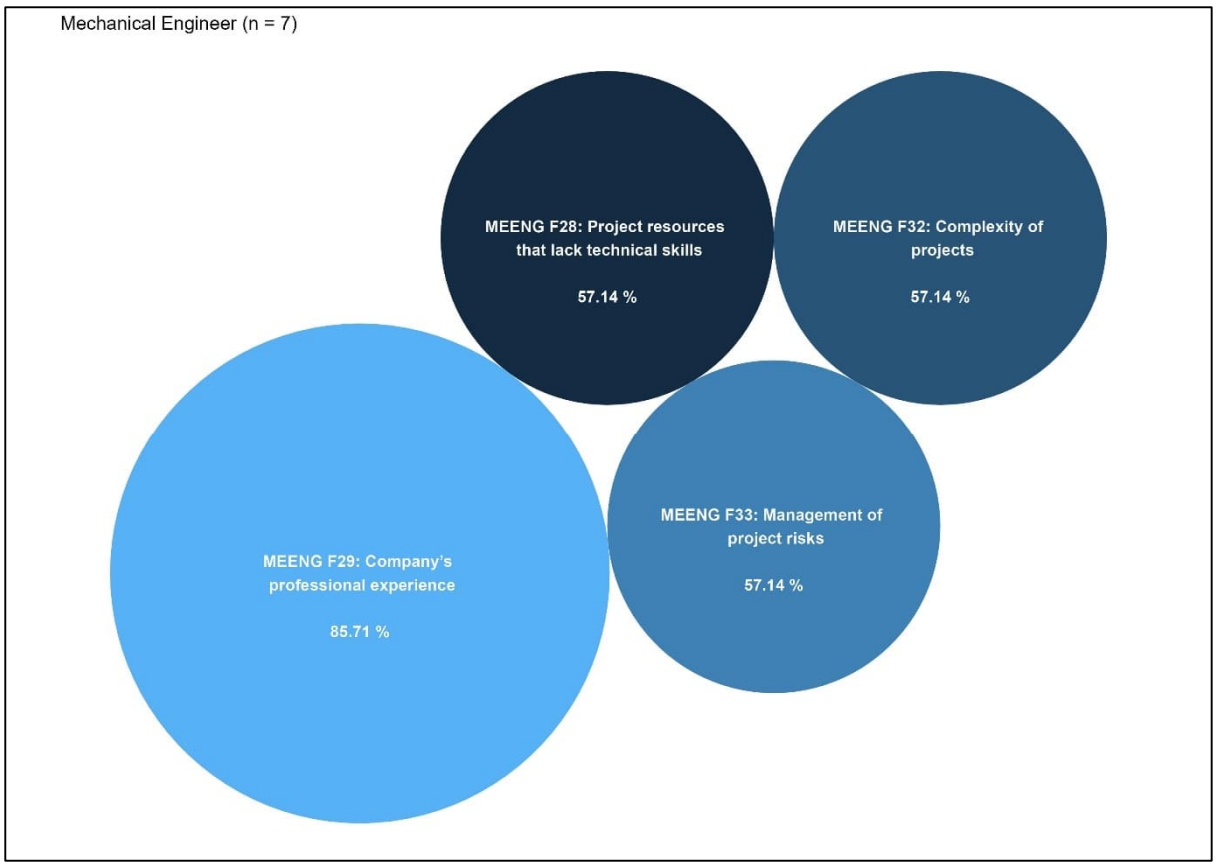


Figure 75: Company factors where "strongly agree" was selected by 50% or more of the mechanical engineers

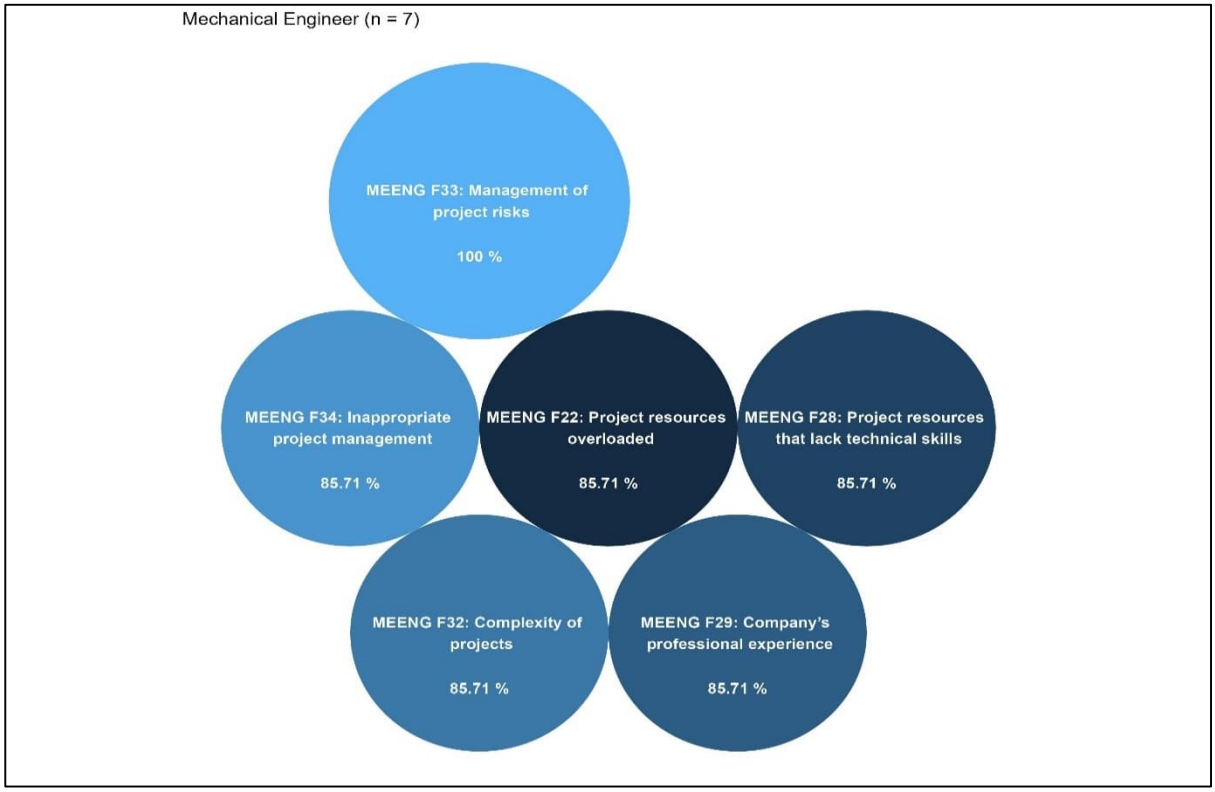


Figure 76: Company factors where "strongly agree" and "agree" was selected by 80% or more of the mechanical engineers

4.2.4.5 Quantity surveyors

Figure 77 provides a heatmap with company factors influencing the quality of PSOs and the distribution of agreement among quantity surveying participants. Two factors received a "strongly agree" response by 50% or more of the participants. On the other hand, only QS F31 (10.3%) generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". QS F28 (64.1%) and QS F22 (53.8%) generated the highest "strongly agree" responses while QS F31 (7.7%), QS F27 (13.2%) and QS 33 (15.8%) generated the three lowest "strongly agree" responses. On the other hand, QS F31 (10.3%), QS F23 (7.7%) and QS F27 (5.3%) generated the three most "strongly disagree" responses while QS F33 (0%), QS F29 (0%), QS F28 (0%) and QS F25 (0%) produced the lowest number of "strongly disagree" responses.



Figure 77: Heat map showing quantity surveyors' distribution of agreement with company factors

Figure 78 contains a stacked bar chart showing quantity surveyors' distribution of agreement with company factors. QS F28 (92%), QS F22 (90%), QS F21 (90%) and QS F34 (90%) were the top factors with the highest level of agreement among participants. On the other hand, QS F31 (46%) and QS F23 (64%) contained the lowest level of agreement. Despite the

aforementioned factors having the lowest level of agreement, only QS F31 contained a level of agreement below 50%. The factor with the lowest level of agreement (QS F31) had the highest percentage of participants selecting “neither agree nor disagree” (33%). The factor with the highest level of agreement (QS F28) had the lowest level of disagreement at 0%. Furthermore, two factors with the lowest levels of agreement (QS F31 and QS F23) also had the highest levels of disagreement of 21%.

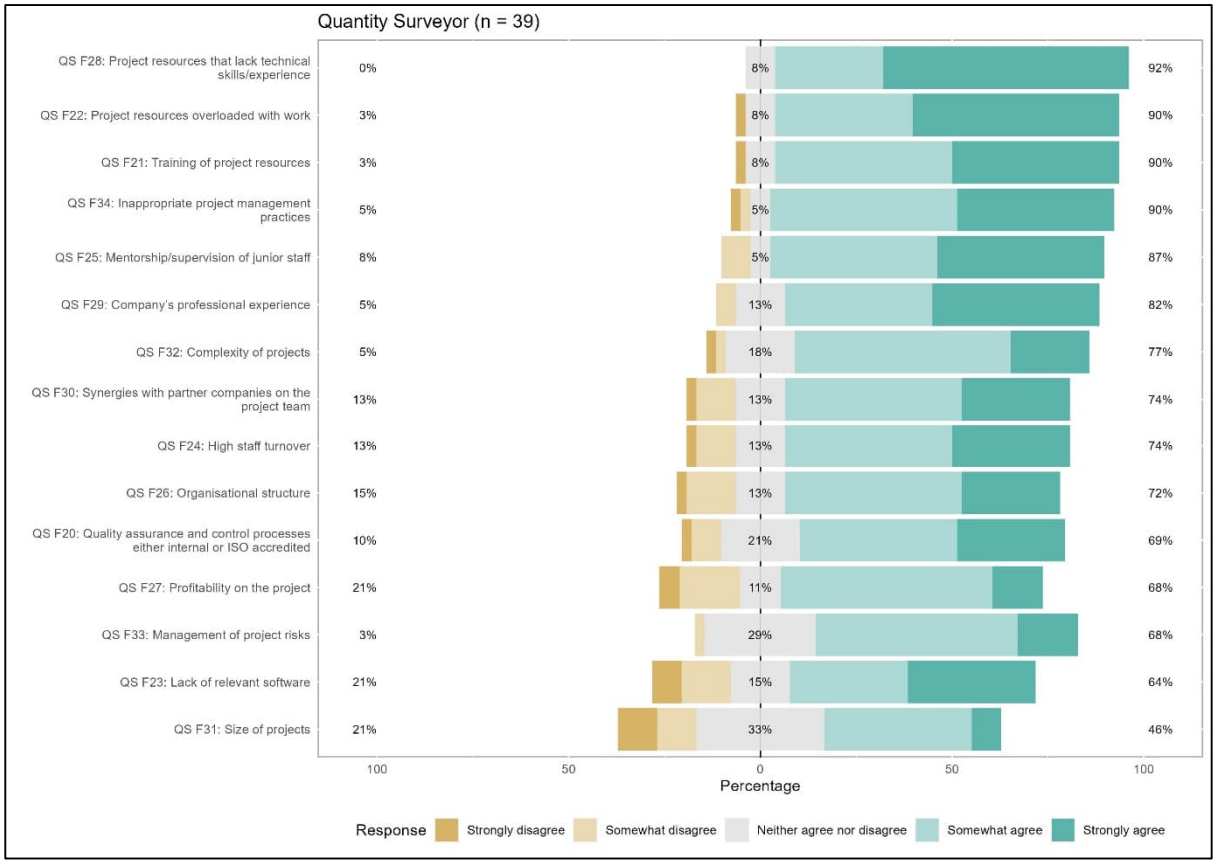


Figure 78: Bar chart showing quantity surveyors’ level of agreement with company factors

The figures below provide insights into company factors that were most important to quantity surveyors, based on their level of agreement. Figure 79 illustrates company factors cited by quantity surveyors where “strongly agree” was selected by 50% or more of the participants. From a total of 15 company factors, only QS F28 (64.1%) and QS F22 (53.85%) satisfied this criterion.

Figure 80 shows company factors cited by quantity surveyors where a combination of “strongly agree” and “agree” was selected by 80% or more of the participants. Six factors satisfied this criterion including QS F28 (92.31%), QS F22 (89.74%), QS F21 (89.74%), QS F34 (89.74%), QS F25 (87.18%) and QS F29 (82.05%).

Notably, only QS F28 and QS F22 appeared in both figures, indicating they were considered the most important factors by participants.

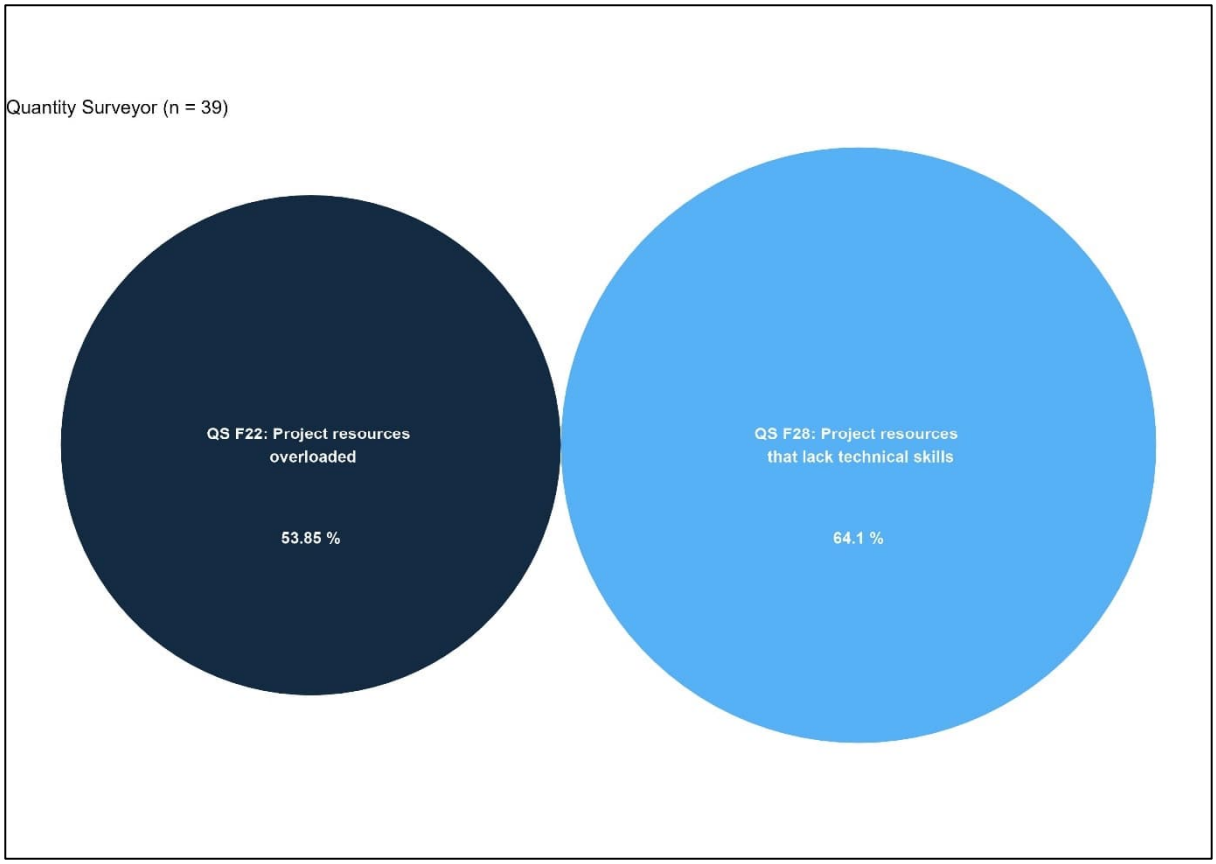


Figure 79: Company factors where "strongly agree" was selected by 50% or more of the quantity surveyors

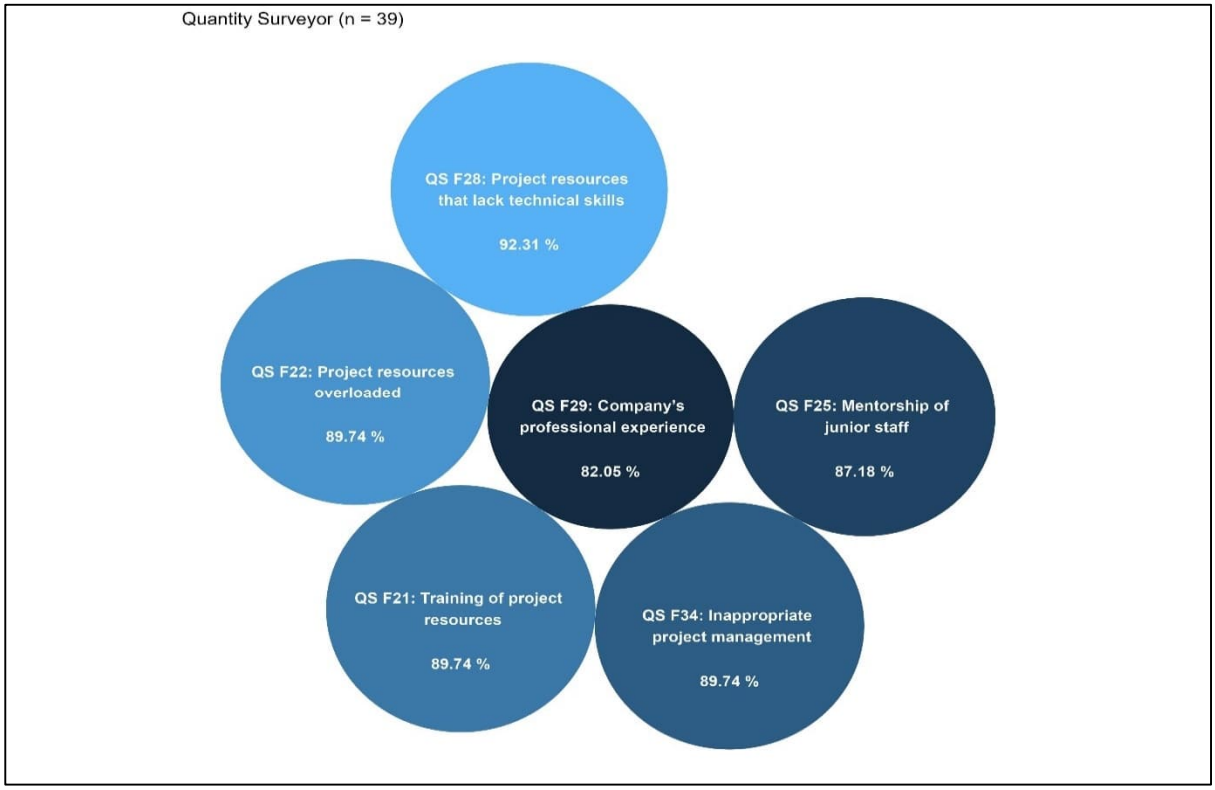


Figure 80: Company factors where "strongly agree" and "agree" was selected by 80% or more of the quantity surveyors

4.2.4.6 Cross-discipline analysis

Four company factors across disciplines had a high level of agreement, namely:

- F22: Project resources overloaded with work.
- F25: Mentorship and supervision of junior staff.
- F28: Project resources that lack technical skills or experience.
- F29: Company's professional experience.

Factor F28 had the highest percentage of "strongly agree" responses for all disciplines except mechanical engineering where it had the second-highest percentage of "strongly agree" responses. Factor F29 contained the highest percentage of "strongly agree" responses for mechanical engineers. Factor F22 had the second-highest "strongly agree" responses for architects and quantity surveyors and the third-highest "strongly agree" responses for civil and electrical engineers. Lastly, factor F25 had the second- and third-highest "strongly agree" responses for civil engineers and quantity surveyors, respectively. Table 51 provides a percentage distribution of "strongly agree" responses per discipline.

Table 51: Discipline-specific percentage of "strongly agree" responses for company factors

Factor	**Percentage of "strongly agree" responses per discipline**				
	Architect	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
F22	50%	52.2%	42.9%	43%	53.8%
F25	42.8%	52.7%	21.4%	29%	43.6%
F28	57.2%	67.1%	57.1%	57%	64.1%
F29	49.1%	51.8%	50%	86%	43.6%

Table 52 provides company factors with a level of agreement (percentage of "somewhat agree" and "strongly agree") of 80% or more of the participants (per discipline). Factor F28 was the only factor to obtain a level of agreement greater than 80% by all disciplines. Factor F29 obtained a level of agreement greater than 80% for all disciplines except electrical engineering. The level of agreement for factors F22 and F25 was greater than 80% for both civil/structural engineers and quantity surveyors. The level of agreement for factors F22 and F25 was greater than 80% for mechanical engineers and architects, respectively.

Table 52: Company factors with agreement of 80% or more of the participants

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F22	-	85.7%	-	85.7%	89.7%
F25	80.9%	86%	-	-	87%
F28	90.7%	93.9%	92.9%	85.7%	92.3%
F29	83.6%	87.7%	-	85.7%	82.1%

Table 53 illustrates factors that obtained 50% or more "strongly agree" responses and a level of agreement of 80% or more of the participants (per discipline). F28 was the only factor to satisfy these criteria for all disciplines. The civil engineering discipline obtained more than 50% of "strongly agree" responses and a level of agreement greater than 80% for factors F22, F25, F28 and F29. Similarly, quantity surveyors and mechanical engineers achieved the same criteria for factors F22 and F29, respectively.

Table 53: Company factors with 50% or more "strongly agree" and a level of agreement of 80% or more of the participants

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F22		✓			✓
F25		✓			
F28	✓	✓	✓	✓	✓
F29		✓		✓	

4.2.5 Section 4: Professional Factors

This section provides a breakdown of the level of agreement among built environment professionals with professional factors influencing the quality of PSOs.

4.2.5.1 Architects

Figure 81 provides a heatmap with professional factors influencing the quality of PSOs and the distribution of agreement among architectural participants. Four factors received a "strongly agree" response by 50% or more of the participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. ARCH

F39 (61.72%), ARCH F43 (58.37%) and ARCH F42 (52.88%) generated the three highest "strongly agree" responses while ARCH F44 (22.44%), ARCH F54 (23.56%) and ARCH F36 (29.95%) generated the three lowest "strongly agree" responses. On the other hand, ARCH F44 (5.85%), ARCH F49 (5.29%) and ARCH F54 (4.33%) generated the three highest "strongly disagree" responses while ARCH F39 (0.48%), ARCH F41 (0.48%) and ARCH F42 (0.48%) contained the lowest "strongly disagree" responses.

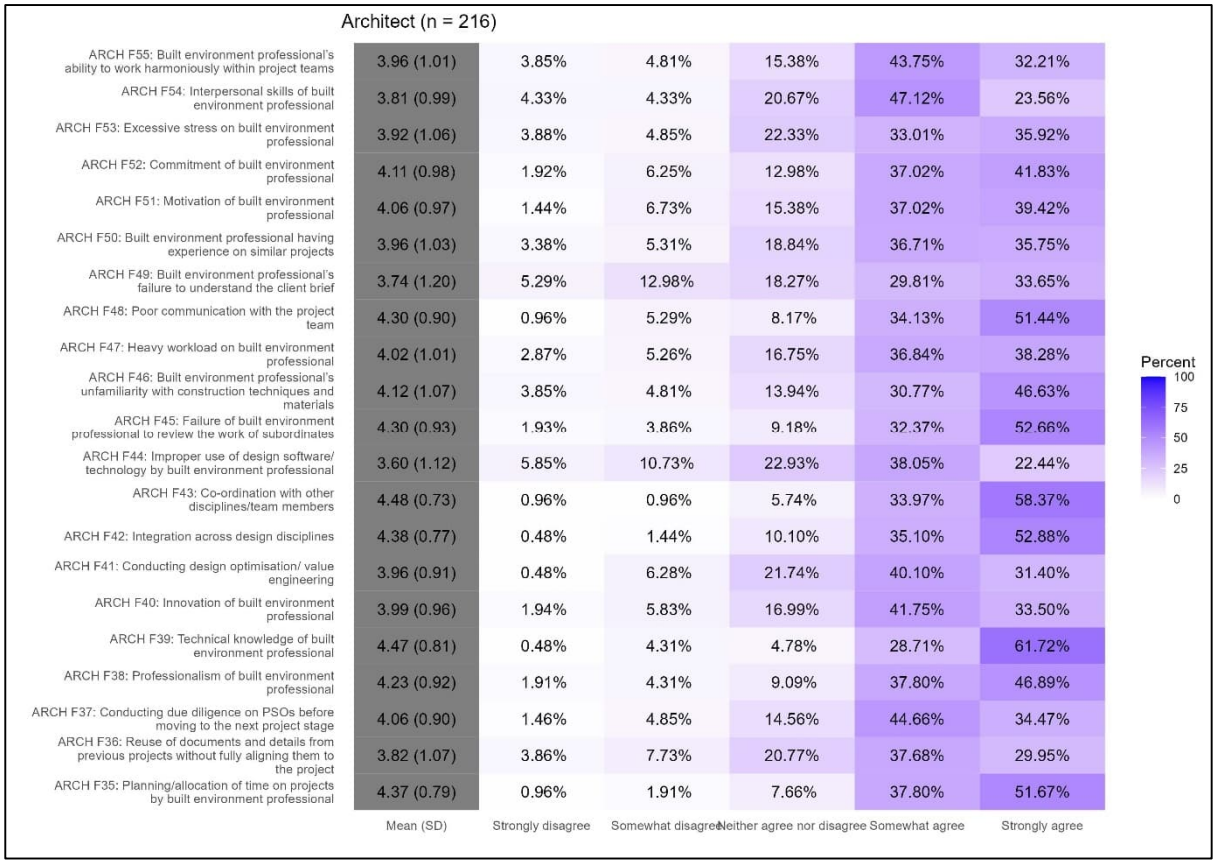


Figure 81: Heat map showing architects' distribution of agreement with professional factors

Figure 62 contains a stacked bar chart showing architects' distribution of agreement with professional factors. ARCH F43 (92%), ARCH F39 (90%), ARCH F35 (89%), ARCH F42 (88%) and ARCH F48 (86%) were the top five factors with the highest level of agreement among participants. On the other hand, ARCH F44 (60%), ARCH F49 (63%) and ARCH F36 (68%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, they all contained a level of agreement that exceeded 50%. ARCH F44 (23%) had the highest percentage of participants selecting "neither agree nor disagree". Interestingly, the factor with the second-highest level of agreement (ARCH F39) had the lowest level of disagreement at 5%. Furthermore, the two factors with the lowest levels of agreement,

ARCH F44 and ARCH F49, also had the highest levels of disagreement at 17% and 18%, respectively.

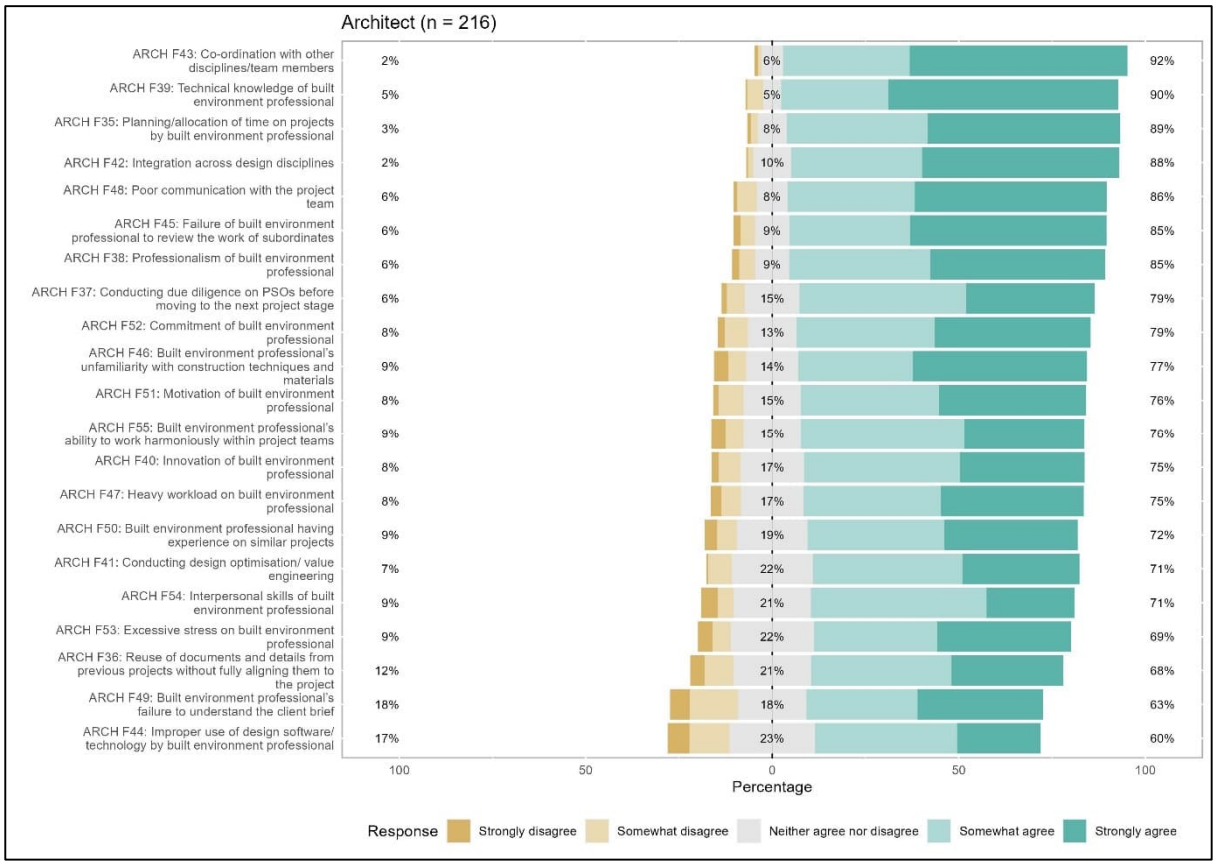


Figure 82: Bar chart showing architects' level of agreement with professional factors

The figures below provide insights into professional factors that were most important to architects, based on their level of agreement. Figure 83 illustrates professional factors cited by architects where "strongly agree" was selected by 50% or more of the participants. From a total of 21 professional factors, only ARCH F39 (61.72%), ARCH F43 (58.37%), ARCH F42 (52.88%), ARCH F45 (52.66%), ARCH F35 (51.67%) and ARCH F48 (51.44%) satisfied this criterion.

Figure 84 shows professional factors cited by architects where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Seven factors satisfied this criterion including ARCH F43 (92.34%), ARCH F39 (90.43%), ARCH F35 (89.47%), ARCH F42 (87.98%), ARCH F48 (85.58%), ARCH F45 (85.02%) and ARCH F38 (84.69%).

Notably, ARCH F39, ARCH F43, ARCH F42, ARCH F45, ARCH F35 and ARCH F48 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

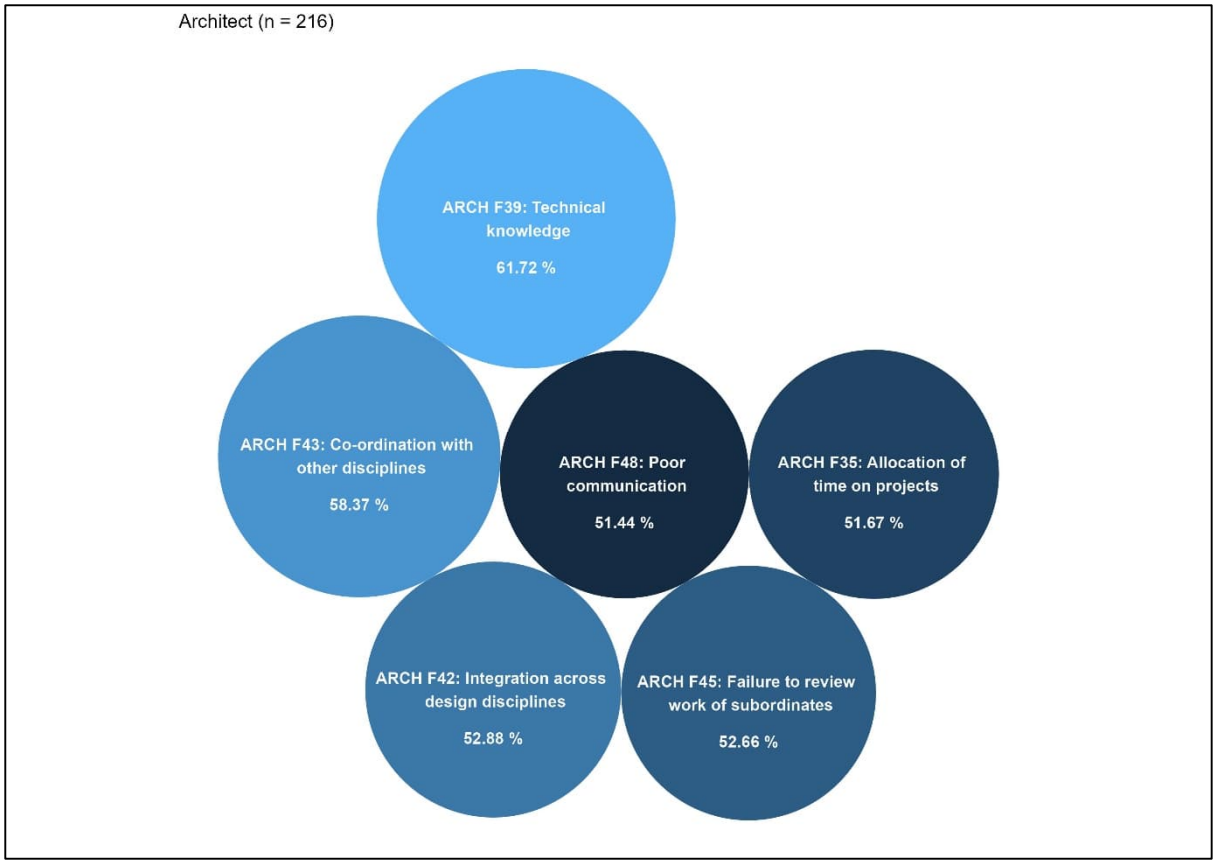


Figure 83: Professional factors where "strongly agree" was selected by 50% or more of the architects

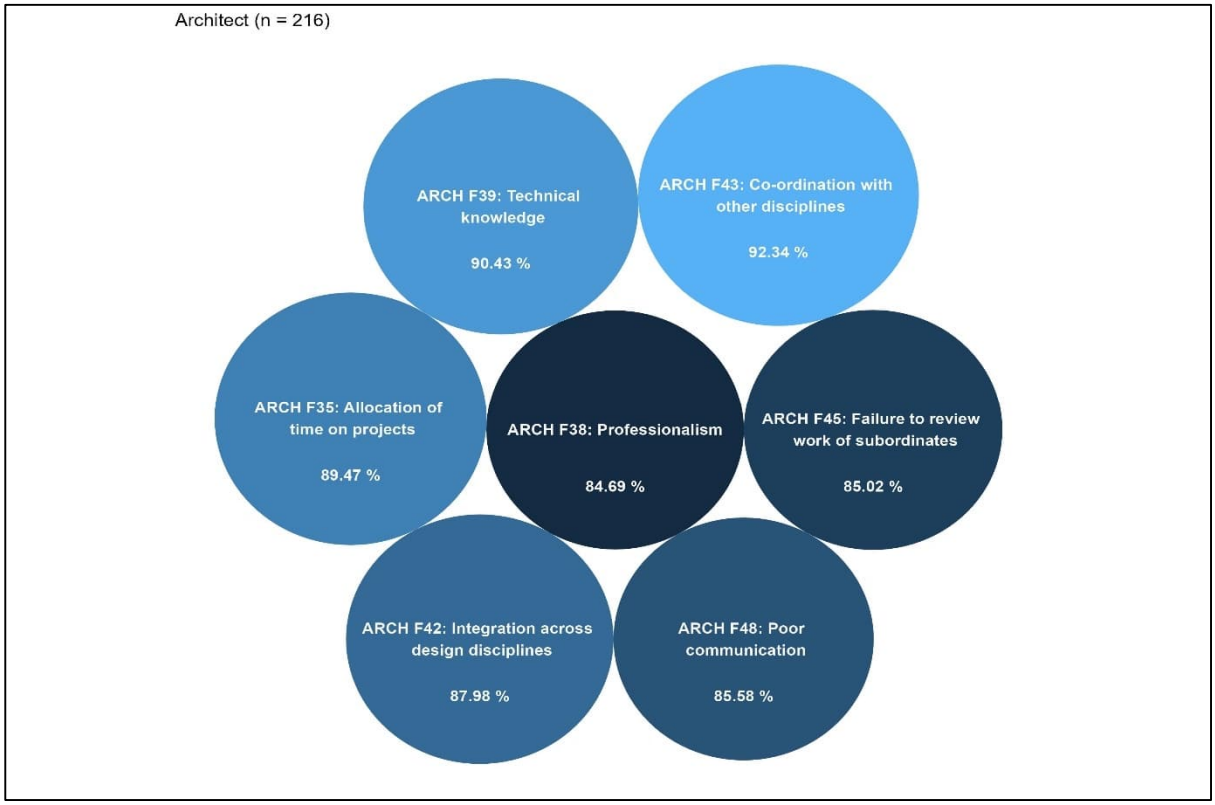


Figure 84: Professional factors where "strongly agree" and "agree" was selected by 80% or more of the architects

4.2.5.2 Civil/Structural engineers

Figure 81 provides a heatmap with professional factors influencing the quality of PSOs and the distribution of agreement among civil/structural engineering participants. Three factors received a "strongly agree" response by 50% or more of the participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. CSENG 39 (66.51%), CSENG F45 (61.93%) and CSENG F38 (51.85%) generated the three highest "strongly agree" responses while CSENG F54 (22.79%), CSENG F51 (25.12%) and CSENG F52 (26.39%) generated the three lowest "strongly agree" responses. On the other hand, CSENG F40 (5.07%), CSENG F52 (4.17%) and CSENG F54 (3.72%) generated the three highest "strongly disagree" responses while CSENG F50 (0.92%), CSENG F45 (0.92%) and CSENG F35 (0.92%) contained the lowest "strongly disagree" responses.

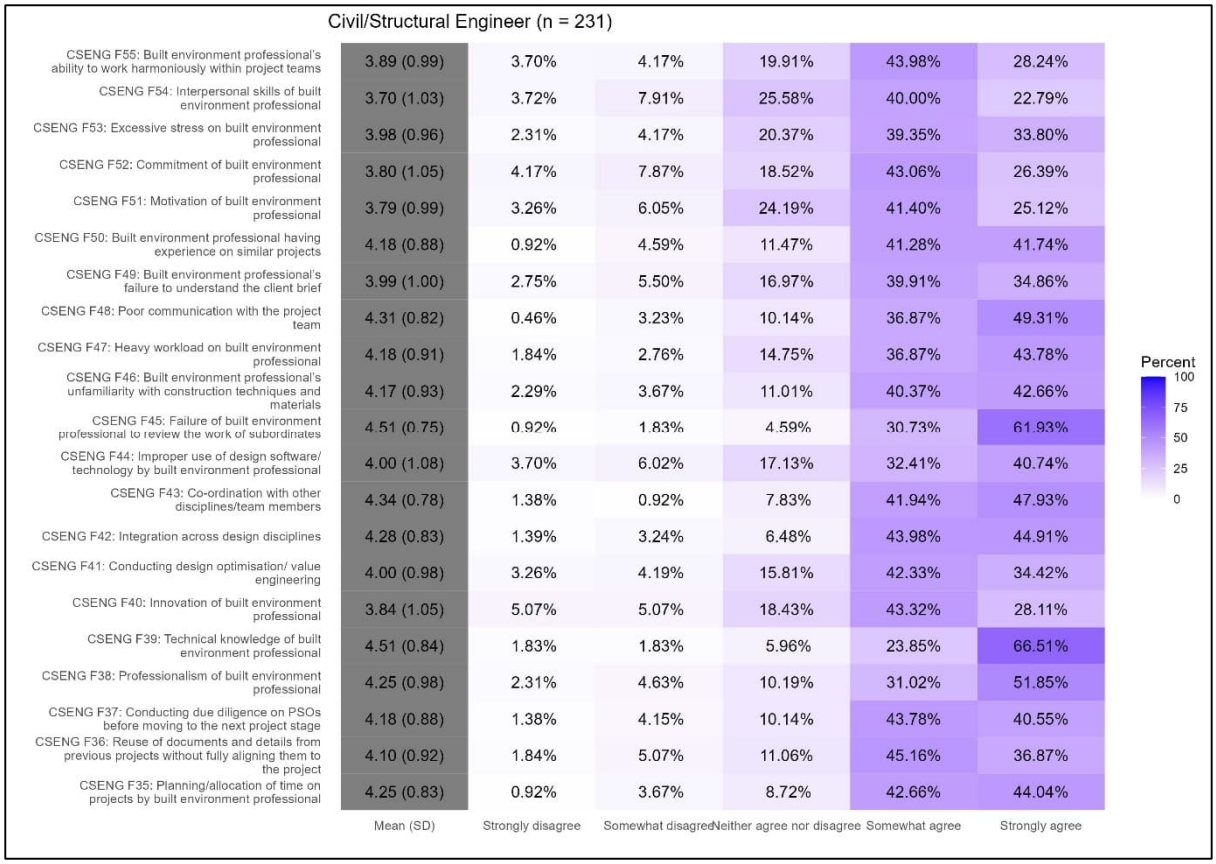


Figure 85: Heat map showing civil/structural engineers' distribution of agreement with professional factors

Figure 85 contains a stacked bar chart showing civil/structural engineers' distribution of agreement with professional factors. CSENG F45 (93%), CSENG F39 (90%), CSENG F43 (90%), CSENG F42 (89%) and CSENG F35 (87%) were the top five factors with the highest level of agreement among participants. On the other hand, CSENG F54 (63%), CSENG F51 (67%) and CSENG F52 (69%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, they all contained a level of agreement that exceeded 50%. The factor with the lowest level of agreement (CSENG F54) had the highest percentage of participants selecting "neither agree nor disagree" (26%). Interestingly, the factor with the second-highest level of agreement (CSENG F43) had the lowest level of disagreement of 2%. Furthermore, two factors with the lowest (CSENG F54) and third lowest (CSENG F52) level of agreement also had the highest levels of disagreement of 12%.

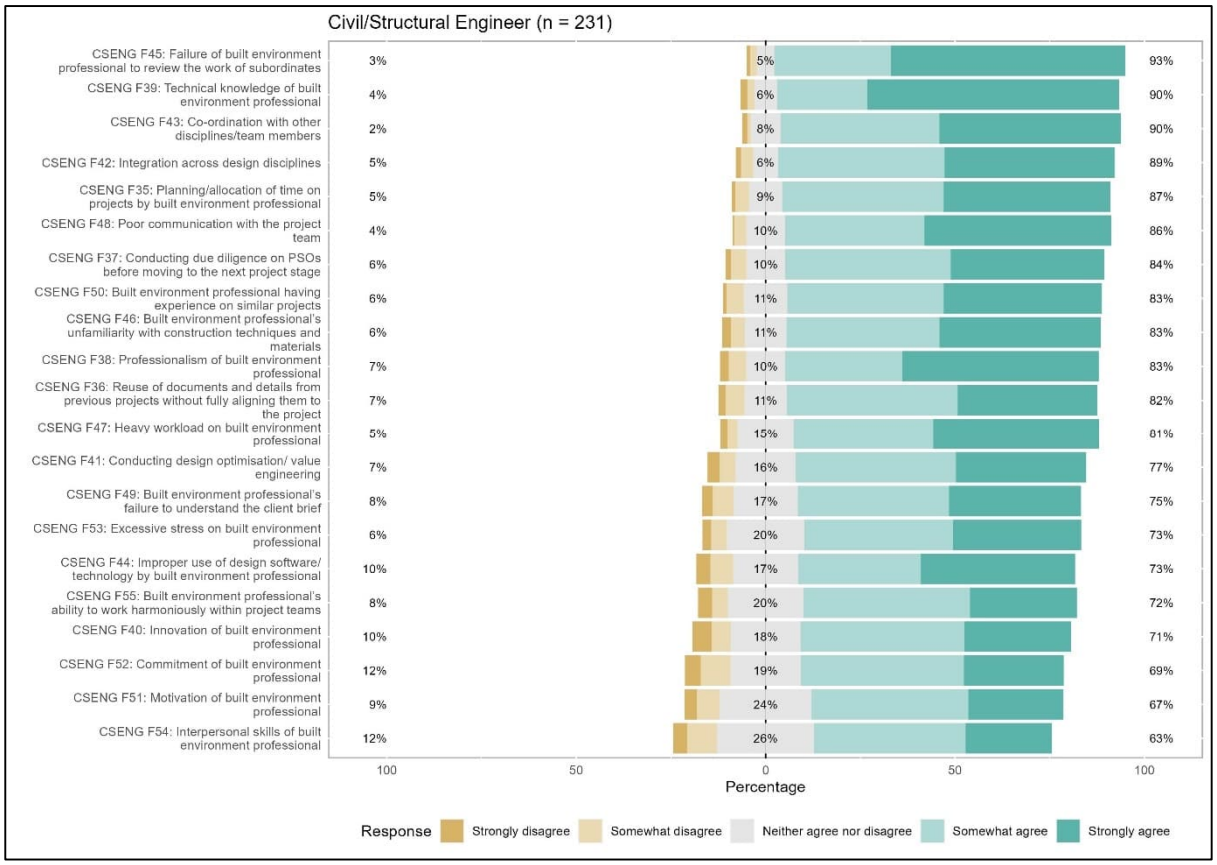


Figure 86: Bar chart showing civil/structural engineers' level of agreement with professional factors

The figures below provide insights into professional factors that were most important to civil/structural engineers, based on their level of agreement. Figure 83 illustrates professional factors cited by civil/structural engineers where "strongly agree" was selected by 50% or more

of the participants. From a total of 21 professional factors, only CSENG F39 (66.51%), CSENG F45 (61.93%) and CSENG F38 (51.85%) satisfied this criterion.

Figure 84 shows professional factors cited by civil/structural engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Twelve factors satisfied this criterion including CSENG F45 (92.66%), CSENG F39 (90.37%), CSENG F43 (89.86%), CSENG F42 (88.89%), CSENG F35 (86.7%), CSENG F48 (86.18%), CSENG F37 (84.33%), CSENG F50 (83.03%), CSENG F46 (83.03%), CSENG F38 (82.87%), CSENG F36 (82.03%) and CSENG F47 (80.65%).

Notably, CSENG F39, CSENG F45 and CSENG F38 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

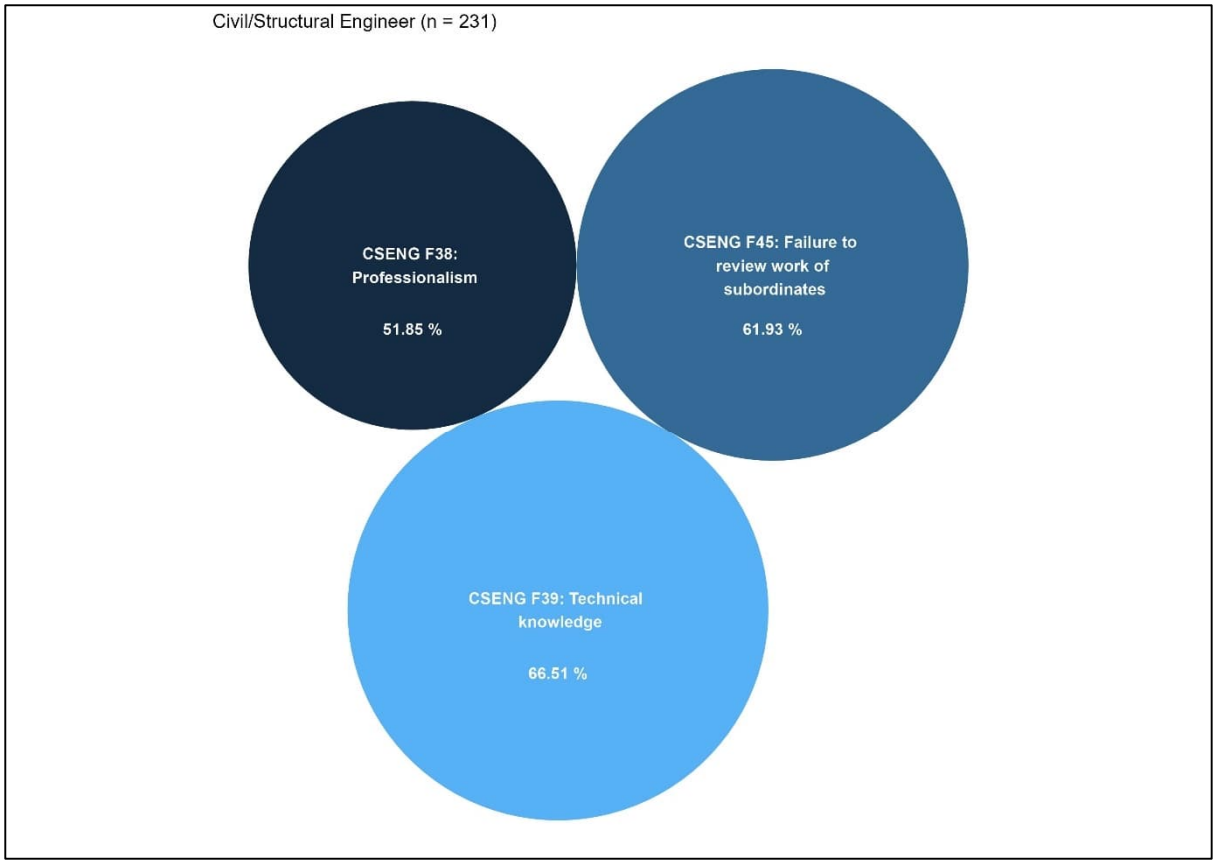


Figure 87: Professional factors where "strongly agree" was selected by 50% or more of the civil/structural engineers

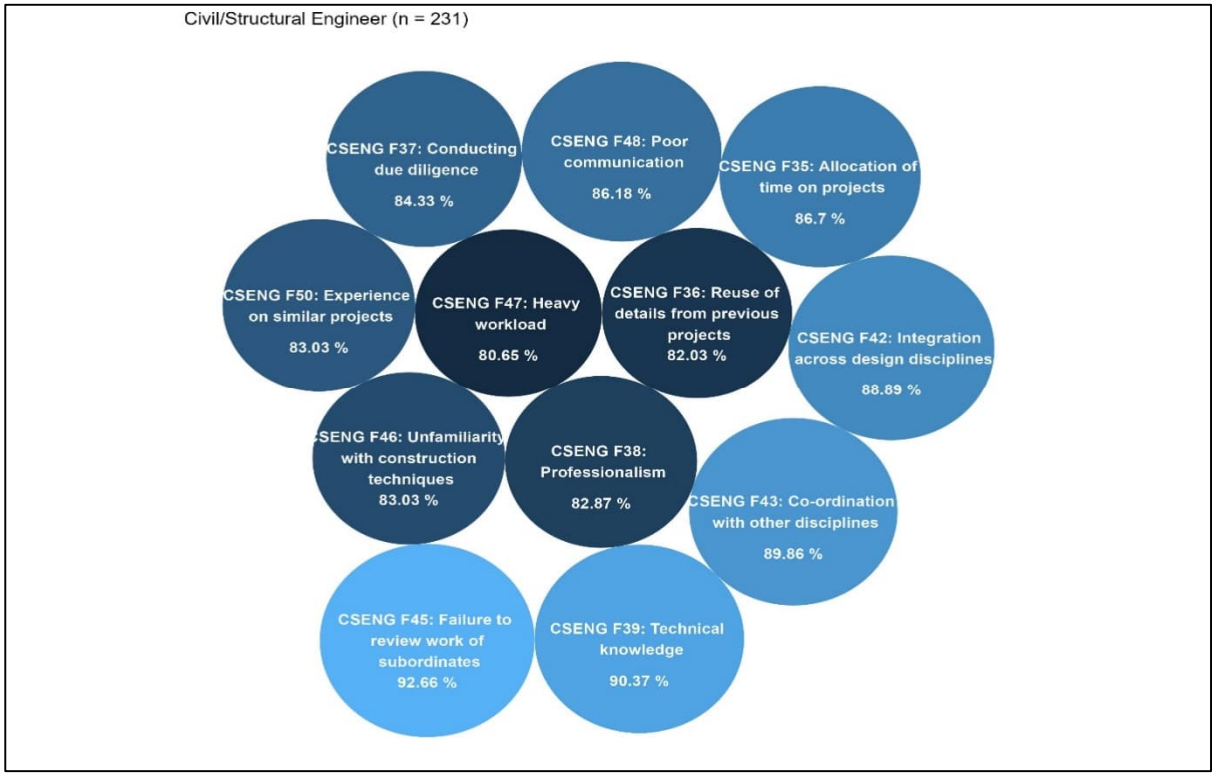


Figure 88: Professional factors where "strongly agree" and "agree" was selected by 80% or more of the civil/structural engineers

4.2.5.3 Electrical engineers

Figure 89 provides a heatmap with professional factors influencing the quality of PSOs and the distribution of agreement among electrical engineering participants. Two factors received a "strongly agree" response by 50% or more of the participants. On the other hand, only EENG F44 generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". EENG 39 (61.5%) and EENG F43 (53.8%) generated the highest "strongly agree" responses while EENG F44 (0%) and EENG F46 (15.4%) generated the lowest "strongly agree" responses. On the other hand, 13 factors generated 0% "strongly disagree" responses, namely, EENG F55, EENG F54, EENG F52, EENG F51, EENG F45, EENG F42, EENG F41, EENG F40, EENG F39, EENG F38, EENG F37, EENG F36 and EENG F35.

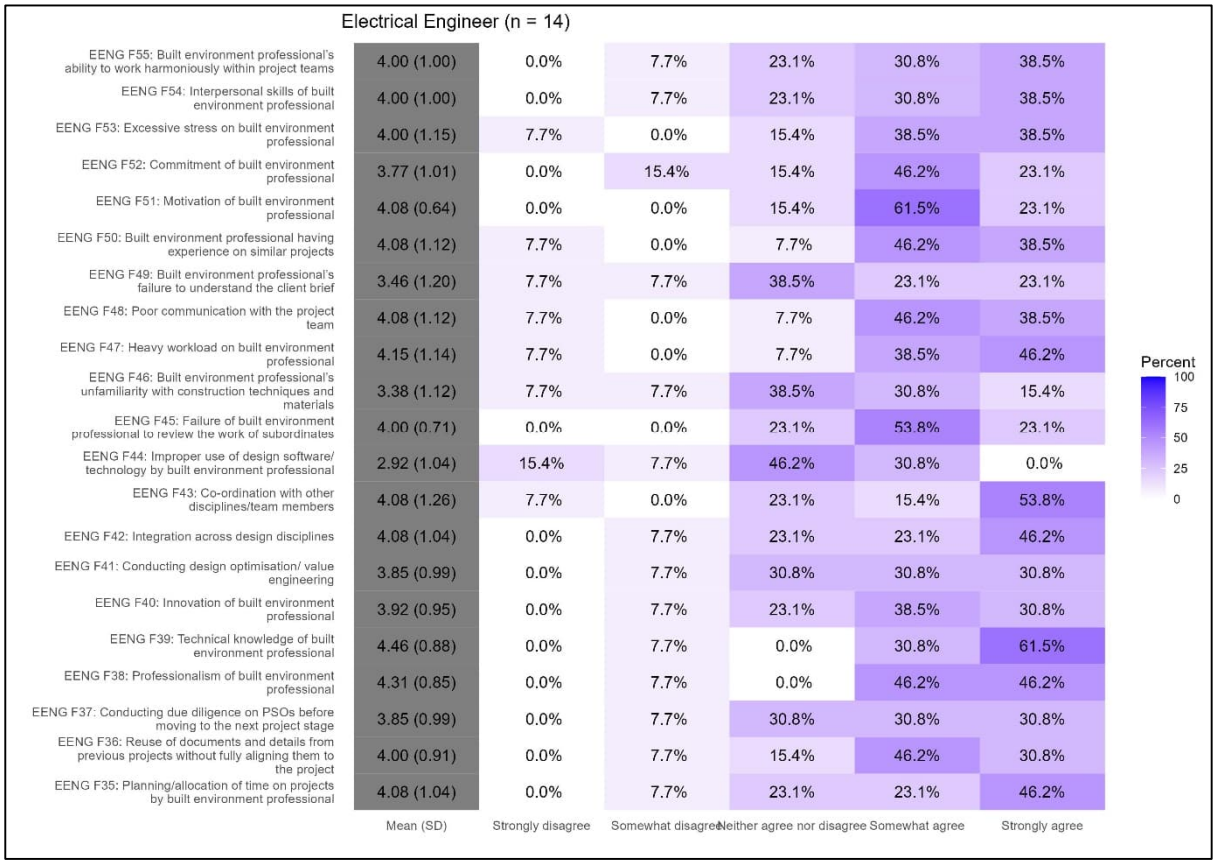


Figure 89: Heat map showing electrical engineers' distribution of agreement with professional factors

Figure 90 contains a stacked bar chart showing electrical engineers' distribution of agreement with professional factors. EENG F39 (92%) and EENG F38 (92%) were the top factors with the highest level of agreement among participants. On the other hand, EENG F44 (31%),

EENG F46 (46%) and EENG F49 (46%) contained the lowest level of agreement. The factor with the lowest level of agreement (EENG F44) had the highest percentage of participants selecting "neither agree nor disagree" (46%). Interestingly, the factor with the third-highest level of agreement EENG F51 had the lowest level of disagreement of 0%. Furthermore, the factor with the lowest level of agreement (EENG F44) had the highest level of disagreement at 23%.

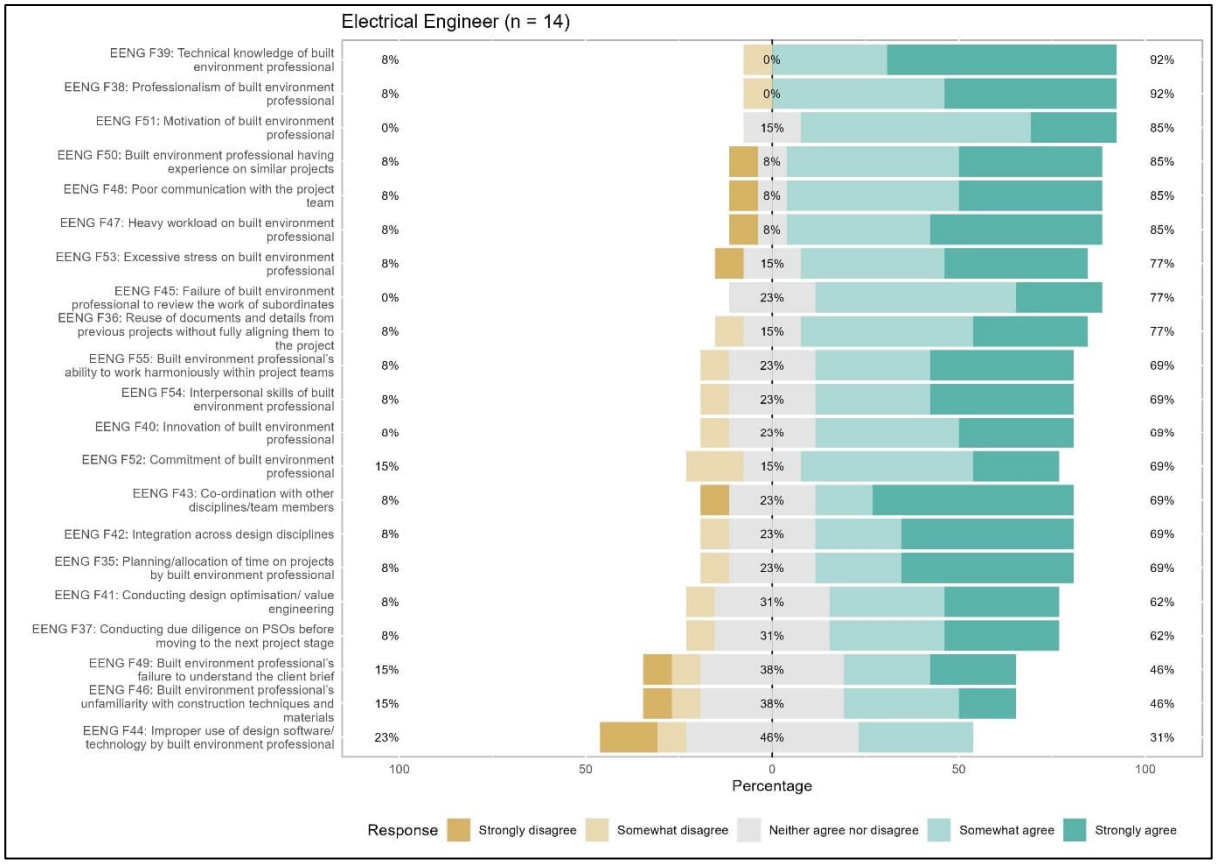


Figure 90: Bar chart showing electrical engineers' level of agreement with professional factors

The figures below provide insights into professional factors that were most important to electrical engineers, based on their level of agreement. Figure 83 illustrates professional factors cited by electrical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 21 professional factors, only EENG F39 (61.54%) and EENG F43 (53.85%) satisfied this criterion.

Figure 84 shows professional factors cited by electrical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Six factors satisfied this criterion including EENG F39 (92.31%), EENG F38 (92.31%), EENG F51 (84.62%), EENG F50 (84.62%), EENG F48 (84.62%) and EENG F47 (84.62%).

Notably, only EENG F39 appeared in both figures, indicating it was considered one of the most important factors by participants.

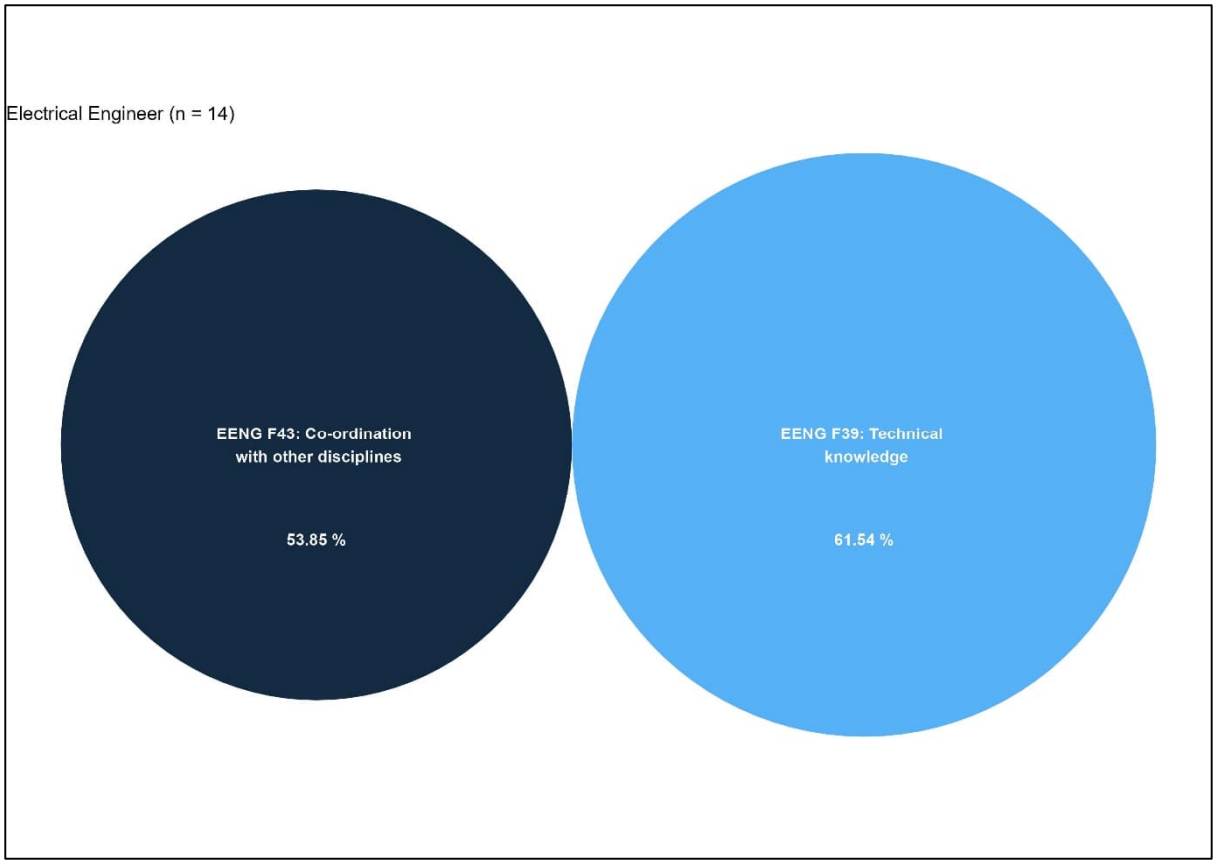


Figure 91: Professional factors where "strongly agree" was selected by 50% or more of the electrical engineers

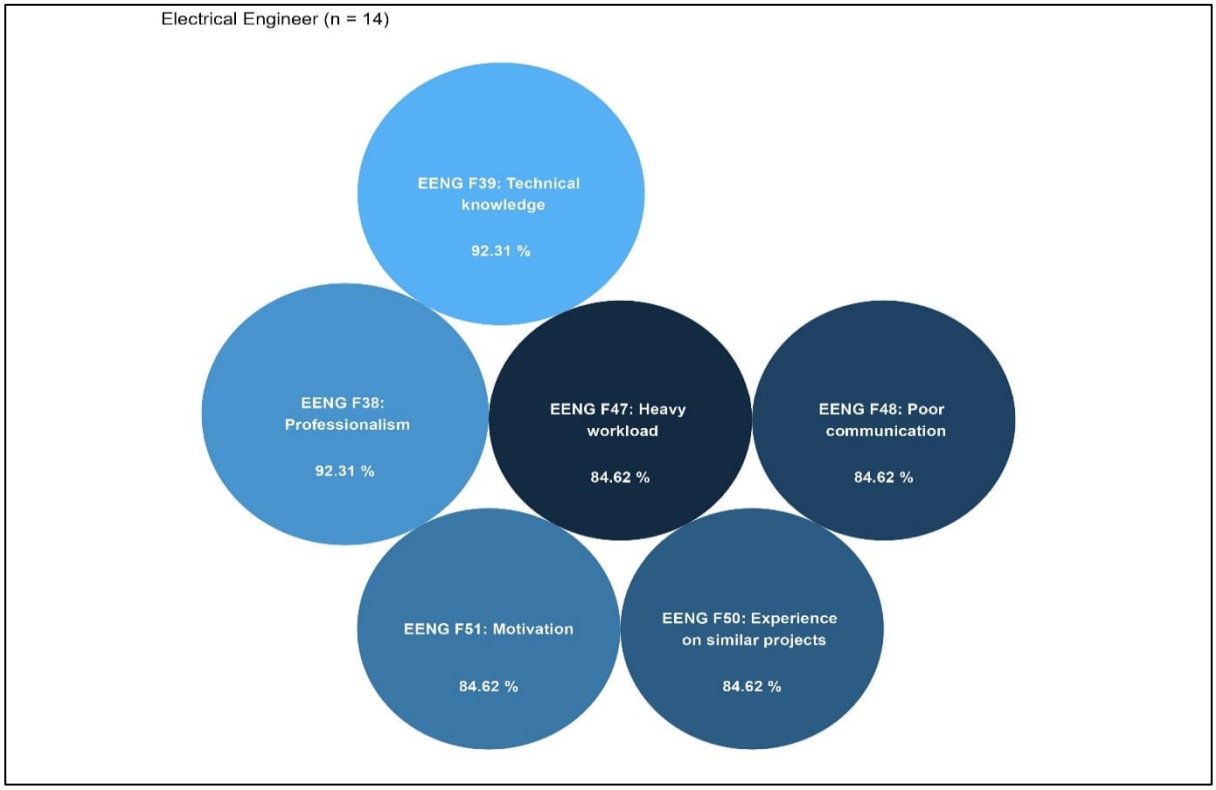


Figure 92: Professional factors where "strongly agree" and "agree" was selected by 80% or more of the electrical engineers

4.2.5.4 Mechanical engineers

Figure 93 provides a heatmap with professional factors influencing the quality of PSOs and the distribution of agreement among mechanical engineering participants. Six factors received a "strongly agree" response by 50% or more of the participants. On the other hand, five factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. MEENG 49 (57%), MEENG 48 (57%), MEENG 47 (57%), MEENG 46 (57%), MEENG 43 (57%) and MEENG 39 (57%) generated the highest "strongly agree" responses while MEENG F54 (0%) and MEENG F41 (0%) generated the three lowest "strongly agree" responses. On the other hand, MEENG F53 (14%), MEENG F52 (14%), MEENG F51 (14%), MEENG F44 (14%) and MEENG F40 (14%) generated the highest "strongly disagree" responses while the rest of the factors generated 0% "strongly disagree" responses.

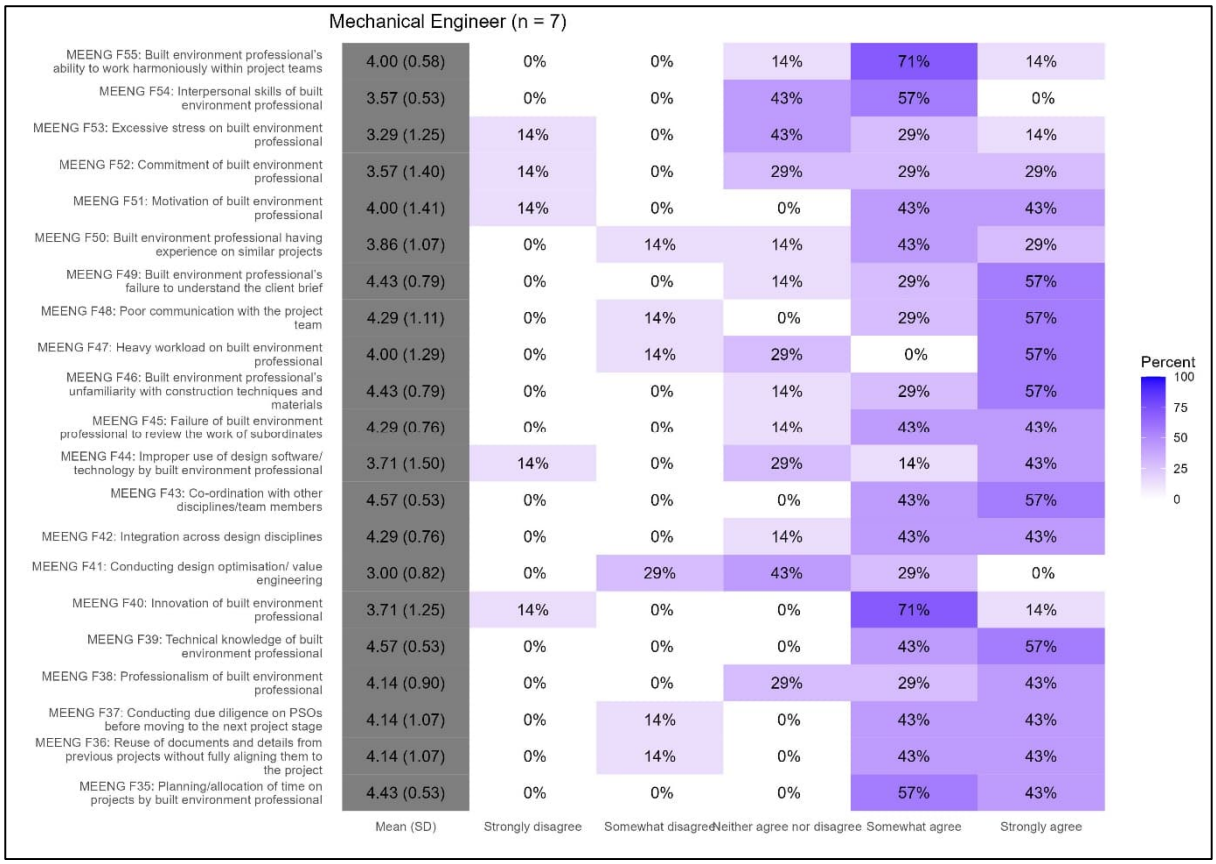


Figure 93: Heat map showing mechanical engineers' distribution of agreement with professional factors

Figure 94 contains a stacked bar chart showing mechanical engineers' distribution of agreement with professional factors. MEENG F43 (100%), MEENG F39 (100%) and MEENG F35 (100%) were the top three factors with the highest level of agreement among participants. The top three factors also had the lowest levels of disagreement with all receiving 0% "strongly disagree" responses. On the other hand, MEENG F41 (29%) and MEENG F53 (43%) contained the lowest level of agreement. Interestingly, MEENG F41, MEENG F53 and MEENG F54 jointly had the highest percentage of participants selecting "neither agree nor disagree".

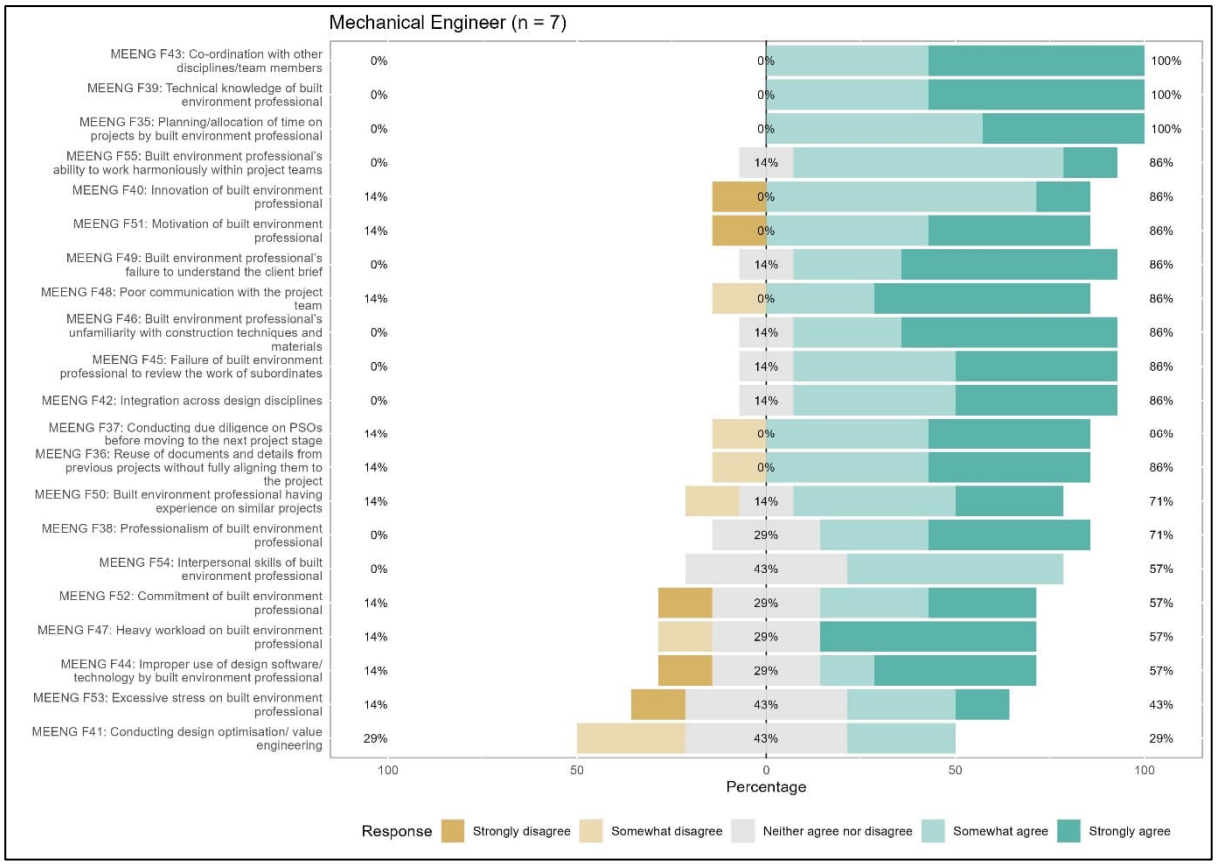


Figure 94: Bar chart showing mechanical engineers' level of agreement with professional factors

The figures below provide insights into professional factors that were most important to mechanical engineers, based on their level of agreement. Figure 95 illustrates professional factors cited by mechanical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of 21 professional factors, only MEENG F49 (57.14%), MEENG F48 (57.14%), MEENG F47 (57.14%), MEENG F46 (57.14%), MEENG F43 (57.14%) and MEENG F39 (57.14%) satisfied this criterion.

Figure 96 shows professional factors cited by mechanical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Thirteen factors

satisfied this criterion including MEENG F43 (100%), MEENG F39 (100%), MEENG F35 (100%), MEENG F48 (85.71%), MEENG F49 (85.71%), MEENG F51 (85.71%), MEENG F46 (85.71%), MEENG F36 (85.71%), MEENG F37 (85.71%), MEENG F40 (85.71%), MEENG F45 (85.71%), MEENG F42 (85.71%) and MEENG F55 (85.71%).

Notably, MEENG F49, MEENG F48, MEENG F46, MEENG F43 and MEENG F39 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

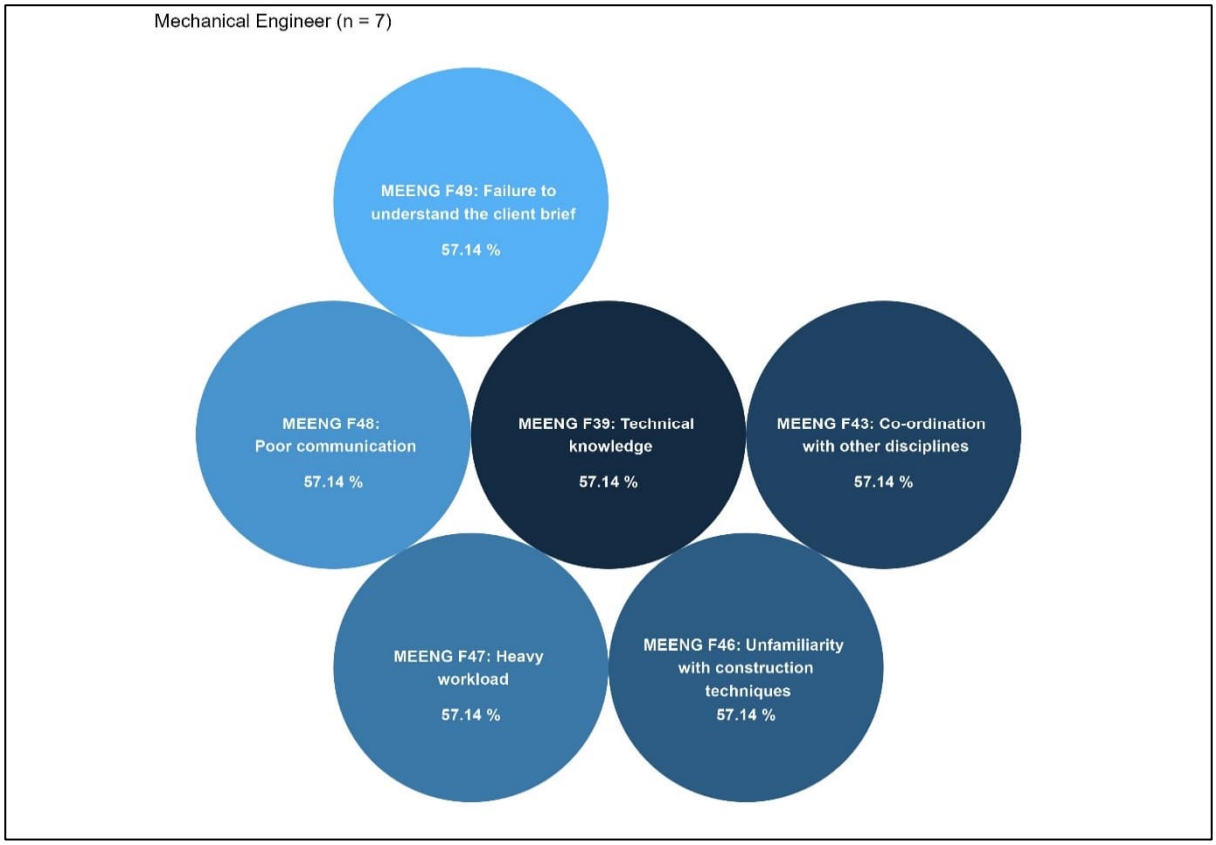


Figure 95: Professional factors where "strongly agree" was selected by 50% or more of the mechanical engineers

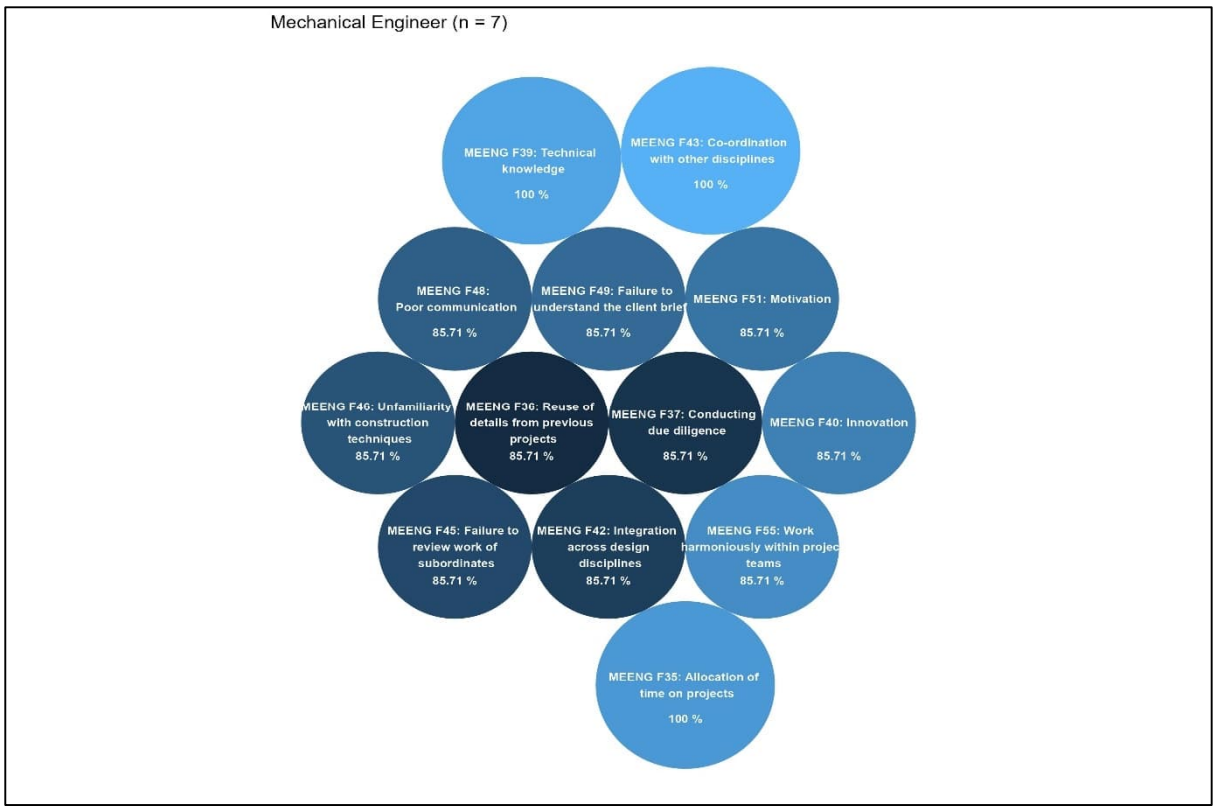


Figure 96: Professional factors where "strongly agree" and "agree" was selected by 80% or more of the mechanical engineers

4.2.5.5 Quantity surveyors

Figure 81 provides a heatmap with professional factors influencing the quality of PSOs and the distribution of agreement among quantity surveying participants. Three factors received a "strongly agree" response by 50% or more of the participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "somewhat agree" and "strongly agree". This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. QS F45 (69.2%), QS F39 (59%) and QS F48 (53.8%) generated the three highest "strongly agree" responses while QS F54 (15.4%), QS F40 (23.1%) and QS F51 (24.3%) generated the three lowest "strongly agree" responses. On the other hand, QS F49 (7.7%), QS F55 (5.1%), QS F54 (5.1%), and QS F44 (5.1%) generated the highest "strongly disagree" responses while the rest of the "strongly disagree" responses ranged between 0% and 2.6% of participants.



Figure 97: Heat map showing quantity surveyors' distribution of agreement with professional factors

Figure 85 contains a stacked bar chart showing quantity surveyors' distribution of agreement with professional factors. QS F45 (97%), QS F43 (97%), QS F39 (95%), QS F48 (92%) and QS F35 (92%) were the top five factors with the highest level of agreement among participants.

On the other hand, QS F40 (67%), QS F50 (67%) and QS F54 (51%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, they all contained a level of agreement that exceeded 50%. The factor with the lowest agreement (QS F54) had the highest percentage of participants selecting "neither agree nor disagree" (33%). Interestingly, factors with the fourth and sixth highest level of agreement, QS F48 and QS F42, respectively, had the lowest levels of disagreement at 0%. Furthermore, the factor with the lowest level of agreement (QS F54) had the second-highest level of disagreement of 15%. QS F46 had the highest level of disagreement at 18%.

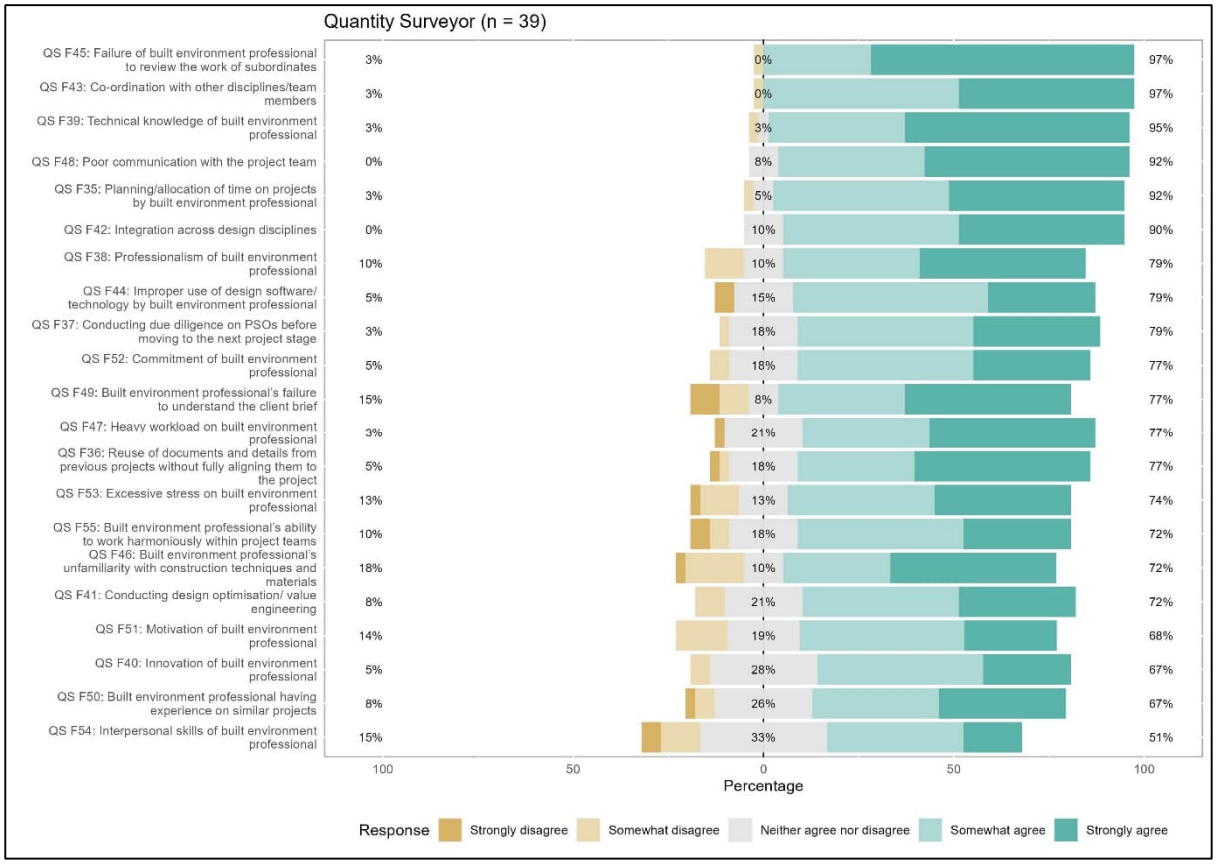


Figure 98: Bar chart showing quantity surveyors' level of agreement with professional factors

The figures below provide insights into professional factors that were most important to quantity surveyors, based on their level of agreement. Figure 83 illustrates professional factors cited by quantity surveyors where "strongly agree" was selected by 50% or more of the participants. From a total of 21 professional factors, only QS F45 (69.23%), QS F39 (58.97%) and QS F48 (53.85%) satisfied this criterion.

Figure 84 shows professional factors cited by quantity surveyors where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Six factors

satisfied this criterion including QS F45 (97.44%), QS F43 (97.44%), QS F39 (94.87%), QS F48 (92.31%), QS F35 (92.31%) and QS F42 (89.74%).

Notably, QS F45, QS F39 and QS F48 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

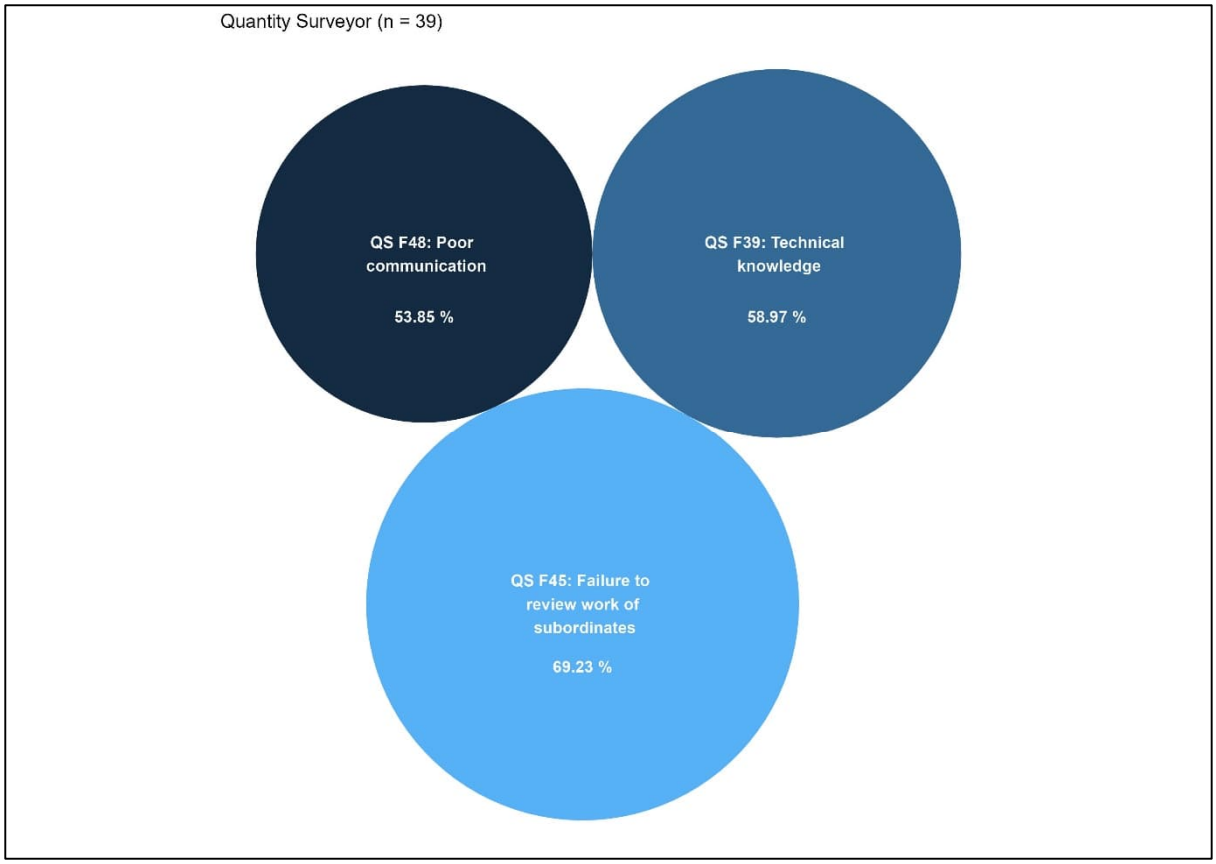


Figure 99: Professional factors where "strongly agree" was selected by 50% or more of the quantity surveyors

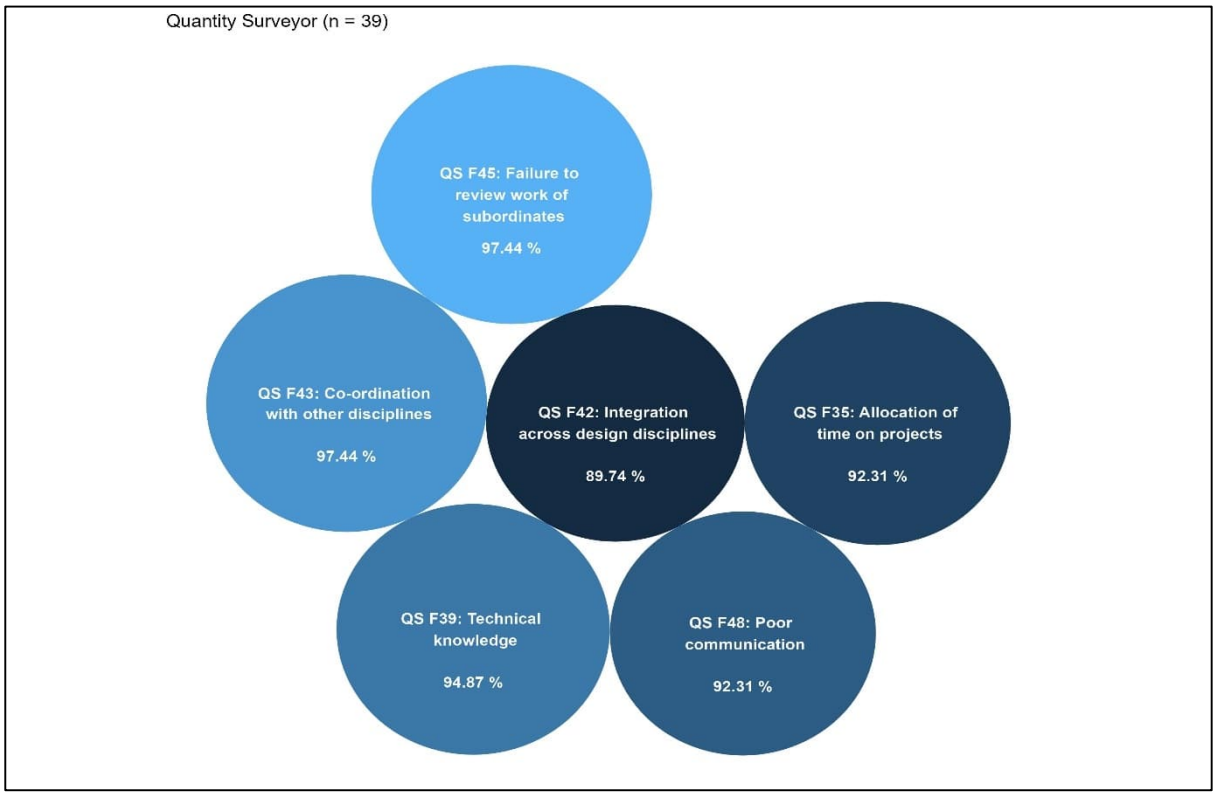


Figure 100: Professional factors where "strongly agree" and "agree" was selected by 80% or more of the quantity surveyors

4.2.5.6 Cross-discipline analysis

Three professional factors across disciplines had a high level of agreement, namely:

- F39: Technical knowledge of built environment professionals.
- F43: Coordination with other disciplines and team members.
- F45: Failure of built environment professional to review the work of subordinates.

Factor F39 had the highest percentage of "strongly agree" responses for all disciplines except quantity surveying, where it had the second-highest percentage of "strongly agree" responses. Factor F43 contained the joint highest percentage of "strongly agree" responses for mechanical engineers and the second-highest percentage of "strongly agree" responses for architects and electrical engineers. Factor F45 had the highest "strongly agree" responses for quantity surveyors and the second-highest "strongly agree" responses for civil engineers. Table 54 provides a percentage distribution of "strongly agree" responses per discipline.

Table 54: Discipline-specific percentage of "strongly agree" responses for professional factors

Factor	**Percentage of "strongly agree" responses per discipline**				
	Architect	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
F39	61.2%	66.5%	61.5%	57%	59%
F43	58.4%	47.9%	53.8%	57%	46.2%
F45	52.7%	61.9%	23.1%	43%	69.2%

Table 55 provides professional factors with a level of agreement (percentage of "somewhat agree" and "strongly agree") of 80% or more of the participants (per discipline). Factor F39 was the only factor to obtain a level of agreement greater than 80% for all disciplines. Interestingly, the level of agreement for F39 exceeded 90% among all disciplines. Factor F43 and F45 obtained a level of agreement greater than 80% for all disciplines except electrical engineering.

Table 55: Professional factors with agreement of 80% or more of the participants

Factor	**Architect**	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
F39	90.4%	90.4%	92.3%	100%	94.9%
F43	92.3%	89.9%	-	100%	97.4%

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F45	85%	92.7%	-	85.7%	97.4%

Table 56 illustrates factors that obtained 50% or more “strongly agree” responses and a level of agreement of 80% or more of the participants (per discipline). F39 was the only factor to satisfy these criteria for all disciplines. The architectural and mechanical engineering disciplines obtained more than 50% “strongly agree” responses and a level of agreement greater than 80% for factor F43. Similarly, the architectural, civil and quantity surveying disciplines achieved the same criteria for factor F45.

Table 56: Professional factors with 50% or more “strongly agree” responses and a level of agreement of 80% or more of the participants

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F39	✓	✓	✓	✓	✓
F43	✓			✓	
F45	✓	✓			✓

4.2.6 Section 5: Industry Factors

This section provides a breakdown of the level of agreement among built environment professionals with industry factors influencing the quality of PSOs.

4.2.6.1 Architects

Figure 101 provides a heatmap with industry factors influencing the quality of PSOs and the distribution of agreement among architectural participants. The highest "strongly agree" response was for ARCH F56, which was selected by 67.96% of participants. This was significantly higher than the factor with the second-highest "strongly agree" response (ARCH 58) by approximately 23%. On the other hand, none of the factors generated a response of more than 10% for “strongly disagree”. From the heatmap, it is evident that responses were mainly spread among “somewhat agree” and “strongly agree”. This suggests a consensus among participants about factors that influence the quality of PSOs, with most participants agreeing or somewhat agreeing about the importance of these factors. ARCH F56 (67.96%) and ARCH F58 (44.88%) generated the highest “strongly agree” responses while ARCH F65 (24.31%) and ARCH F63 (25.98%) generated the lowest “strongly agree” responses. On the other hand, ARCH F62 (9.27%) and ARCH F57 (9.18%) generated the highest “strongly disagree”

responses while ARCH F56 (0.97%) and ARCH F60 (1.97%) contained the lowest "strongly disagree" responses.



Figure 101: Heat map showing architects' distribution of agreement with industry factors

Figure 102 contains a stacked bar chart showing architects' distribution of agreement with industry factors. ARCH F56 (89%), ARCH F58 (74%) and ARCH F64 (69%) were the top three factors with the highest level of agreement among participants. On the other hand, ARCH F65 (51%), ARCH F62 (52%) and ARCH F63 (56%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, they all contained a level of agreement that exceeded 50%. The factor with the lowest agreement (ARCH F65) had the highest percentage of participants selecting "neither agree nor disagree" (35%). The factor with the highest level of agreement ARCH F56 had the lowest level of disagreement of 3%. Furthermore, the factor with the second lowest level of agreement ARCH F62 had the highest level of disagreement of 22%.

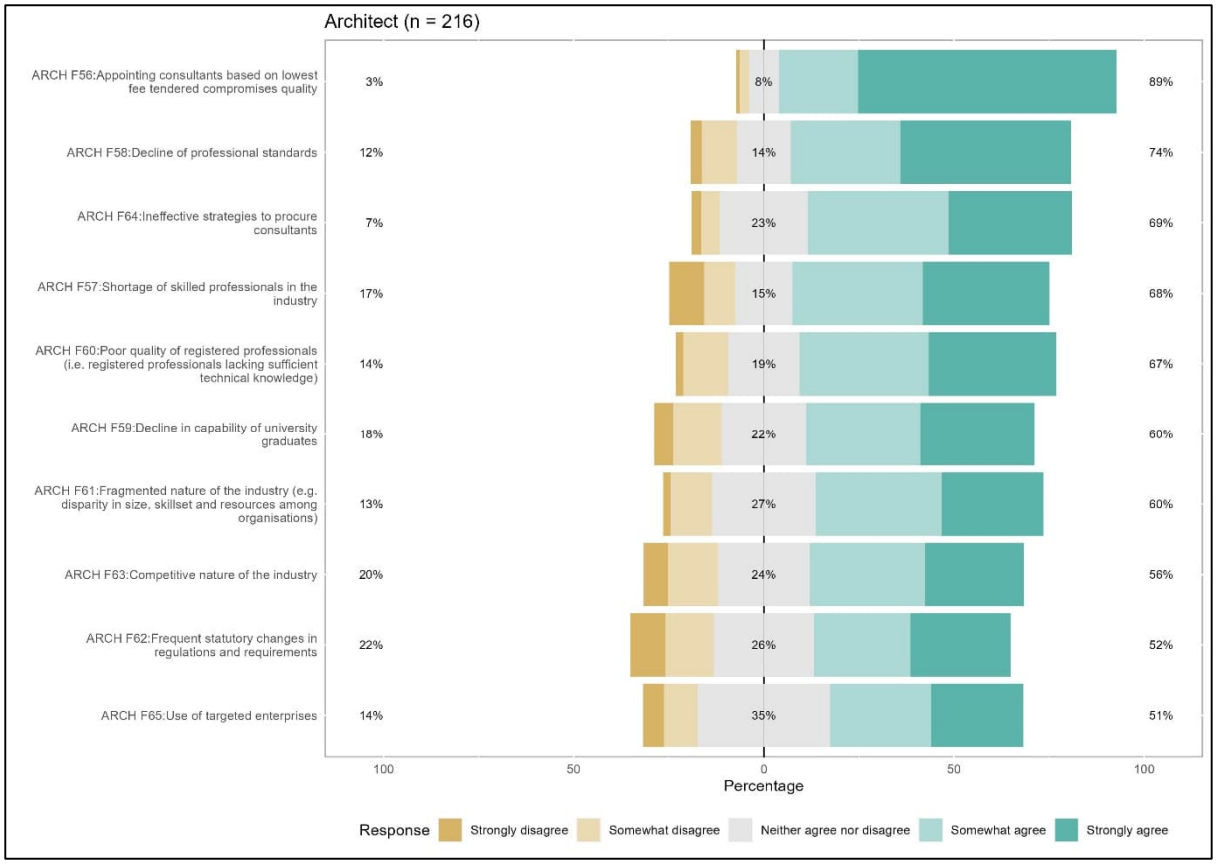


Figure 102: Bar chart showing architects' level of agreement with professional factors

The figures below provide insights into industry factors that were most important to architects, based on their level of agreement. Figure 103 illustrates industry factors cited by architects where "strongly agree" was selected by 50% or more of the participants. From a total of ten industry factors, only ARCH F56 (67.96%) satisfied this criterion.

Figure 104 shows industry factors cited by architects where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. One factor satisfied this criterion, namely, ARCH F56 (88.83%).

Notably, only ARCH F56 appeared in both figures, indicating it was considered one of the most important factors by participants.

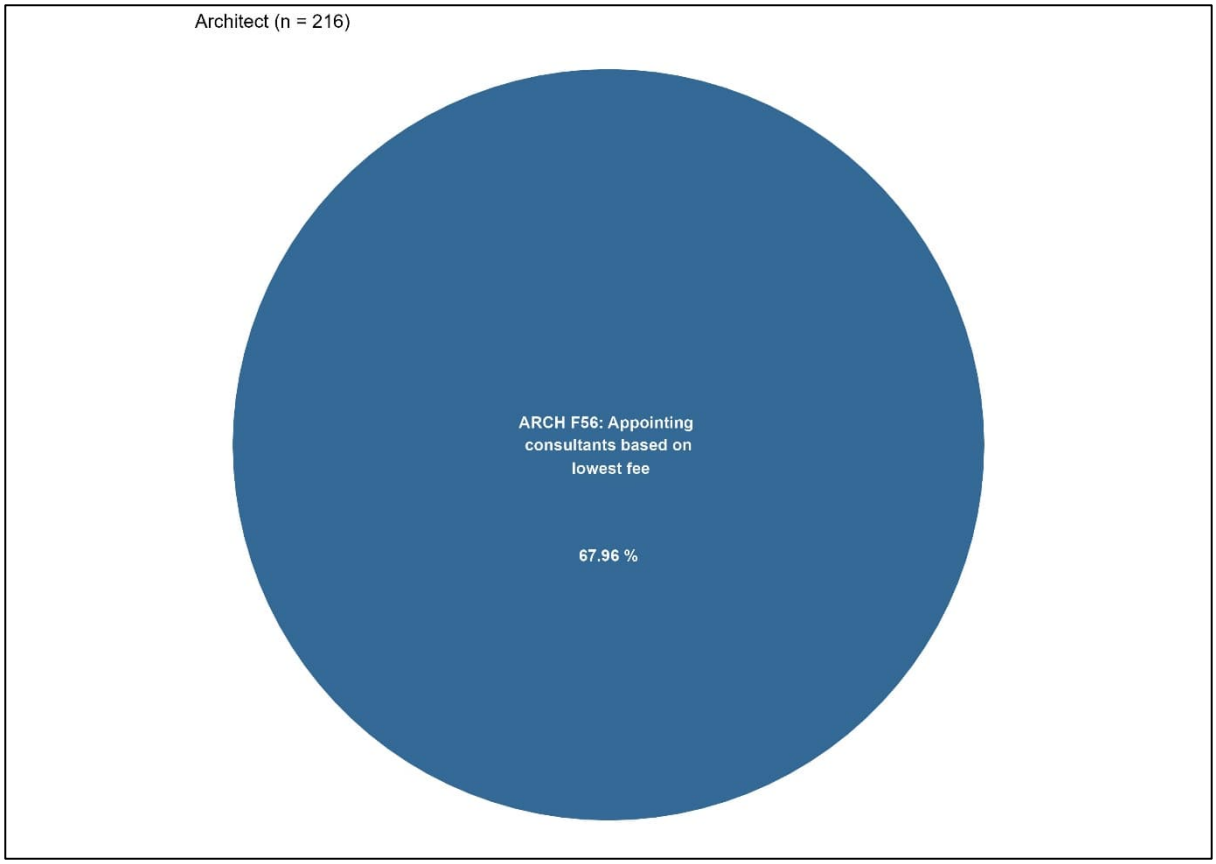


Figure 103: Industry factors where "strongly agree" was selected by 50% or more of the architects

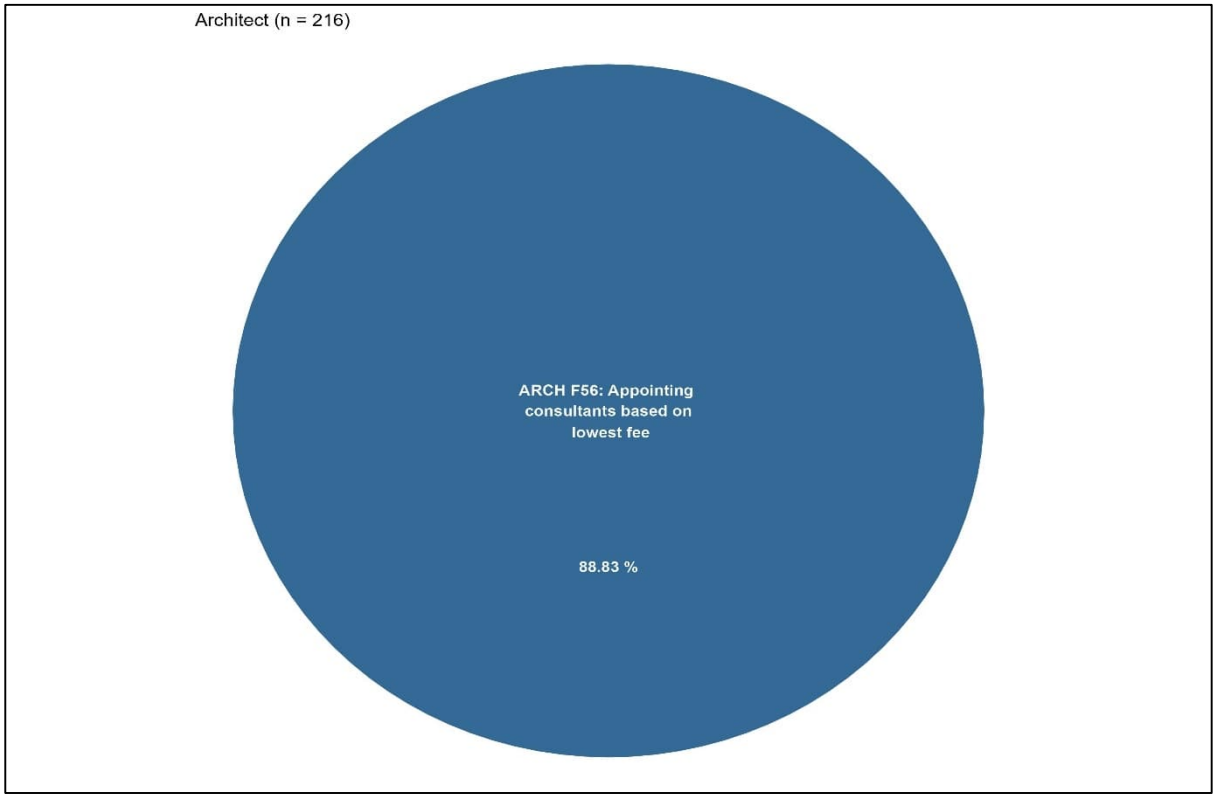


Figure 104: Industry factors where "strongly agree" and "agree" was selected by 80% or more of the architects

4.2.6.2 Civil/Structural engineers

Figure 105 provides a heatmap with industry factors influencing the quality of PSOs and the distribution of agreement among civil/structural engineering participants. Two factors received a “strongly agree” response by 50% or more of the participants. The highest "strongly agree" response was for CSENG F56, which was selected by 76.17% of participants. This was significantly higher than the factor with the second-highest "strongly agree" response (CSENG F64) by approximately 23%. On the other hand, none of the factors generated a response of more than 10% for “strongly disagree”. From the heatmap, it is evident that responses were mainly spread among “neither agree nor disagree”, “somewhat agree” and “strongly agree”. CSENG F56 (76.17%) and CSENG F64 (52.58%) generated the highest “strongly agree” responses while CSENG F62 (9.52%) and CSENG F61 (16.43%) generated the lowest “strongly agree” responses. On the other hand, CSENG F62 (8.10%) and CSENG F60 (6.13%) generated the highest “strongly disagree” responses while CSENG F64 (0.94%) and CSENG F56 (2.34%) contained the lowest “strongly disagree” responses.

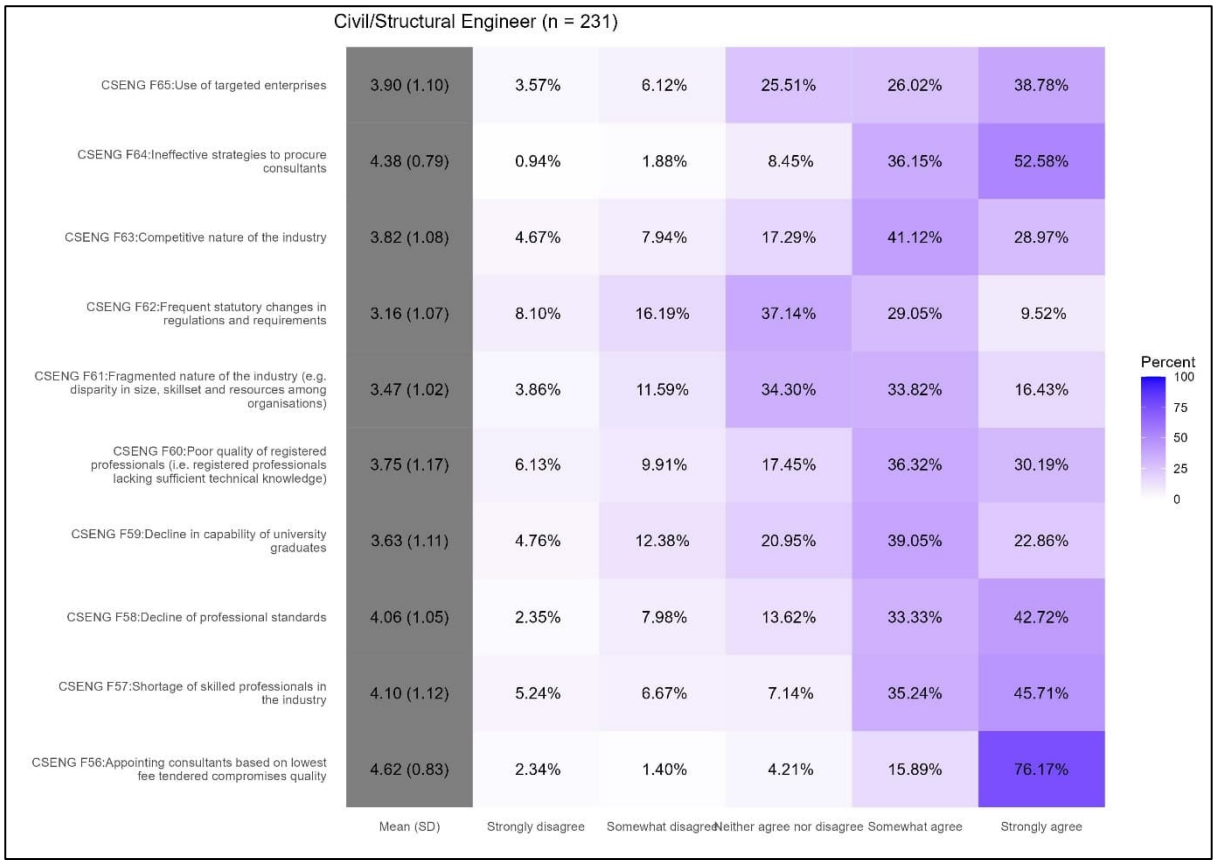


Figure 105: Heat map showing civil/structural engineers’ distribution of agreement with industry factors

Figure 106 contains a stacked bar chart showing civil/structural engineers' distribution of agreement with industry factors. CSENG F56 (92%), CSENG F64 (89%) and CSENG F57 (81%) were the top three factors with the highest level of agreement among participants. On the other hand, CSENG F62 (39%), CSENG F61 (50%) and CSENG F59 (62%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, only CSENG F62 contained a level of agreement of under 50%. The factor with the lowest level of agreement (CSENG F62) had the highest percentage of participants selecting "neither agree nor disagree" (37%). The top two factors with the highest level of agreement CSENG F56 and CSENG F64 had the lowest levels of disagreement of 4% and 3%, respectively. Furthermore, the factor with the lowest level of agreement (CSENG F62) had the highest level of disagreement of 24%.

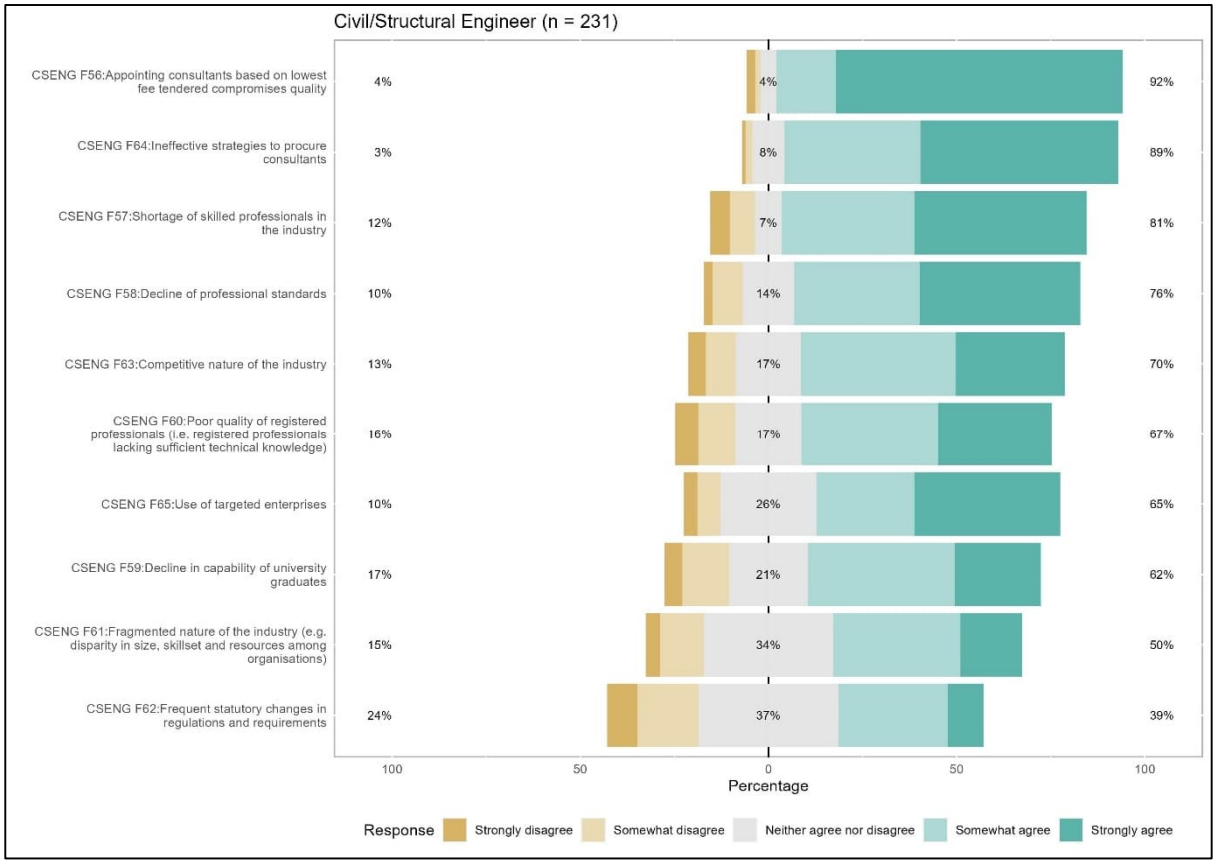


Figure 106: Bar chart showing civil/structural engineers' level of agreement with industry factors

The figures below provide insights into industry factors that were most important to civil/structural engineers, based on their level of agreement. Figure 107 illustrates industry factors cited by civil engineers where "strongly agree" was selected by 50% or more of the participants. From a total of ten industry factors, CSENG F56 (76.17%) and CSENG F64 (52.58%) satisfied this criterion.

Figure 108 shows industry factors cited by civil/structural engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Three factors satisfied this criterion: CSENG F56 (92.06%), CSENG F64 (88.73%) and CSENG F57 (80.95%).

Notably, CSENG F56 and CSENG F64 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

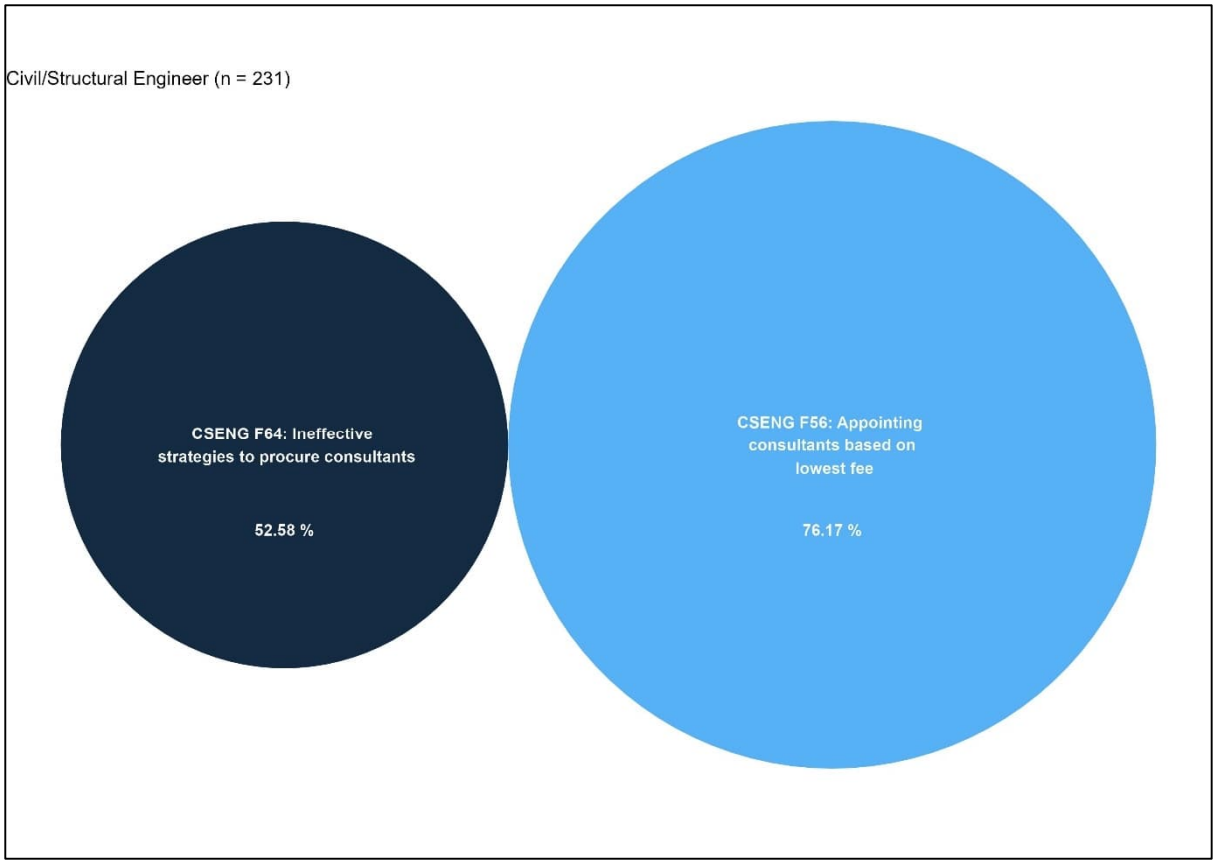


Figure 107: Industry factors where "strongly agree" was selected by 50% or more of the civil engineers

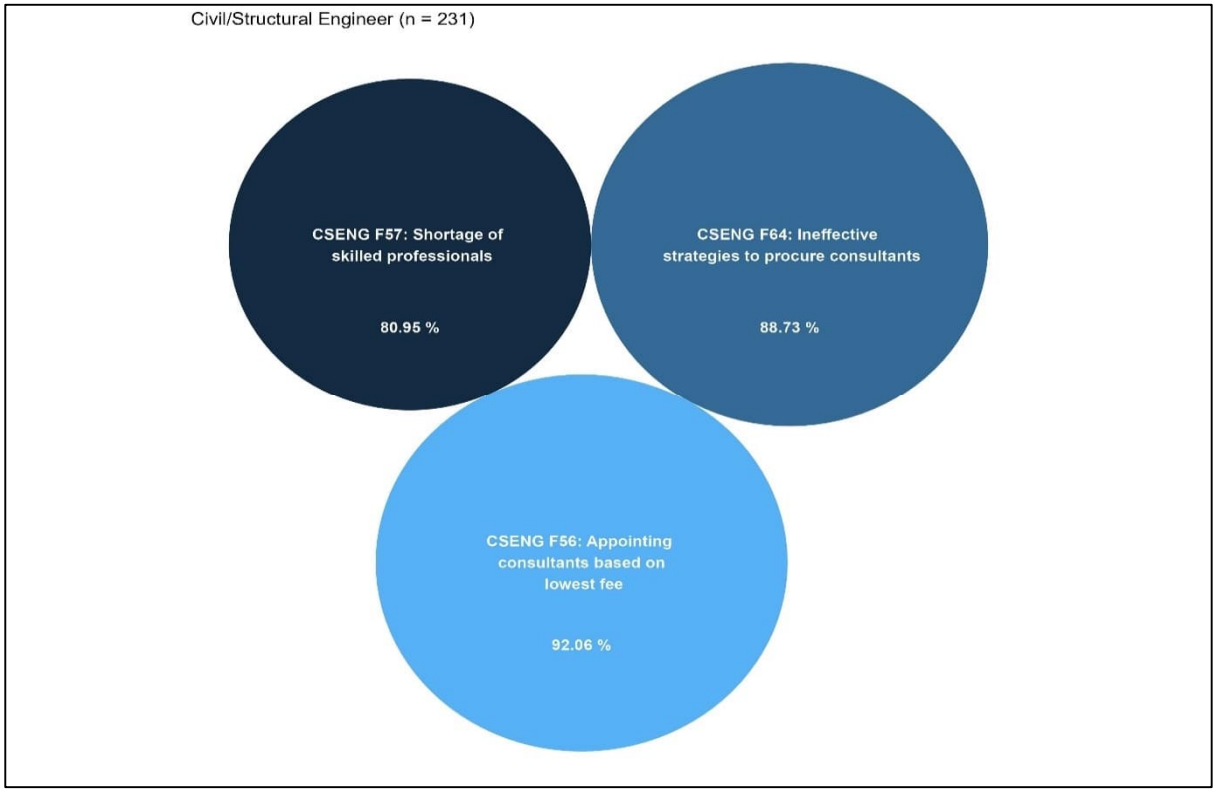


Figure 108: Industry factors where "strongly agree" and "agree" was selected by 80% or more of the civil engineers

4.2.6.3 Electrical engineers

Figure 105 provides a heatmap with industry factors influencing the quality of PSOs and the distribution of agreement among electrical engineering participants. Three factors received a "strongly agree" response by 50% or more of the participants. From the heatmap, it is evident that responses were spread across all categories. EENG F56 (76.9%) and EENG F64 (58.3%) generated the highest "strongly agree" responses while EENG F62 (15.4%) and EENG F61 (16.7%) generated the lowest "strongly agree" responses. On the other hand, EENG F62 (23.1%) and EENG F65 (15.4%) generated the highest "strongly disagree" responses while EENG F64, EENG F63, EENG F57 and EENG F56 contained the lowest "strongly disagree" responses with 0%.



Figure 109: Heat map showing electrical engineers' distribution of agreement with industry factors

Figure 110 contains a stacked bar chart showing electrical engineers' distribution of agreement with industry factors. EENG F56 (92%), EENG F57 (92%) and EENG F58 (85%) were the top three factors with the highest level of agreement among participants. On the other hand, EENG F62 (31%), EENG F63 (46%) and EENG F60 (54%) contained the lowest level of agreement. Both EENG F62 and EENG F63 contained a level of agreement of under 50%. The factor with the second lowest agreement (EENG F63) had the highest percentage of participants selecting

"neither agree nor disagree" (38%). Interestingly, the factor with the second-highest level of agreement EENG F56 had the lowest level of disagreement at 0%. Furthermore, the factor with the lowest level of agreement (EENG F62) had the highest level of disagreement at 38%.

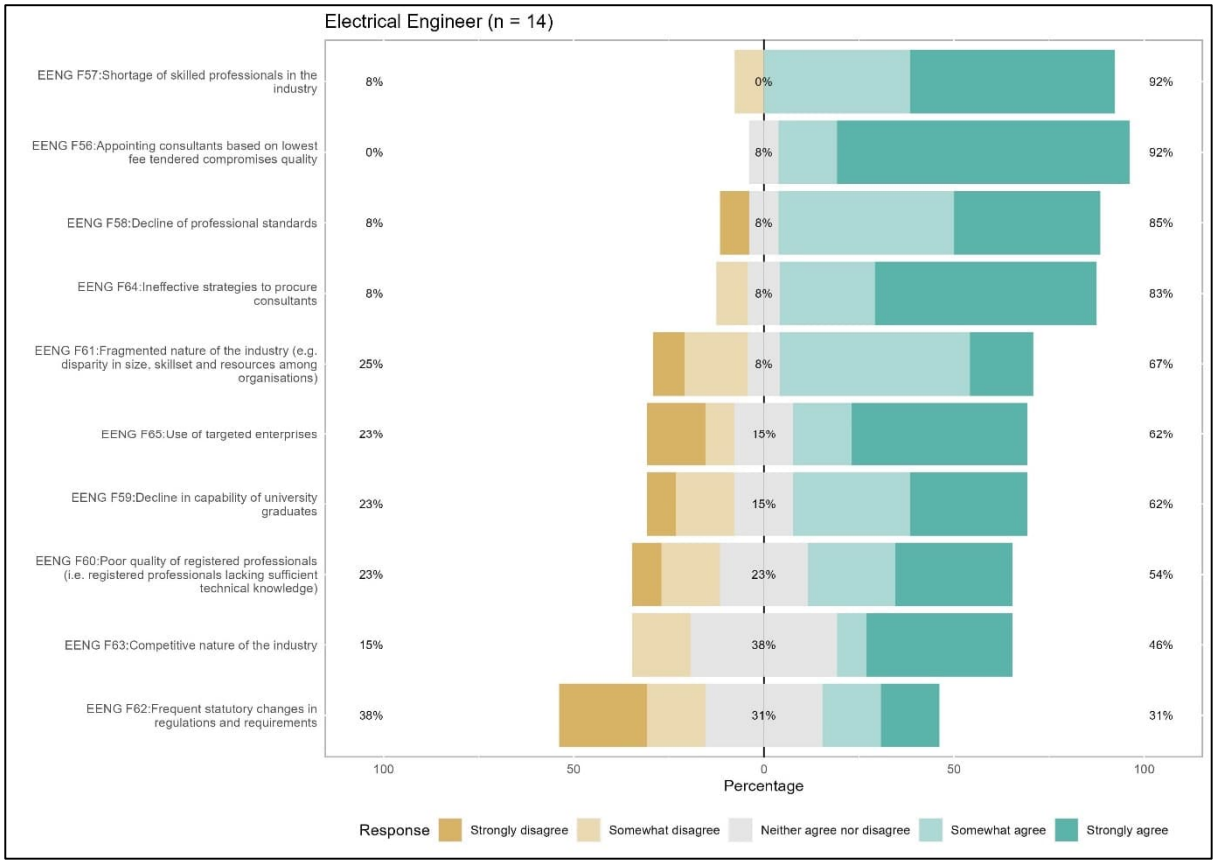


Figure 110: Bar chart showing electrical engineers' level of agreement with industry factors

The figures below provide insights into industry factors that were most important to electrical engineers, based on their level of agreement. Figure 111 illustrates industry factors cited by electrical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of ten industry factors, EENG F56 (76.92%), EENG F64 (58.33%) and EENG F57 (53.85%) satisfied this criterion.

Figure 112 shows industry factors cited by electrical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Three factors satisfied this criterion: EENG F57 (92.31%), EENG F56 (92.31%), EENG F58 (84.62%) and EENG F64 (83.33%).

Notably, EENG F56, EENG F64 and EENG F57 were the only factors appearing in both figures, indicating they were considered the most important factors by participants.

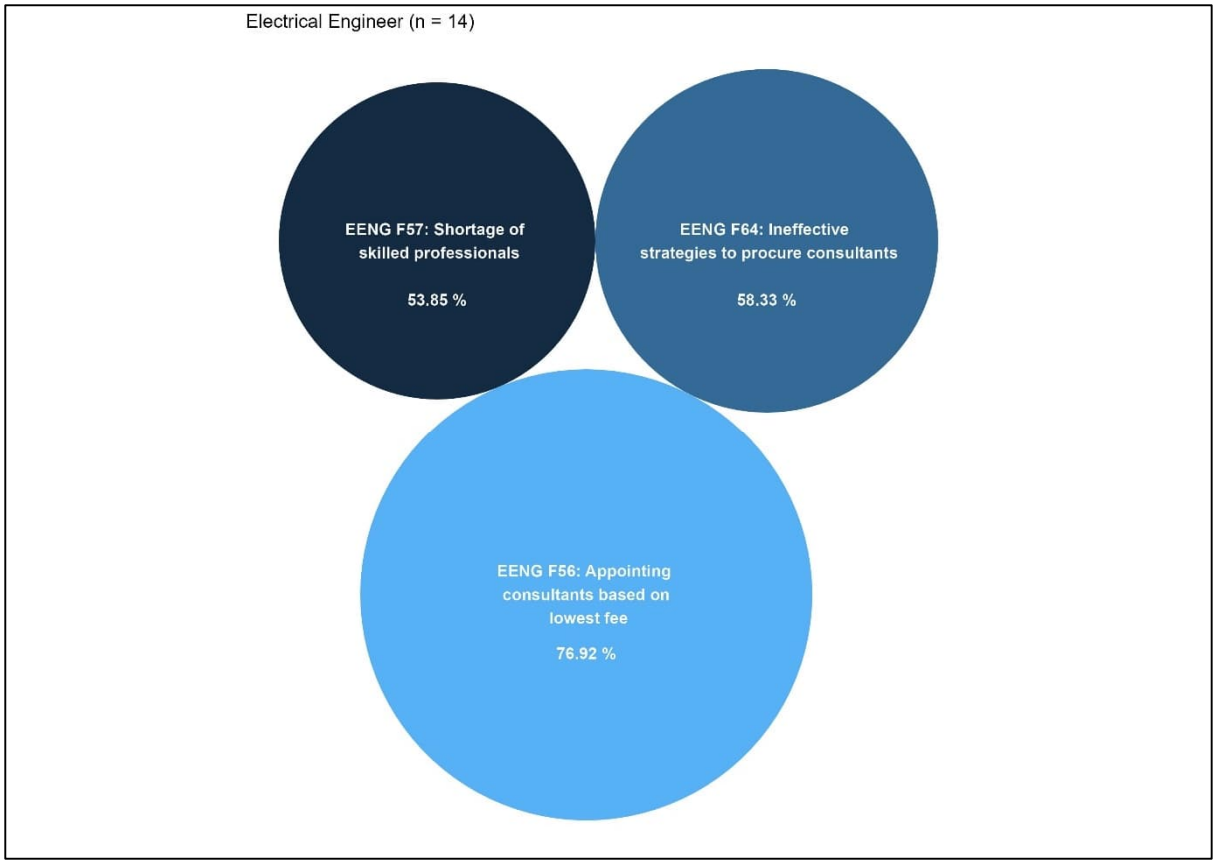


Figure 111: Industry factors where "strongly agree" was selected by 50% or more of the electrical engineers

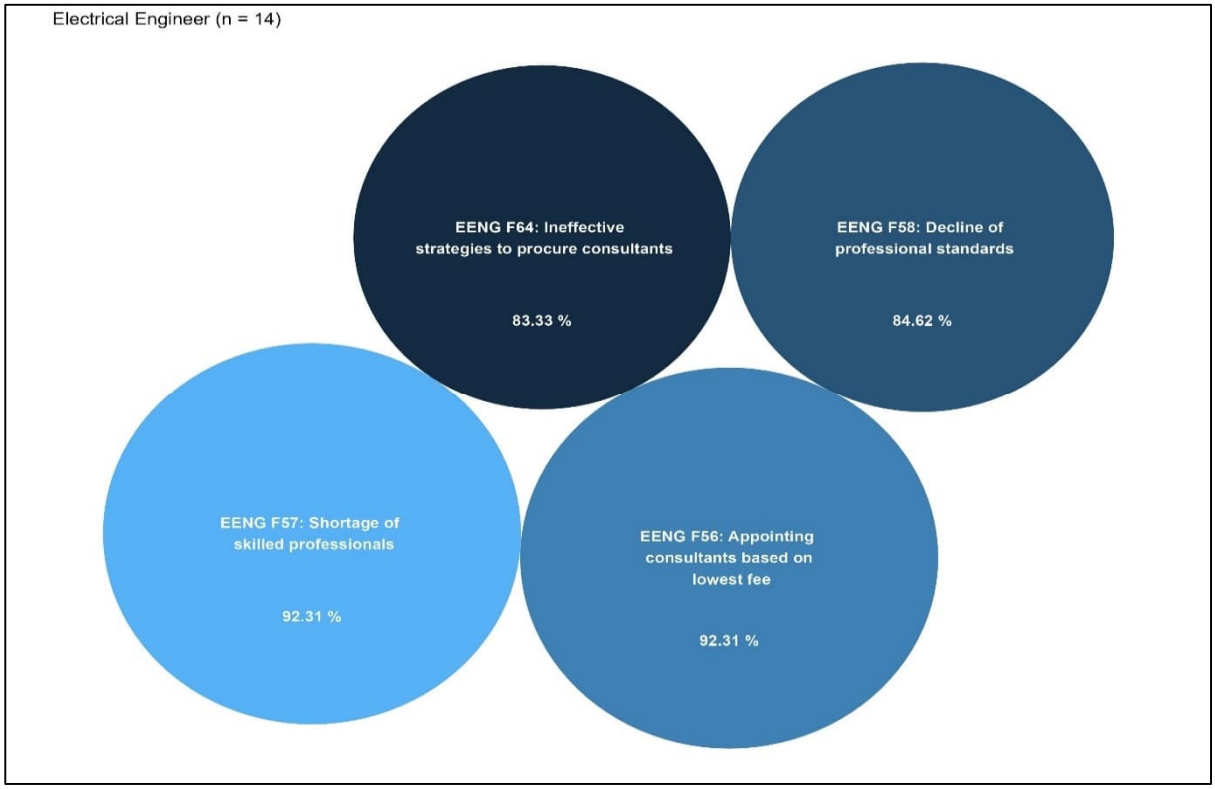


Figure 112: Industry factors where "strongly agree" and "agree" was selected by 80% or more of the electrical engineers

4.2.6.4 Mechanical engineers

Figure 113 provides a heatmap with industry factors influencing the quality of PSOs and the distribution of agreement among mechanical engineering participants. The highest "strongly agree" response was for MEENG F64, which was selected by 67% of participants. This was significantly higher than factors with the second-highest "strongly agree" responses by approximately 24%. On the other hand, MEENG F62 (0%) generated the fewest “strongly agree” responses. Most factors generated more than 10% responses for “strongly disagree” with only MEENG F64 and MEENG F61 generating a 0% response. From the heatmap, it is evident that responses were spread across all categories. This suggests that participants have a range of opinions about factors that influence the quality of PSOs.

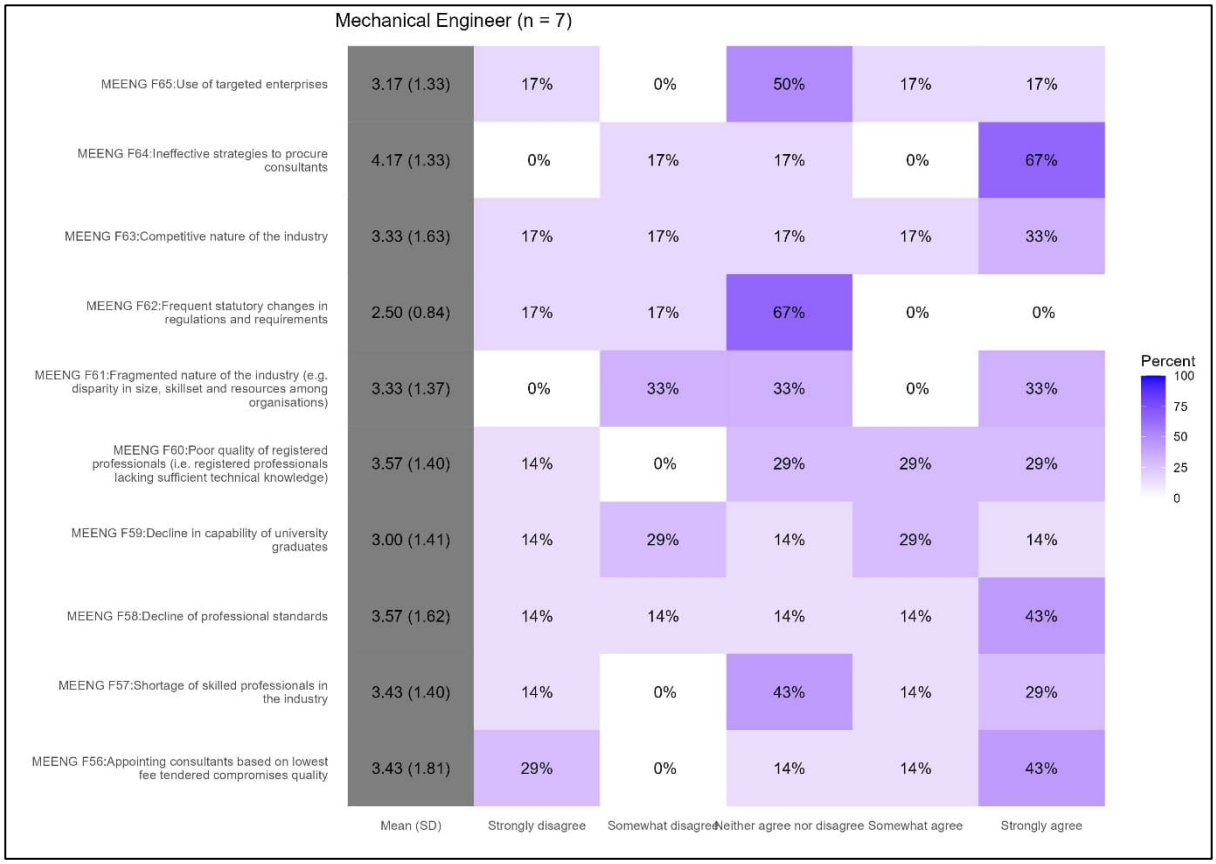


Figure 113: Heat map showing mechanical engineers’ distribution of agreement with industry factors

Figure 114 contains a stacked bar chart showing mechanical engineers’ distribution of agreement with industry factors. MEENG F64 (67%) was the top factor with the highest level of agreement among participants. On the other hand, MEENG F62 (0%) contained the lowest level of agreement. MEENG F62 also had the highest percentage of participants selecting

"neither agree nor disagree" (67%). Factors MEENG F60 and MEENG F57 had the lowest levels of disagreement of 14%. MEENG F59 had the highest level of disagreement at 43%.

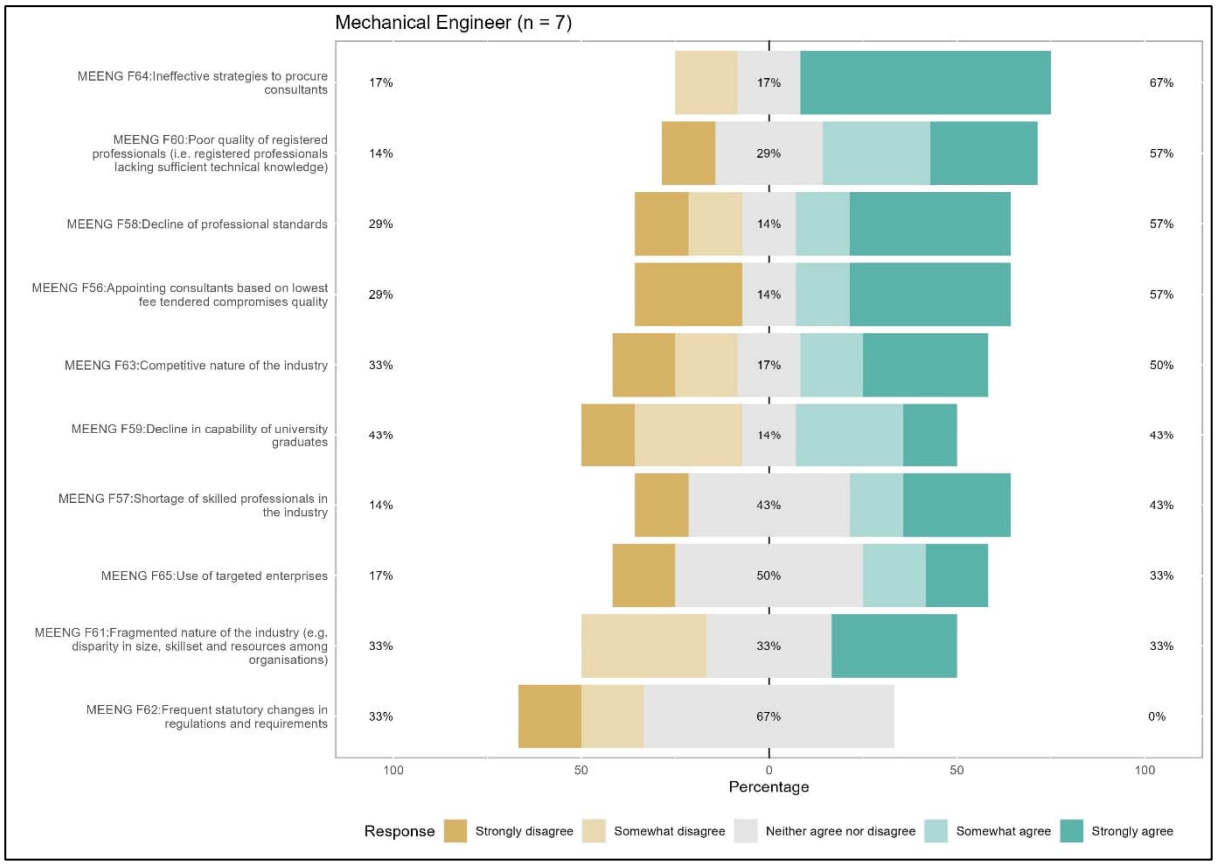


Figure 114: Bar chart showing mechanical engineers' level of agreement with industry factors

The figures below provide insights into industry factors that were most important to architects, based on their level of agreement. Figure 115 illustrates industry factors cited by mechanical engineers where "strongly agree" was selected by 50% or more of the participants. From a total of ten industry factors, only MEENG F64 (66.67%) satisfied this criterion.

Figure 116 shows industry factors cited by mechanical engineers where a combination of "strongly agree" and "agree" was selected by 80% or more of the participants. Only MEENG F58 (84.62%) satisfied this criterion.

Notably, none of the factors appeared in both figures.

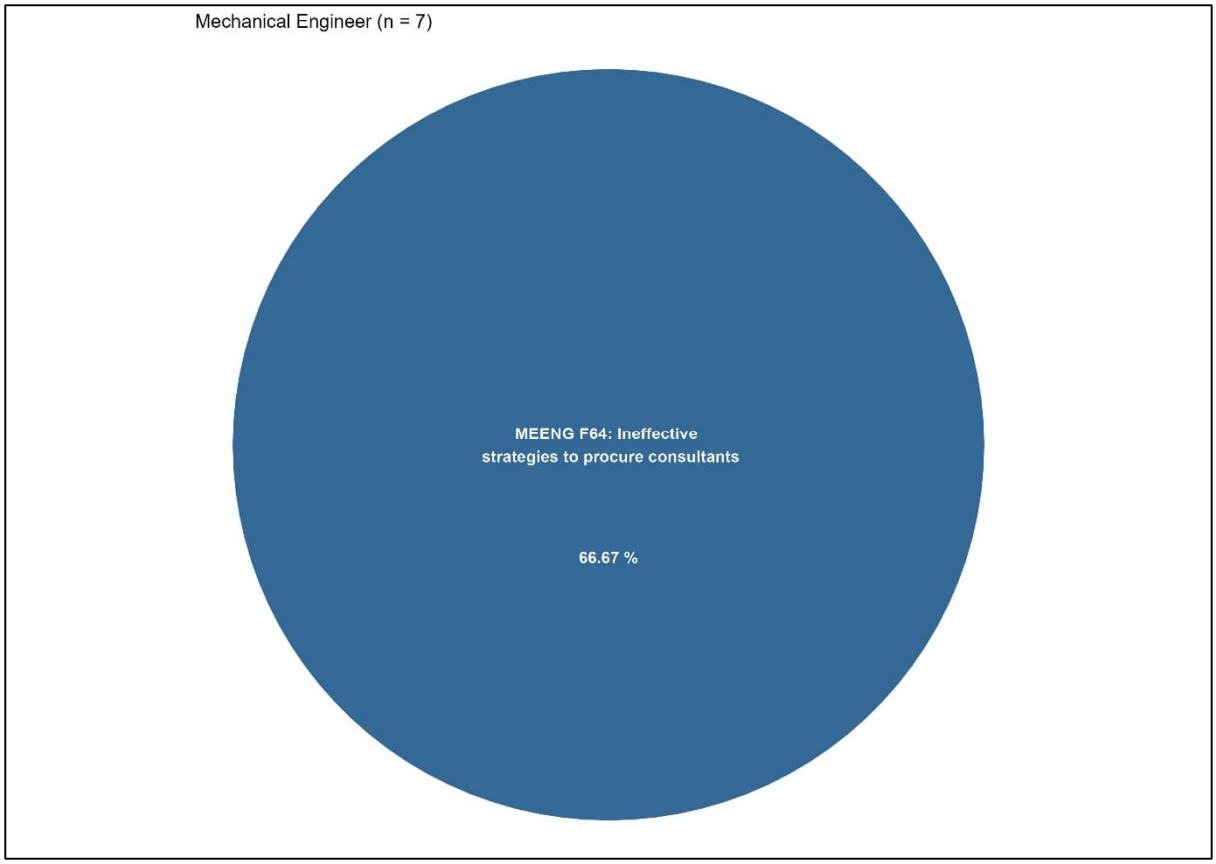


Figure 115: Industry factors where "strongly agree" was selected by 50% or more of the mechanical engineers

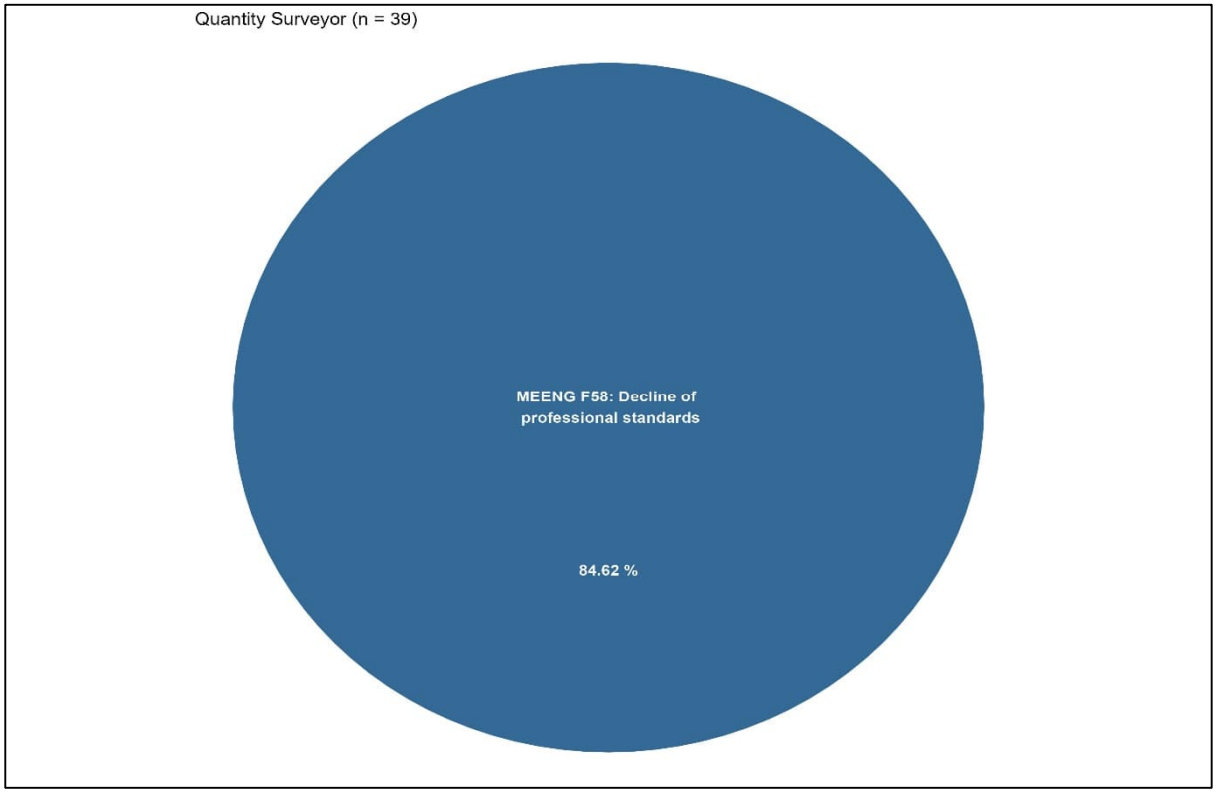


Figure 116: Industry factors where "strongly agree" and "agree" was selected by 80% or more of the mechanical engineers

4.2.6.5 Quantity surveyors

Figure 117 provides a heatmap with industry factors influencing the quality of PSOs and the distribution of agreement among quantity surveying participants. None of the factors received a "strongly agree" response by 50% or more of the participants. On the other hand, none of the factors generated a response of more than 10% for "strongly disagree". From the heatmap, it is evident that responses were mainly spread among "neither agree nor disagree", "somewhat agree" and "strongly agree". QS F58 (46.2%) and QS F56 (43.6%) generated the highest "strongly agree" responses while QS F62 (7.7%) and QS F61 (10.5%) generated the lowest "strongly agree" responses. On the other hand, QS F64 (5.3%), QS F62 (5.1%), QS F60 (5.1%) and QS F59 (5.1%) generated the highest "strongly disagree" responses while QS F58 (0%) had the lowest number of "strongly disagree" responses.



Figure 117: Heat map showing quantity surveyors' distribution of agreement with industry factors

Figure 118 contains a stacked bar chart showing quantity surveyors' distribution of agreement with industry factors. QS F58 (85%), QS F56 (77%) and QS F60 (69%) were the top three factors with the highest level of agreement among participants. On the other hand, QS F62 (31%), QS F57 (51%) and QS F59 (54%) contained the lowest level of agreement. Despite the aforementioned factors having the lowest level of agreement, only QS F62 contained a level of

agreement of under 50%. The factor with the lowest agreement (QS F62) had the highest percentage of participants selecting “neither agree nor disagree” (38%). The factor with the highest level of agreement (QS F58) had the lowest level of disagreement at 0%. Furthermore, the factor with the lowest level of agreement (QS F62) had the highest level of disagreement at 31%.

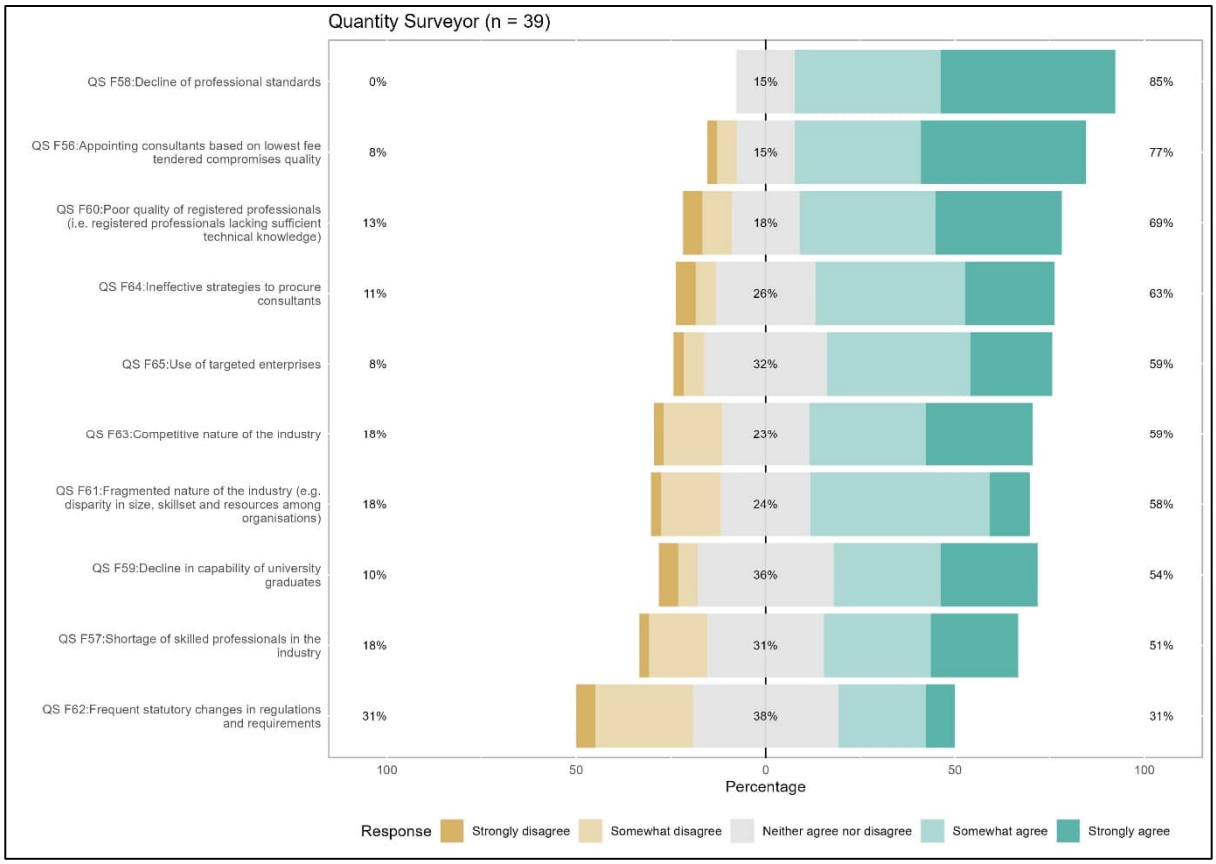


Figure 118: Bar chart showing civil engineers’ level of agreement with industry factors

The figure below provides insights into industry factors that were most important to quantity surveyors, based on their level of agreement. From a total of ten industry factors, none of the factors contained 50% or more “strongly agree” responses from participants.

Figure 119 shows industry factors cited by quantity surveyors where a combination of “strongly agree” and “agree” was selected by 80% or more of the participants. Only one factor satisfied this criterion, namely, QS F58 (84.62%).

Notably, none of the factors appeared in both figures.

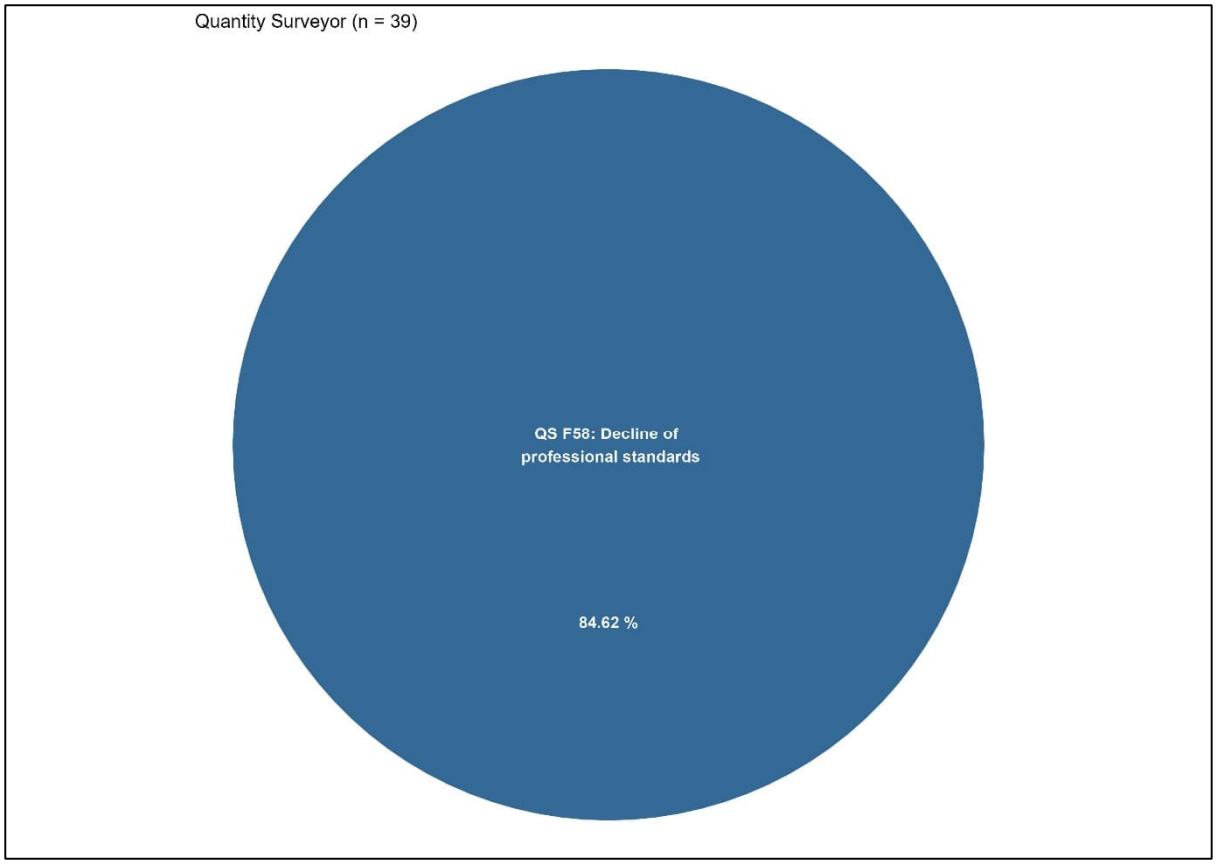


Figure 119: Industry factors where "strongly agree" and "agree" was selected by 80% or more of the quantity surveyors

4.2.6.6 Cross-discipline analysis

Three industry factors across disciplines had a high level of agreement, namely:

- F56: Appointing consultants based on the lowest fee tendered.
- F58: Decline of professional standards.
- F64: Ineffective strategies to procure consultants.

Factor F56 had the highest percentage of "strongly agree" responses for all disciplines except quantity surveying and mechanical engineering where it had the second-highest percentage of "strongly agree" responses. Factor F58 contained the highest percentage of "strongly agree" responses for quantity surveyors and the second-highest percentage of "strongly agree" responses for architects and mechanical engineers. Factor F64 had the highest "strongly agree" responses for mechanical engineers and the second-highest "strongly agree" responses for civil engineers and electrical engineers. Table 57 provides a percentage distribution of "strongly agree" responses per discipline.

Table 57: Discipline-specific percentage of "strongly agree" responses for industry factors

Factor	Percentage of "strongly agree" responses per discipline				
	Architect	**Civil/Structural Engineer**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity Surveyor**
F56	68%	76.2%	76.9%	43%	43.6%
F58	44.9%	42.7%	38.5%	43%	46.2%
F64	32.5%	52.6%	58.3%	67%	23.7%

Table 58 provides industry factors with a level of agreement (percentage of "somewhat agree" and "strongly agree") of 80% or more of the participants (per discipline). The electrical engineering discipline obtained a level of agreement greater than 80% for factors F56, F58 and F64. The civil engineering discipline obtained a level of agreement greater than 80% for factors F56 and F64. Factor 56 also achieved a level of agreement greater than 80% by the architectural discipline. The mechanical engineering and quantity surveying disciplines had a level of agreement greater than 80% for factor F58.

Table 58: Industry factors with agreement of 80% or more of the participants

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F56	88.8%	92.1%	92.3	-	-
F58	-	-	84.6%	84.6%	84.6%
F64	-	88.7%	88.3%	-	-

Table 59 illustrates factors that obtained 50% or more "strongly agree" responses and a level of agreement of 80% or more of the participants (per discipline). Factor F56 satisfied these criteria for the architectural, civil/structural engineering and electrical engineering disciplines. Similarly, the civil/structural engineering and electrical engineering disciplines also achieved the criteria for factor F64. Interestingly, all disciplines failed to obtain more than 50% of "strongly agree" responses and a level of agreement greater than 80% for factor F58.

Table 59: Industry factors with 50% or more "strongly agree" responses and a level of agreement equal to or greater than 80%

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F56	✓	✓	✓		

Factor	Architect	Civil/Structural Engineer	Electrical Engineer	Mechanical Engineer	Quantity Surveyor
F58					
F64		✓	✓		

4.3 Survey of Industry Experts

4.3.1 Data Collection

The survey of industry experts included structured interviews as the data collection technique. Importantly, industry experts participating in the interviews did not participate in the industry-wide survey. Interviews were held from 12 through 21 April 2022 and were conducted via MS Teams. Data from the interview were transcribed by the researcher and analysed with a combination of content analysis and thematic analysis.

The researcher identified at least one industry expert to represent each discipline. A total of nine industry experts with an average of 38 years of experience per participant were selected to participate in the semi-structured interviews. The experts had an appropriate depth of knowledge to comment on key factors influencing the quality of PSOs, validity of data emerging from the industry-wide survey and to provide feedback on the relationship between fees and the quality of PSOs. A summary of industry experts and their background is provided in Table 60.

Table 60: Summary of construction industry experts

Participant ID	**Registrations and qualifications**	**Years of experience**	**Discipline**	**Nature of experience**
IE 01	Pr Arch, B Arch and Diploma in Arbitration	42	Architectural (ARCH)	Professional architect running own practice with significant public sector project experience. Involved with a broad range of projects such as healthcare facilities; education facilities; civic centres and commercial and residential buildings. Extensive involvement with the SACAP and SAIA.
IE 02	Pr Eng, Pr CPM, MBL and BSc Eng (Civil)	50	Civil engineering (CSENG)	Senior civil engineer with experience in diverse water engineering and dam safety projects. Registered as an Approved Professional Person with the Dam Safety Office (DSO).
IE 03	CEng, MBA and BSc Eng (Electrical)	22	Electrical engineering (EENG)	Senior electrical engineer with experience in international projects. Currently focuses on commercial aspects of projects.
IE 04	Pr Eng, CEng, CEnv, PMP, MBL and BSc Eng (Mechanical)	51	Mechanical engineering (MEENG)	Experience in engineering, project management and construction of large projects in diverse industries locally and internationally. Involved in offshore oil and gas projects since 1983 including management of South Africa's first offshore gas development,

Participant ID	**Registrations and qualifications**	**Years of experience**	**Discipline**	**Nature of experience**
				sub-sea pipelines and marine structures internationally.
IE 05	Pr Eng, Ceng, Pr CPM and BSc Eng (Civil)	25	Civil engineering and project management (CSENG)	Experience locally and internationally in the management of multidisciplinary teams and engineering projects, with specific focus on water, wastewater and waste management infrastructure. Former director of a medium-sized consulting firm specialising in civil/structural engineering, project management and environmental services.
IE 06	Pr Eng and BSc Eng (Civil)	32	Structural engineering (CSENG)	Senior structural engineer with experience working in consulting and contracting, dealing with commercial and industrial structures.
IE 07	Pr Eng and BEng (Civil)	30	Structural engineering and quality management systems (CSENG)	Structural engineer with international experience. Now specialises in developing quality management systems for consulting engineering companies. Initial involvement with quality management systems in consulting engineering companies commenced in 1999.

Participant ID	**Registrations and qualifications**	**Years of experience**	**Discipline**	**Nature of experience**
IE 08	Pr QS, BSc (QS), MSc (QS) and PhD	40	Quantity Surveying (QS)	Senior quantity surveyor with commercial experience in various roles within consulting, contracting and government as Chief Quantity Surveyor.
IE 09	Pr Eng, MSc Eng and BSc Eng (Mechanical)	51	Mechanical engineering and multidisciplinary mechanical and electrical engineering projects (MEENG)	Senior mechanical engineering consultant with broad experience in multidisciplinary mechanical and electrical engineering projects. Served as managing director at a prominent mechanical and electrical engineering consulting company for 21 years. Actively involved with ECSA and CESA for the past 20 years to update fee scales.

Table 61 provides details regarding the dates and durations of various interviews. In total, 602 minutes of audio recording were captured.

Table 61: Summary of interview dates and durations

Participant ID	**Discipline**	**Date of interview**	**Duration of interview**
IE 01	Architectural	13 April 2022	87 minutes
IE 02	Civil engineering	14 April 2022	93 minutes
IE 03	Electrical engineering	20 April 2022	58 minutes
IE 04	Mechanical engineering	12 April 2022	61 minutes
IE 05	Civil engineering and project management	19 April 2022	59 minutes
IE 06	Structural engineering	12 April 2022	56 minutes
IE 07	Structural engineering and quality management systems	12 April 2022	58 minutes
IE 08	Quantity surveying	20 April 2022	72 minutes
IE 09	Mechanical engineering and multidisciplinary mechanical and electrical engineering projects	21 April 2022	58 minutes

4.3.2 Section 1: Key Factors Influencing the Quality of PSOs (Open-Ended)

Table 62 shows key factors influencing the quality of PSOs based on an open-ended question to industry experts, namely, “Based on your experience in industry, what are the key factors influencing the quality of PSOs?” The two factors with the highest frequency were the level of fees and competence of resources. Several experts highlighted concerns around consultants tendering for work at unsustainably low fee levels. Some experts (IE 01, IE 03, IE 08) indicated that if consultants were not running a financially sustainable operation, it would be difficult to deliver quality outputs.

Several industry experts (IE 01, IE 03, IE 04 and IE 06) also asserted that competence of resources was essential in producing quality PSOs. They mentioned it was important to have competent resources with relevant project experience working on projects. Several other factors were identified by industry experts as being key factors (e.g., availability of time, client competence, company culture, professionalism and review). The remaining factors (e.g., organisational structure, planning, procurement strategies by clients, shortage of skilled professionals, training, use of BIM or technology and workload) were each raised by only a single industry expert.

Table 62: Key factors influencing the quality of PSOs

Factors	**Participant ID**								
	IE 01	**IE 02**	**IE 03**	**IE 04**	**IE 05**	**IE 06**	**IE 07**	**IE 08**	**IE 09**
Availability of time	✓						✓	✓	
Client competence		✓			✓				
Company culture			✓						✓
Competence of resources	✓		✓	✓		✓			
Level of fees	✓		✓	✓				✓	
Organisational structure					✓				
Planning							✓		
Procurement strategies by clients		✓							
Professionalism					✓	✓			
Review						✓	✓		
Shortage of skilled professionals				✓					
Training	✓								
Use of BIM or technology	✓								
Workload			✓						

Table 63: Selected verbatim survey data extracts for key factors influencing the quality of PSOs

Key Factor	Verbatim data extract	Participant
Level of fees	*"The level of fees paid on a job. If you start eroding remuneration this has an impact on quality. Practices end up relying more on library-type information if remuneration is not appropriate."*	IE 01 (ARCH)
	"The level of fees charged by many companies is less but costs of running consulting companies are getting higher. Companies need to be financially sustainable to deliver a quality product... I think the micro businesses tend to be more profitable than the bigger businesses and have more ability to make their fees work."	IE 03 (EENG)
	"Fee discounts and the horror stories of 50 and 60% discounts. You cannot give a comprehensive service with such a high discount. You see it in the bill of quantities being produced where people don't measure extensively anymore. Instead, they measure the basic items and load the allowances for other items instead of measuring. It's not like in the old days where time was spent measuring all the items in the BoQ. Consultants also tend not to do a proper final account."	IE 08 (QS)
Client competence	*"There has also been the disappearance of the City Engineer. Most municipalities and clients are filled with non-technical people that put together bids but a lot of the time they don't make sense. It is deeply concerning that in most meetings, public sector clients fail to understand the technical complexities of projects. In most cases, engineers and projects are being controlled and driven by non-technical people – this is a fundamental problem. As engineers, our position in society has slipped."*	IE 02 (CSENG)
Company culture	*"Companies that have a strong culture and sense of pride in their work will not allow deliverables to be issued if they do not meet the required levels of quality. I personally don't think quality systems add any value. You can't take a company with bad culture and give them ISO 9001."*	IE 03 (EENG)
Organisational structure	*"It's not about the level of staff that's doing the work, it's about an integrated approach of delivering a product and effective quality management during the delivery of that product."*	IE 05 (CSENG)
Professionalism	*"Professionalism and the way that you approach each project (i.e., the attitude that you have when it comes to delivering a quality product)."*	IE 06 (CSENG)
Time	*"Deadlines are shorter which result in companies failing to implement plans to deliver projects. One of the reasons for a failure to do planning and checking is there's just no time. Consultants are driven by clients and they have*	IE 07 (CSENG)

Key Factor	Verbatim data extract	Participant
	to cut costs and deliver with these really tight timeframes."	

4.3.3 Section 2: Client Factors

Table 64 shows key client factors influencing the quality of PSOs. Significantly, industry experts unanimously agreed that "client selection of consultants based on low fees" was a key factor. One expert (IE 03) asserted that when fees were "too low", consultants may take shortcuts due to inadequate budgets being available to undertake tasks on projects. Another expert (IE 01) mentioned that it was difficult to reinvest back into the profession when fees were reduced on projects.

The second-highest cited client factor was "unrealistic time expectations". One expert (IE 06) mentioned that lack of time results in tasks being undertaken in parallel, which may cause rework if adequate coordination is not performed. Another expert (IE 05) asserted that lack of time was often due to clients that delayed implementation of projects for years, when those projects hit the market, they are urgent and need to be delivered rapidly. This sentiment was shared by another expert (IE 03) who works in both the South African and UK markets. He mentioned that projects in the UK generally spend more time in the design stages.

"Client's insistence to commence procurement and construction stages before signing off detail design", "numerous changes to project requirements or scope by the client" and "poor brief prepared by the client" were the remaining key client factors cited by industry experts. Two industry experts (IE 05 and 08) mentioned that the insistence to move onto subsequent project stages without signing off on detail design was partly due to a lack of planning resulting in expedited projects. Industry experts mentioned that a lack of knowledge (IE 01, 02, 05 and 06) among clients was one of the core reasons for numerous changes to project requirements and poor client briefs.

Table 64: Key client factors influencing the quality of PSOs

Factors	**Participant ID**								
	IE 01	**IE 02**	**IE 03**	**IE 04**	**IE 05**	**IE 06**	**IE 07**	**IE 08**	**IE 09**
Client selection of consultants based on low fees.	✓	✓	✓	✓	✓	✓	✓	✓	✓
Client's insistence to commence procurement and construction stages before signing off on detail design.	✓				✓			✓	✓
Numerous changes to project requirements or scope by the client.		✓			✓				✓
Poor brief prepared by the client.		✓		✓	✓				✓
Unrealistic time expectations.			✓		✓	✓		✓	✓

Table 65: Selected verbatim survey data extracts for key client factors influencing the quality of PSOs

Key client factors	Verbatim data extract	Participant
Client selection of consultants based on low fees	*"This is a massive negative in the industry, I know it and experience it. It is also evident when tendering for clients who do not understand the industry well and are bound to procurement checklists. Appointing based on lowest fee tendered is eroding the profession. Built into the fee amount is capacity of the firm to plough back into the profession. But this becomes difficult when bid evaluation is based on price."*	IE 01 (ARCH)
	"On multidisciplinary teams, if the fee is too low, consultants end up cutting corners and this may result in rework and negatively affect the different disciplines in the team."	IE 03 (EENG)
Client's insistence on commencing procurement and construction stages before signing off on detail design	*"Best practice protocol that SACAP publishes is not being followed and clients are jumping project stages. This is facilitated by computer-generated imagery where you can see the final constructed project at an early stage in the project."*	IE 01 (ARCH)
Poor brief prepared by the client	*"Most clients don't allow the engineer to express any opinions on whether the client's idea of what needs to be done is correct or not."*	IE 02 (CSENG)
Unrealistic time expectations	*"We operate in South Africa and the UK and we see that South African projects go a lot faster than the UK projects which will spend a lot more time in the design phase and getting the documentation right before it goes to construction."*	IE 03 (EENG)
Numerous changes to project requirements or scope by the client	*"Some clients don't know what they want, they don't undertake feasibility studies to adequately scope a project. This is also related to the lack of knowledge among public sector clients nowadays."*	IE 05 (CSENG)

4.3.4 Section 3: Company Factors

Table 66 shows key company factors influencing the quality of PSOs. "Project resources that lack skill or experience" was the highest cited key company factor by industry experts. Several industry experts (IE 02, 03 and 09) asserted that there was a general lack of experienced professionals in the industry. Two experts (IE 06 and 08) indicated that companies were taking a lower number of skilled or experienced resources due to budgets on projects being low and not having significant funds to employ experienced resources. One expert (IE 07) indicated that due to the pressure to deliver, lots of younger or less-experienced resources were taking on complex work they should not be doing (due to their inexperience), to compound this problem they were not being adequately supervised by experienced professionals.

"Training of project resources" was the second-highest cited key company factor. Two experts (IE 06 and 07) asserted that training of resources was essential to obtain quality PSOs and deliver on time. IE 03 mentioned a perceived decrease in spending on training in the industry. One expert (IE 09) stated that more training was required on non-technical aspects of the job as many students exiting university had technical skills but were not adequately equipped with the soft skills required in the industry.

The remaining factors were "project resources that are overloaded" and "company's professional experience". Two experts (IE 03 and 08) indicated that overloading resources may be inevitable in some instances where companies are unlikely to turn down work, especially in a competitive environment with reduced profit margins on projects. One expert opined that it was management's responsibility to ensure that resources were not overloaded. In terms of a company's professional experience, IE 05 mentioned that in the past companies bid for work in their area of specialisation. Nowadays due to competition, many companies bid for all projects even if they do not have adequate prior experience. This is problematic when companies are awarded projects but do not have the resources with the necessary skills to execute the project.

Table 66: Key company factors influencing the quality of PSOs

Factors	**Participant ID**								
	IE 01	**IE 02**	**IE 03**	**IE 04**	**IE 05**	**IE 06**	**IE 07**	**IE 08**	**IE 09**
Project resources that lack skill or experience.		✓	✓	✓		✓	✓	✓	✓
Overloaded project resources.			✓					✓	✓
Company's professional experience.			✓		✓				
Training of project resources.			✓	✓		✓	✓		✓

Table 67: Selected verbatim survey data extracts for key company factors influencing the quality of PSOs

Key company factors	**Verbatim data extract**	**Participant**
Company's professional experience	*"Consultants tend to tender for everything. Previously you would tender in your area of specialisation but now to keep a company profitable you need to tender for everything. Then once you are appointed on certain projects, resources in your company are not skilled for that particular scope of project. If appropriately skilled resources are not recruited quality will suffer."*	IE 05 (CSENG)
Project resources that lack skill or experience	*"There's a general lack of experienced people and this may be associated with the brain drain that's happening both with people leaving the country as well as with people leaving the industry. I think there is a shortage of very experienced and good professionals in certain sectors."*	IE 03 (EENG)
Overloaded project resources	*"That's certainly a case and I think that is a function of too many projects, which is a function of not generating appropriate fees."*	IE 03 (EENG)
	"If there's a lot of work coming into your company, you as a professional are not going to refuse it. Everybody is overloaded and they are reluctant especially in today's climate to appoint extra people."	IE 08 (QS)
Training of project resources	*"I think it's a key factor because you have to know your industry. You have to also train people in a certain way to ensure they are able to do the job. In recent contracts, they put a youngster who has no experience, and ask him to do things that he is not trained for. That is a problem in terms of the skills that you put on the project."*	IE 04 (MEENG)

4.3.5 Section 4: Professional Factors

Table 68 shows key professional factors that influence the quality of PSOs. The highest cited factor was “failure to review work of subordinates”. A few industry experts (IE 02, 03, 08 and 09) mentioned that on some projects, PSOs prepared by less-experienced resources were issued without being adequately reviewed before submission due to tight deadlines. Three industry experts (IE 02, 05 and 06) asserted that the onus was on professionals to guide and review the work of subordinates before PSOs were issued. IE 03 mentioned an imbalance in the ratio of experienced professionals and junior resources in South Africa, which resulted in an increased workload on professionals and impacted their availability to review PSOs.

The remaining factors were all cited equally by industry experts as being key factors influencing the quality of PSOs. Two industry experts (IE 01, 02) mentioned that “technical knowledge of built environment professionals” was a key factor and important in ensuring that quality PSOs were produced. However, two industry experts (IE 02 and 07) also stated that technical knowledge goes together with experience and having a blend of knowledge and experience when producing PSOs was important.

Two industry experts (IE 04 and 05) mentioned that coordination and integration were two important project management aspects that needed to be conducted. Industry experts asserted that proactively managing these two factors was essential for the production of good-quality PSOs. IE 09 stated that coordination and integration were dependent on the team leader who was responsible for ensuring that coordination and integration activities happened. Three industry experts (IE 04, 05 and 09) highlighted communication among the project team as essential to ensuring the production of quality PSOs.

Table 68: Key professional factors influencing the quality of PSOs

Factors	**Participant ID**								
	IE 01	**IE 02**	**IE 03**	**IE 04**	**IE 05**	**IE 06**	**IE 07**	**IE 08**	**IE 09**
Technical knowledge of built environment professionals.	✓	✓					✓		
Failure to review the work of subordinates.		✓	✓		✓	✓		✓	✓
Coordination with other disciplines.				✓	✓				✓
Integration with other disciplines.				✓	✓				✓
Communication among the project team.				✓	✓				✓

Table 69: Selected verbatim survey data extracts for key professional factors influencing the quality of PSOs

Key professional factors	**Verbatim data extract**	**Participant**
Technical knowledge of built environment professional	*"The more technical knowledge, you've got, the better you will be at your job. But knowledge and experience go hand in hand. You need to know how to use your knowledge. If you don't have enough experience to use the knowledge you have then that can also be a problem."*	IE 02 (CSENG)
Failure to review the work of subordinates	*"I know it is a problem based on what I've been receiving from other consultants and even in our own company. A lot of stuff is going out because it's been delegated to a lower-level person without experience to do the job. But then it also hasn't been properly reviewed before being sent out for construction or for information."*	IE 02 (CSENG)
	"If you getting junior resources to do work, number one, you need to explain to them what to do in terms of systems and making them aware of reference documents. You need to guide them through the design and be there for them every step of the way. Then you need to review the work. Sometimes the level of review may not be satisfactory as senior staff have other priority projects."	IE 05 (CSENG)
Coordination with other disciplines	*"This totally depends on the team leader, because somebody has to take a leadership role to ensure that coordination happens. That's not only technical coordination of drawings, but it's coordination of all activities. So whoever's running the project has a vital role to play, and it's certainly a key factor."*	IE 09 (MEENG)
Integration with other disciplines	*"Absolutely a key factor because that can easily go wrong if each discipline works in a silo without talking to the other disciplines."*	IE 09 (MEENG)
Communication among the project team	*"The project manager must facilitate discussion between the parties or disciplines to ensure there is alignment on the project."*	IE 05 (CSENG)

4.3.6 Section 5: Industry Factors

Table 70 shows key industry factors that influence the quality of PSOs. The key industry factor cited by industry experts was the appointment of consultants based on the lowest fee tendered. IE 05 mentioned that profit margins significantly decreased since the 1980s and 1990s. The current perceived low levels of fees were viewed as unsustainable by several industry experts (IE 01, 02, 03). IE 03 supported this viewpoint, stating that a gradual degradation of the quality of PSOs would be observed in the industry due to reduced fees. IE 05 mentioned that when fees were "low" the consultant was unable to absorb changes, especially if PSOs required revisions. One expert (IE 01) stated that projects with low fees placed a burden on consultants to produce the same quality PSOs on those projects that are generally produced at "normal or higher" fees. This typically required extracting more from resources i.e., working longer hours. IE 04 and 05 stated that inappropriate or "low" fees may cause consultants to cut corners. Three industry experts (IE 06, 08 and 09) further asserted that reduced fees impacted the level (particularly experience) of resources deployed to projects, which influenced the quality of PSOs. IE 07 stated that reduced fees affected planning and reviewing work, which impacted the quality of PSOs.

The second-highest cited key industry factor was "ineffective strategies to procure consultants". IE 01 and IE 09 indicated that the procurement system in South Africa was detrimental to the consulting engineering industry. IE 01 asserted that current public sector procurement systems (based on the lowest fee) caused inconsistent workflow in companies and negatively impacted a company's ability to maintain resources. This makes it difficult for companies to develop experience within their ranks. IE 02 stated that the public sector procurement system in South Africa was excluding competent companies from participating in projects. IE 05 asserted that globally, procurement for professional services was more focused on quality instead of price.

Declining professional standards were also cited by industry experts as a key factor influencing the quality of PSOs. IE 05 mentioned that low fees contributed to declining professional standards. Two industry experts (IE 08 and IE 09) indicated that the increase in professional indemnity claims was indicative of the decline in professional standards.

A shortage of skilled professionals was cited by two industry experts as a key factor influencing the quality of PSOs. IE 02 mentioned this was a problem based on the "brain drain" in South Africa where various skilled professionals are emigrating overseas.

Table 70: Key industry factors influencing the quality of PSOs

Factors	**Participant ID**								
	IE 01	**IE 02**	**IE 03**	**IE 04**	**IE 05**	**IE 06**	**IE 07**	**IE 08**	**IE 09**
Appointing consultants based on lowest fee tendered.	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ineffective strategies to procure consultants.	✓	✓			✓				✓
Shortage of skilled professionals.		✓	✓						
Decline of professional standards.					✓			✓	✓

Table 71: Selected verbatim survey data extracts for key industry factors influencing the quality of PSOs

Key industry factors	Verbatim data extract	Participant
Decline of professional standards	*"There's definitely a decline in standards, I'm more interested in why this has happened. I spoke to a colleague, and he said the number of complaints, against consultants' professional indemnity insurances has skyrocketed over the last two years. This has to do with professionalism – it seems that people just don't care anymore and that is unfortunate."*	IE 08 (QS)
Shortage of skilled professionals	*"This is definitely a problem. The reason I know that is the number of people emigrating. In a thriving population, you would look at the immigration numbers of engineering and technical staff into the country. However, in South Africa, it's exactly the opposite. A lot of our engineers have gone to New Zealand, Australia, Canada and to some extent UK. They are spread all over the place. In South Africa, we are experiencing a major brain drain."*	IE 02 (CSENG)
Ineffective strategies to procure	*"Most of the world uses Quality Cost Based Selection to procure consultants. However, in South Africa, few clients are knowledgeable about technical quality which is impacting on appointment of competent consultants. The procurement system in South Africa may not be flawed but implementation of the system is probably flawed."*	IE 05 (CSENG)
	"It is a problem and I don't think the current system is working. The way that professionals are being appointed is incorrect and not good for South Africa."	IE 09 (MEENG)

4.3.7 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

There was a consensus among most participants that the level of fees impacted the quality of PSOs. IE 03 stated that low fees impacted the quality of PSOs over time. IE 05 mentioned that the impact of fees on the quality of PSOs was dependent on the size of the company while IE 01 stated there was generally no margin for error on projects with low fees since those projects included limited budgets and time constraints. IE 04 and IE 05 asserted that when fees were too low, consultants absorbed costs by cutting corners to accommodate reduced fees and profit margins. IE 03 and IE 09 mentioned that generating insufficient revenue and low profit margins due to the level of fees could impact hiring experienced resources and quality of PSOs, as available resources (within the fee requirement) may not be well equipped to deliver on projects. On the other hand, IE 02 mentioned that the level of fees may not have much impact

on professionals who were not motivated by profit and rather wanted to give back to the industry.

IE 01, IE 05 and IE 09 asserted that services such as value engineering were generally omitted when delivering projects on reduced fees due to the need to design more quickly. IE 01, IE 06 and IE 07 also mentioned that more reliance was generally placed on contractors' experience and technical knowledge to mitigate issues related to PSO quality. This is problematic in South Africa where several experienced contractors no longer operate and many emerging contractors are still developing their skills and expertise.

IE 06, 07, 08 and 09 asserted that projects with low fees generally use less-experienced resources without sufficient support. Senior resources were only involved in a review role. This may impact the quality of PSOs, especially if senior resources do not have adequate time to undertake detailed reviews. This was supported by IE 07 and IE 08, who mentioned that resources did not have adequate time to comprehensively review deliverables on projects with low fees, which can have detrimental impacts on the quality of PSOs.

Interestingly, IE 07 mentioned that some companies took on projects with lower fees as a marketing exercise to obtain new clients. In these instances, quality PSOs must be produced regardless of the fee, to ensure the client is satisfied and improve the likelihood of getting future work.

Table 72: Selected verbatim survey data extracts on the impact of fees on the quality of PSOs

	Verbatim data extract	**Participant**
Level of fees	*"It places a huge burden as you are trying to produce the same quality of services that you would with a normal fee but for less. You end up extracting more from staff. They must work longer hours to render the same quality. You no longer have the luxury to spend on training. Your risks grow and your capacity to build and develop your resources is constrained. The problem is it's not sustainable."*	IE 01 (ARCH)
	"If you have a company in a "cash cow" position they can moderate their margins because they have cash available to sustain the business. But if you're a large company managing a project on a fee that is too low, it would be really hard to manage so that the loss wasn't too significant. It becomes a sustainability issue if you continuously have projects running at a loss."	IE 02 (CSENG)
	"If you went to a company and looked at ten of their projects and one of them had a bad fee but nine of them	IE 03 (EENG)

	Verbatim data extract	Participant
	had normal fees. I don't think you'll see a correlation between that project having bad outputs and the rest being fine. It's more over time if all your projects are being implemented on reduced fees, then quality within the company on all the projects will suffer. The decline in quality will happen over years on multiple projects as opposed to on one project. This trend will also be prevalent in the industry as a whole."	
	"You know in my field you actually build up the man hours and cost the man hours to determine your fee. Thereafter, you include a profit. Where the consultants have a table of fees to determine their fee is not built from the basics. You must build from the basics to actually get an appropriate fee and I believe that is a problem with consultants at the moment."	IE 04 (MEENG)
	"If you have been appointed with a significantly reduced fee, you have no option but to use less-experienced resources to do the work. You can't afford to have the experienced staff working on the project, so you try and get less-experienced staff doing 80 to 90% of the works and then only an input of 5 to 10% from a senior resource. That impacts on outputs because it isn't enough time to do detailed checking."	IE 06 (CSENG)
	"As an organisation, we used to take on projects with low fees, but it was purely as a marketing project and so maybe it's a new client that you want to break in with. You then take on a specific project, and even though the fee was low, we knew that we had to perform even though you may make a bit of a loss on the project. But there was a strategy in place, where we understood that the initial project would not be profitable but in the long term, we would have profitable projects with that client. So sometimes tendering with a low fee can be a strategic decision."	IE 07 (CSENG)

4.3.7.1 Professionalism

IE 02 and IE 03 asserted that the level of professionalism in the industry was directly related to the personalities of individuals working on projects, stating that some personalities will not allow a poor-quality product to be issued. IE 08 mentioned that every professional should conduct themselves professionally and it was the responsibility of the respective professional bodies to instil these values and professional attitudes in their members.

IE 04 posited that the current situation in the industry was dire and some professionals were desperate for work. However, IE 04 opined that professionals should theoretically deliver quality PSOs under their contract regardless of whether projects were generating a profit or

loss. IE 02 asserted that maintaining a level of excellence and professionalism becomes difficult especially when projects are not profitable, and professionals' standards of living are eroded.

IE 09 stated that firms have different opinions about professionalism. Some firms may lean towards a business-oriented approach and focus on strictly delivering within the level of fees that are tendered on projects with little or no flexibility for rework. IE 05 asserted that most professionals work for companies and are guided by their employers. These professionals have to listen to their managers and may be asked to engage in activities (e.g., spending less time on projects, using resources that may not have the requisite skills) that may compromise the quality of PSOs but are not construed as unethical by management.

IE 06 stated one of the reasons for the lack of professionalism in the industry was the lack of passion of people entering the profession. IE 06, IE 07 and IE 09 mentioned that those in the construction industry driven by money should still ensure that a level of professionalism is maintained.

Table 73: Selected verbatim survey data extracts on the role of professionalism

	Verbatim data extract	**Participant**
Professionalism	*"As engineers when you see your standard of living dropping because the industry is in a poor state, it is also difficult to maintain that level of professionalism and excellence in your job. One of the impacts of this is that consulting engineers often do not go far enough with their designs and rely on the contractor which in this country is part of the problems in the construction industry."*	IE 02 (CSENG)
	"I think engineers in particular and architects are very much similar where they're driven by their professionalism and their nature to please and solve problems. But then, even within that, you are obviously going to have a range of personalities and I think you see that in the industry as well you'll have certain engineers and companies who will refuse to do a bad job and not let something go out the door if it is not ready or not submit poor information to a client."	IE 03 (EENG)
	"People are desperate for work... You have to be professional in what you are doing, and your fee should not influence your quality. You must deliver to your client in terms of the brief and what has been agreed whether it costs you money or not."	IE 04 (MEENG)
	"All professionals do not own their own companies. Some professionals are employees of these companies	IE 05 (CSENG)

	Verbatim data extract	Participant
	and they have employment contracts. Professionals within these companies have to listen to their managers, where certain things may not be construed as unethical by management."	
	"I've found that professionalism is certainly creeping out of the industry."	IE 06 (CSENG)
	"We should be self-regulating as professionals. Every professional must conduct themselves in a professional manner. At the moment this is being eroded, perhaps due to the level of fees or pressure of work."	IE 08 (QS)
	"You will find in the country the different firms have different views on this and quite strongly different views … But if you haven't got that basic professionalism built into your DNA, I believe your quality has to fail and you will fail as an engineer and as a business."	IE 09 (MEENG)

4.3.7.2 Motivation of Built Environment Professionals

IE 01, IE 03 and IE 06 asserted that professionals are generally motivated to deliver quality PSOs regardless of the fee level on a project. IE 06 mentioned that the quality delivered by professionals was dependent on the attitudes of professionals. IE 06 further stated that if professionals did not act professionally, the fee level on a project was unlikely to change their behaviour.

IE 02, IE 07 and IE 08 supported the notion that professionals were motivated by fees to deliver quality PSOs. However, IE 02 mentioned that some professionals took on projects because they were interesting, and they wanted to give back to the industry and develop younger professionals. IE 08 mentioned that professionals needed an income to survive; hence fees and profitability on projects were important. IE 09 highlighted the perception in industry that younger professionals were motivated by money.

IE 04 mentioned that the motivation of professionals was linked to companies where professionals were employed. Many companies pride themselves in their outputs and want to deliver quality PSOs regardless of the level of fees. IE 05 asserted that the relationship between fees and the quality of PSOs was not a question of motivation but rather related to buying power. Consultants generally sell their time; therefore, only a limited amount of work can be undertaken depending on the fee and time available on projects.

Table 74: Selected verbatim survey data extracts on the motivation of built environment professionals

Sub-theme	Verbatim data extract	Participant
Motivation	*"But when they are appointed on a less realistic fee, I don't think that their motivation drops. However, to know that you are fully compensated provides a positive impact. Sustainability of rendering a good service is limited as level of remuneration drops."*	IE 01 (ARCH)
	"But when you look at smaller one-man outfits like myself, I am not that interested in the fee. I do projects because they're interesting and you know, I feel I'm helping the guys coming up by imparting some of my knowledge. I feel like a lot of the older guys would probably be willing to do that."	IE 02 (CSENG)
	"It's not a question of motivation. It is a question of buying power – how many hours did the client buy from you? In consulting it's about time. Although objectives are same for one- or two-hour job, the level of effort will be greater if you have an appropriate fee."	IE 05 (CSENG)
	"Fees almost overrule everything else and even if you are a professional and you try your best, at the end of the day you need to make a living.	IE 08 (QS)

4.4 Case Studies of Built Environment Consulting Companies

4.4.1 Data Collection

Case studies included semi-structured interviews as the data collection technique. A built environment consulting company from each discipline being investigated in the study was included. The architectural and civil/structural engineering disciplines included two companies as these two disciplines had the highest number of participants in the study and the researcher was able to identify two companies from each of these disciplines that were willing to participate in the study.

Interviews were arranged and confirmed via email. Interviews were held from 18 July through 9 September 2022 and conducted via MS Teams. Data from the interviews were transcribed by the researcher and analysed using thematic analysis.

Table 75 illustrates the profiles of the companies investigated in the study.

Table 75: Profile of companies participating in case studies

Case Study No.	Services	Approximate Staff Count	Estimated Turnover	Years of Operation	Client Profile
1	Electrical Engineering	Total = 16 (11 technical and	R12 million	36	Public: 70%

Case Study No.	Services	Approximate Staff Count	Estimated Turnover	Years of Operation	Client Profile
		five administrative)			Private: 30%
2	Mechanical Engineering	Total = 26 (20 technical and six administrative)	R25 million	21	Public: 50% Private: 50%
3	Civil/Structural Engineering	Total = 34 (26 technical and eight administrative)	R27 million	23	Public: 50% Private: 50%
4	Architectural	Total = 22 (20 technical and two administrative)	R15 million	23	Public: 5% Private: 95%
5	Quantity Surveying	Total = 120 (108 technical and 12 administrative)	R200 million	27	Public: 0% Private: 100%
6	Architectural	Total = 5 (four technical and one administrative)	R3 million	44	Public: 70% Private: 30%
7	Civil/Structural Engineering	Total (South Africa business) = 250 (238 technical and 12 administrative)	R450 million	101	Public: 40% Private: 60%

Within these companies, the technical lead responsible for the delivery of three projects was interviewed. Semi-structured interviews with the technical lead were conducted to obtain project-specific feedback about factors influencing PSO quality and to determine how and to what extent fees influenced the quality of PSOs on those projects. The technical lead was selected due to their intimate knowledge of project delivery and key factors impacting the quality of PSOs. Furthermore, they would know most of the challenges on projects that other members of the team may not know about due to their involvement in the project from start to end.

Additionally, a director of the company was also interviewed (using semi-structured interviews) to get an understanding of the company-related factors that may have impacted the

quality of PSOs on projects that were investigated. The director also provided specific commentary on the extent to which fees influenced the quality of PSOs on projects within their company and the industry in general. Table 76 provides a summary of interview participants per case study.

Table 76: Summary of interview participants per case study

Case Study No.	Interviewee	Professional Registration	Experience (Years)	Interview Duration (Minutes)
1	Technical Lead (Electrical Engineer)	Pr Tech Eng.	12	79
	Director	Pr Tech Eng.	20	36
2	Technical Lead (Mechanical Engineer)	Pr Tech Eng.	7	70
	Managing Director	Pr Tech Eng.	33	28
3	Technical Lead (Civil Engineer)	Pr Eng.	15	63
	Managing Director	Pr Eng.	23	34
4	Technical Lead (Architect)	Pr Arch.	23	57
	Managing Director	Pr Arch.	40	35
5	Technical Lead (Quantity Surveyor) and Director	Pr QS.	38	91
6	Technical Lead (Architect) and Managing Director	Pr Arch.	41	76
7	Technical Lead (Civil Engineer)	Pr Eng.	17	58
	Managing Director	Pr Eng.	25	20

4.4.2 Case Study 1 – Electrical Engineering (Company 1)

Table 77 provides a summary of the projects included in Case Study 1.

Table 77: Summary of projects in Case Study 1

	Project 1A	Project 1B	Project 1C
Project Scope	Provision of electrical	Provision of electrical engineering services	Provision of electrical

	Project 1A	**Project 1B**	**Project 1C**
	engineering services from inception to close out (as per ECSA Project Stage 1 – 6) for a new motor vehicle manufacturing facility. Electrical engineering installation including medium voltage (MV), small power and lighting.	from inception to close out (as per ECSA Project Stage 1 – 6) for a new battery manufacturing facility. Electrical engineering installation including medium voltage (MV), small power and lighting.	engineering services from inception to close out (as per ECSA Project Stage 1 – 6) for a new safety mask manufacturing facility. Electrical engineering installation including medium voltage (MV), small power and lighting.
Approximate construction value	R80 million (excl. VAT).	R150 million (excl. VAT).	R60 million (excl. VAT).
Approximate professional fee value:	Electrical engineering fees: 10% of the electrical engineering construction value.	Electrical engineering fees: 10% of the electrical engineering construction value.	Electrical engineering fees: 10% of the electrical engineering construction value.
Contracting strategy	Design by employer	Design by employer	Design by employer
Client Type	Public sector	Public sector	Public sector
Project status	Completed in 2021	Completed in 2021	Completed in 2022

4.4.2.1 Key Factors Influencing the Quality of PSOs

Theme 1: Quality control

Company 1 maintained an ISO 9001 accredited quality management system that prescribed quality processes in the company. Both the technical lead and director in the company highlighted the importance of following quality control processes during the production of PSOs on projects. Across the three projects, quality control was raised as a key factor impacting the quality of PSOs. The technical lead mentioned that all deliverables that were issued went through the company's quality control procedures. On the issue of quality control, the senior director of the company asserted the following:

"We have our own internal quality control policies … you've got to abide by the policies to get the required quality. So yes, that affects the quality that we put out."

One of the key components in the quality management process included a review of PSOs. PSOs were to be reviewed both by the originator of the PSO and by various competent individuals before they were issued to clients. Importantly, time was allocated to senior members of staff to undertake the review of each PSO. This process ensured that experienced staff members had sight of deliverables before their issue, even if they did not spend significant time on the project.

Both participants viewed the quality control system as a key component of maintaining quality on projects. Both the technical lead and director in the firm highlighted that even if other constraints were prevalent on projects, implementing a standardised quality process for all PSOs was a means of upholding project quality. This process aimed to minimise quality defects in PSOs and maintain overall project quality. However, as mentioned by the managing director, the amount of time spent undertaking reviews as part of this process was sometimes reduced due to short project programmes, which caused PSOs to be issued without a rigorous review process.

Theme 2: Resources

In the context of the case studies, resources refer to personnel and professional staff. The managing director mentioned that the company possessed over 35 years of experience in delivering consulting mechanical and electrical engineering services to both public and private sector clients in South Africa. The staffing profile of the company also included a high proportion of technical staff that were registered with the ECSA and other professional associations. This suggested that resources in the company had the technical competence to deliver projects.

The technical lead mentioned that from a resourcing perspective, all three projects were adequately resourced. The projects had a mix of mid-level and senior personnel. The mid-level personnel were responsible for most of the day-to-day work on the project. The project also included senior personnel who were responsible for client interface and liaison. Senior resources played an active role in guiding mid-level resources on the projects from a technical and management perspective. They were also responsible for ensuring that all PSOs being issued to the client were reviewed and internally approved before they were released for distribution to external stakeholders.

The technical lead and director in the company both indicated that resources were a key factor influencing the quality of PSOs. Having sufficient resources with requisite experience and competence was critical to ensuring that quality PSOs were produced. Furthermore, the quantum of resources within the company was also highlighted as being important when delivering projects. The director indicated that the availability of resources was important when planning for a project. In some instances when long-term projects were being delivered, sourcing additional resources to meet the demands of projects were assessed. The director posited the following regarding the allocation of resources on projects:

"Internally, we would look at resources. What you have to do, and what time and you know, how many people and it also depends on the service you provide … sometimes we look at long-term, long-term viability, if we do need somebody, then we would get a resource that would sit or stay with us for years, you know, long-term permanent employment. So the employment of a new long-term permanent resource would depend on whether a project was financially viable over the long term."

Theme 3: Time

Having adequate time to deliver projects was viewed as important to delivering quality PSOs. The technical lead asserted that the time provided on the three projects was sufficient to allow all the necessary processes to be undertaken before PSOs were issued on the three projects. This included allowing the design to be fully developed and optimised by the professional team. Even when changes were required by the end user, the client provided the professional team with adequate time to make the necessary changes. The time provided on the project also ensured that all PSOs that were produced were comprehensively reviewed by the senior team before being issued to the client. Following the reviews, staff on projects had the necessary time to comprehensively respond and address comments raised by the senior team within the company. This process of continuous improvement before issuing PSOs can only be comprehensively undertaken if adequate time is given to the professional team. The time allocation in Projects 1A, 1B and 1C shows that when teams are comprised of competent resources and have been given adequate time to deliver, it is more likely that quality PSOs will be produced.

Both the technical lead and director agreed that the amount of time available on projects was a key factor influencing the quality of PSOs. The director mentioned where sufficient time was not provided on projects, key processes in the production of PSOs such as peer review were

conducted in shorter periods, which can negatively affect quality. The director asserted the following:

"So just because sometimes we are really constrained that the only option we've got is to deliver on time, we don't have the two days for peer review. That can make a difference in terms of the quality we put out. "

The sentiments above reflect that having adequate time was closely linked to the extent to which staff on projects were able to follow quality control processes. Insufficient time was a likely cause that certain activities in the production of PSOs were not performed as rigorously and robustly as required. This was a potential contributor to quality-related issues.

4.4.2.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

The technical lead indicated that the level of fee tendered did not impact the quality of PSOs for the three projects that were investigated. The company pricing strategy entailed tendering fees at a "reasonable" level that allowed the company to render all the necessary services to complete the job. The technical lead stated the following:

"Our strategy is not going too low so that we don't have to reduce our services unless it's agreed upfront with the client."

The strategy adopted by the company in Projects 1A, 1B and 1C highlighted the importance of calculating an appropriate fee, which ensures the company can deliver the project. Discussions with the technical lead suggested that the level of fees for the various projects did not impact the management of the various projects. Furthermore, the fee level of 10% did not seem to impact the quality of resources that were deployed on the three projects.

From a people perspective, the technical lead stated that the level of fees on projects was a motivator for project teams and may impact the attitude of the team. The technical lead asserted the following:

"Projects have an energy. On projects, teams often pull together to deliver but sometimes when fees are too low the attitude of the team is not as positive as should be."

On Project 1B, the technical lead stated that there was discontent among the team due to continuous revisions of the tender documents being requested by the end user. Despite the discontent, the team still ensured that they completed PSOs to an acceptable level of quality

and only approached the client for additional fees after PSOs were completed and approved. In this instance, quality PSOs were produced despite a lack of agreement on the fees. This highlights the level of professionalism of the staff working on the project to deliver regardless of the fees.

The director of the firm believed that a certain acceptable minimum level of quality should be produced on projects regardless of the fee level. The director mentioned that the company did their best on projects whether big or small as it was important for them to maintain their reputation. The director stated the following:

"It's actually a company kind of principle. You've got to do your best whether the job is a small one or a big one. You retain your reputation based on what you do."

From a business perspective, the director suggested that the company gave more attention to projects where larger fees were provided. However, this did not necessarily imply that the company delivered other projects poorly. The director mentioned the following:

"You would pay more attention to where you've been compensated better than you would to less compensation, it doesn't mean that you are slack on the job and the like, but you tend to pay more attention."

Typically, attention in the company was given to larger fee projects by allowing senior resources to spend more time working on those projects. Projects with lower fees involved allocating more time to junior staff. The deployment of junior resources and allocation of their time on projects was only done to ensure that the project was profitable from a business perspective. The director asserted the following:

"So you know, salaries obviously are benchmarked against experience, professional registration and the like so yes, you know, you don't want the guys who are expensive to work on the jobs that you know, are low paying, so we would tend to have maybe a junior person work on it, obviously with some review from someone senior. But again, it also builds experience for the junior person. So yes, that's just how we would play it, but it does not mean that we don't provide the service. It's just that we give a less-experienced person the opportunity to become experienced just because the remuneration is a bit lower."

Importantly, although less-experienced staff were given opportunities on projects with "lower" fees, experienced resources were still involved in line with the company's quality process, to ensure that PSOs issued were of acceptable quality.

In conclusion, the company director was adamant that the quality of PSOs was not impacted by the level of fees due to internal quality control processes used in the company. The director stated the following:

"I think with our internal quality control system, there is a level of quality that we provide that doesn't change, regardless of the size of project or the amount of fees that we receive. There is a level of quality that just doesn't change. We've got a standard for documentation and there is no way you can water it down just because you are being paid less … It doesn't really affect the quality that we put out. We might just have a less-experienced person doing it or spending more time on it instead of a more experienced person."

4.4.3 Case Study 2 – Mechanical Engineering (Company 2)

Table 78 provides a summary of the projects included in Case Study 2.

Table 78: Summary of projects in Case Study 2

	Project 2A	**Project 2B**	**Project 2C**
Project Scope	Provision of mechanical engineering services from inception to close out (as per ECSA Project Stage 1 – 6) to replace the HVAC system on an existing campus consisting of a multi-storey office building and a few other minor buildings.	Provision of mechanical engineering services from inception to close out (as per ECSA Project Stage 1 – 6) to replace the HVAC system in an existing multi-storey office building.	Provision of mechanical engineering services from inception to close out (as per ECSA Project Stage 1 – 6) to replace the HVAC system in an existing multi-storey office building.
Approximate construction value	R30 million (excl. VAT)	R19 million (excl. VAT)	R20 million (excl. VAT)
Approximate professional fee value:	Mechanical engineering fees: 7% of the mechanical engineering construction value	Mechanical engineering fees: 10% of the mechanical engineering construction value	Mechanical engineering fees: 12% of the mechanical engineering construction value
Contracting strategy	Design by employer	Design by employer	Design by employer
Client Type	Public sector	Public sector	Public sector (outside of South Africa)
Project status	Completed in 2020	Completed in 2022	Completed in 2022

4.4.3.1 Key Factors Influencing the Quality of PSOs

Theme 1: Experience

The technical lead indicated that experience of resources was a key factor that influenced the quality of PSOs on all three projects. Within Project 2A, PSOs initially issued to the client contained several quality issues. The technical lead believed that the quality issues in the documents arose due to inexperienced staff involved in the project. The inexperienced staff developed inaccurate technical information that was subsequently used in the tender document that was submitted to the client for review. The technical lead mentioned the following:

"Experience was key like I told you. The guys who first compiled the documents, they were actually fresh out of school with very little knowledge and I would say experience did affect the quality of PSOs on the project very much. Even on my side, although I had a few years' experience, there were a couple of things that I hadn't encountered particularly on the chilled water system that we were dealing with."

On Projects 2B and 2C, the technical lead mentioned that he had acquired sufficient experience to deliver good-quality PSOs on both projects. By having the necessary experience, the technical lead was familiar with the engineering problem at hand and was able to draw on his knowledge from past projects to inform the delivery of Projects 2B and 2C. When identifying key factors influencing the quality of PSOs, the managing director asserted the following:

"The first point will be to have suitably qualified and experienced principal engineers that lead the project."

The managing director mentioned that having resources with appropriate experience leading projects was important as these resources set the direction of the project for the team. Having sufficient experience ensured that staff leading projects appreciate complexities and risks during project delivery, which can be overlooked by inexperienced resources.

Theme 2: Software

The use of appropriate software especially for producing models and drawings was highlighted as a key factor that impacted the quality of PSOs. The technical lead mentioned that on Projects 2B and 2C, the use of 3D modelling software assisted in improving the quality of PSOs (including BoQ and drawings) as the software automatically reconciled the design components and produced a BoQ. Modelling software assisted in the production of drawings and BoQ by

simplifying onerous tasks that typically need to be executed by the technical team e.g., extracting quantities and manually scheduling items.

On Project 2A, itemising design components and quantifying for the BoQ was undertaken manually as the 2D modelling software was unable to automatically generate quantities. This resulted in several errors in the BoQ. The technical lead stated the following:

"We were using AutoCAD at the time. The project was heavy on mechanical equipment as it's a chilled water system, it was a very big plant. The contractor was using Revit, so they exploited our drawings a lot because we did not design in 3D. A lot of items were missed in the BoQ because we were designing in 2D."

The technical lead mentioned that resources producing the BoQ for Project 2A did not have the requisite experience. Therefore, it was difficult for them to extract relevant items and quantities from the 2D model as the mechanical components in Project 2A were technically complex and needed experienced mechanical engineers to assist with this task.

The technical lead used the experiences from Project 2A to ensure that 3D modelling software was used on Projects 2B and 2C. The technical lead asserted the following on Project 2B:

"We've also learned that for a mechanical project, it is imperative to use a 3D design or a drafting software like Revit … We outsourced a Revit draughtsman, who did our design in 3D. So everything just went well. In terms of scheduling, the Revit software is very accurate. It calculates all the components in the system, and the compilation of the BoQ also becomes very easy and very accurate."

By using the 3D modelling software on Projects 2B and 2C, the project team simply needed to review the accuracy of output in the BoQ that was produced by the software. It also reduced the amount of time needed by the professional team to prepare the BoQ. From a drawings perspective, the 3D model ensured that the client could visualise the project before it was constructed.

4.4.3.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

The technical lead indicated that the level of fee did not impact the quality of PSOs on the three projects. The technical lead stated that once fees were agreed upfront by the company directors with the client, it did not influence the quality of PSOs in any way. The technical lead asserted the following:

"I don't think it had any impact. Those commercial details were discussed way before stage one of the project and it was agreed upon between the client and us. I don't think the fees had an effect on the quality itself, since it was something which was already agreed between all the parties."

The managing director expressed a similar view on the influence of fees on the quality of PSOs, he stated the following:

"Once we've submitted a fee proposal and we get awarded that project, we will not jeopardise the quality of the service. So the level of fee has no influence on quality."

The company's approach of not compromising quality after being appointed made the profiling of the project and determination of fees before appointment a critical function. The company ensured that comprehensive due diligence and risk profiling was conducted on a project before bidding. If the project was deemed suitable from a technical and commercial perspective, a bid was submitted. When bidding for new work, the company ensured that the fee tendered enabled the project to be delivered with an acceptable profit margin while maintaining the necessary level of quality. Since the determination of professional fees was carefully considered before project appointment, when bids were successful, the company knew they could deliver the project.

When discussing professional fee determination, the managing director mentioned that consultants in the industry were tendering at unsustainably low levels. The managing director further indicated that it was difficult to comprehend how some consultants were able to tender excessively reduced fees and still render all the services. When determining professional fees, Company 2 always ensured they could render all services required by the client – even with a reduced fee. The managing director stated the following:

"We do not prefer to give more than 35% discount, we lose a lot of bids because of that. We just believe once we've made the calculations, you can't do the various phases as prescribed in the engineering code and spend the required time on the project if you give more discount than that, it's just not possible!"

4.4.4 Case Study 3 – Civil/Structural Engineering (Company 3)

Table 79 provides a summary of the projects included in Case Study 3.

Table 79: Summary of projects in Case Study 3

	Project 3A	**Project 3B**	**Project 3C**
Project Scope	Provision of civil engineering services from inception to close out (as per ECSA Project Stage 1 – 6) for construction of a 900mm diameter outfall sewer pipeline 1.7km in length.	Provision of civil engineering services from inception to close out (as per ECSA Project Stage 1 – 6) for construction of a 600mm diameter outfall sewer pipeline 3km in length.	Provision of civil engineering services from inception to close out (as per ECSA Project Stage 1 – 6) for construction of a pump room and emergency water tanks.
Approximate construction value	R27.5 million (excl. VAT)	R26 million (excl. VAT)	R800,000 (excl. VAT)
Approximate professional fee value:	Civil engineering fees: 8% of the civil engineering construction value.	Civil engineering fees: 8% of the civil engineering construction value.	Fee value not available.
Contracting strategy	Design by employer	Design by employer	Design by employer
Client Type	Public sector	Public sector	Private sector
Project status	Completed in 2020	Completed in 2019	Completed in 2022

4.4.4.1 Key Factors Influencing the Quality of PSOs

Theme 1: Quality control

Company 3 maintained an ISO 9001 accredited quality management system that prescribed quality processes in the company. The technical lead and managing director both stressed the importance of conducting internal reviews on PSOs to maintain quality. The technical lead and managing director both shared the view that if processes outlined in the company's quality management system were followed during PSO production, the likelihood of issuing PSOs with deficient quality would be minimised. The company's quality management policy stated that those reviewing PSOs before distribution needed to be a senior member of the project team. Therefore, those senior members of project teams needed to have the necessary experience and competence to undertake a comprehensive review of PSOs.

The technical lead mentioned that "copy and paste" of items from one project to the next was commonplace in the civil engineering industry. However, having a quality control system

ensured that errors associated with "copy and paste" could be identified and addressed before PSOs were issued. The technical lead stated the following:

"Regrettably, I think that many tender documents are a case of copy and paste, especially with the civil engineering type of scenario … and that definitely affects the quality and the output."

On the three projects that were examined (Projects 3A, 3B and 3C), the technical lead indicated that many of the quality-related issues were identified through an internal review process before documents were issued to the respective contractors. Reviewers of PSOs were professionally registered and experienced personnel within the company, which meant that they had the skills required to identify quality-related issues. The technical lead stated the following about the review process:

"We were able to review the documents in-house and there we were able to sort out a lot of potential issues before the document went out to the contractor."

The quality management system in this case study shows that quality-related shortcomings can be identified before PSOs are issued, provided that those reviewing the PSOs have the necessary skills, expertise and time to carry out the review.

4.4.4.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

The technical lead indicated that fee levels on the three projects did not impact the quality of PSOs. The technical lead asserted that the quality of PSOs on the three projects would have been the same even if the fee levels were lower. The one aspect of project delivery that was influenced by the fee level was the number of site visits that were undertaken. The level of resource that was deployed to undertake site visits and the number of site visits could have been improved if a higher fee was paid. The technical lead stated the following:

"Even if our fee was lower we would have still delivered the same quality at the end of the day, but the fee also did determine how often we went to site. For instance, if a fee was maybe twice as much we would have been there every day almost, you know, we would have allocated more resources to do that. But the nature of the project and location of the projects and the way the construction progressed, it was only necessary to be there once a week, which suited us quite fine."

The technical lead believed that the quality of PSOs was within the control of the technical team. The technical lead opined that PSO quality-related issues could be reduced or eliminated

if projects were delivered under the requirements of the company's quality management system. Similarly, the managing director mentioned that the level of fee does not impact the technical aspects of PSOs. He mentioned that the same delivery process was followed to develop PSOs on all projects regardless of the level of fee charged. The managing director mentioned that internal errors arising during design development were not charged to the client. The managing director agreed with the technical lead that fee levels could be challenging during the construction stage of projects especially when the construction period drags on longer than anticipated. The managing director stated the following:

"Yes so on the technical side, very little difference, if anything. We really try to design efficiently and effectively and that's the skill we sell. We've also had a couple of fights on directors' level on that but that's something that I'm very adamant about, is to get the technical stuff right. We've had cases where the guys replot the same drawing 100 times until it's right, but that I won't charge to my client, because that's internal mistakes … Where we see the issue with the fees coming in is on the inspection side, stage five of our projects, where you run out of time or where the project starts dragging on or you get a contractor that's either incompetent or delayed."

The approach adopted by the managing director ensures that after the company is appointed on a project, quality PSOs are delivered regardless of the fee level. The managing director stressed that producing an efficient and effective design was a skill that the company sold clients; therefore, they needed to deliver quality PSOs once appointed.

4.4.5 Case Study 4 – Architectural (Company 4)

Table 80 provides a summary of the projects included in Case Study 4.

Table 80: Summary of projects in Case Study 4

	Project 4A	**Project 4B**	**Project 4C**
Project Scope	Providing architectural professional services from inception to close out (as per SACAP work stage 1 – 6) for a new luxury house.	Providing architectural professional services from inception to close out (as per SACAP work stage 1 – 6) for a new apartment block comprising of four apartments 200m^2 each.	Providing architectural professional services from inception to close out (as per SACAP work stage 1 – 6) for a new luxury house.
Approximate construction value	R50 million (excl. VAT)	R35 million (excl. VAT)	R20 million (excl. VAT)

	Project 4A	**Project 4B**	**Project 4C**
Approximate professional fee value:	Architectural fees: 5% of the construction value.	Architectural fees: 6% of the construction value.	Architectural fees: 10% of the construction value.
Contracting strategy	Design by employer	Design by employer	Design by employer
Client Type	Private sector	Private sector	Private sector
Project status	Completed in 2020	Completed in 2022	Completed in 2020

4.4.5.1 Key Factors Influencing the Quality of PSOs

Theme 1: Resources

The technical lead and managing director emphasised that having sufficiently experienced resources on projects was an essential part of producing quality PSOs. Consistency of resources particularly the resource leading the project (i.e., the lead architect) was a key factor impacting the quality of PSOs. The technical lead stated the following:

"One of the key factors that influenced the quality of PSOs on the project was having a dedicated project architect who saw the documentation through from beginning to end."

Projects 4A and 4B benefitted from having consistency of resources as the PSOs that were produced on both projects were an acceptable level of quality. Consistency of senior staff benefitted the team as they were given stability and clear direction as the projects developed.

Although the managing director agreed that resources on the project were an important factor influencing the quality of PSOs, he went further and stated that the quality of staff and management was vital. When referring to the quality of staff, the managing director elaborated that this would include aspects such as experience, expertise, fastidiousness and enthusiasm.

The managing director stated the following:

"I'd say the quality of staff and quality of management is a key factor. In other words, the level of expertise, the level of experience, the level of enthusiasm, the level of fastidiousness, because on the technical side of things, as you translate the design into technical elements, there's a degree of precision needed, and a degree of understanding needed. So the quality of staff is a critical function. The management is a critical function. Management of that staff is a critical function."

Theme 2: Quality control

The technical lead and managing director both highlighted the importance of getting PSOs checked during the production process. The technical lead mentioned that checking was carried out on all projects throughout the development of PSOs. On Project 4C, the technical lead asserted that the key factor impacting the quality of the tender document was the level of internal checking that was conducted. The technical lead indicated that the client's lack of trust during the project led to the project team placing extra scrutiny on deliverables that were subject to review.

"I suppose the extent of fastidious in-house checking of our drawings going out and the kind of mistrust from the client which caused us to question our work all the time."

The managing director acknowledged that the company did not have a formally documented quality management system in place. This was primarily due to overhead costs associated with managing such a system particularly as Company 4 was relatively small (i.e., fewer than 30 staff). The managing director mentioned that despite the lack of a formal quality management system, the quality process, which included rigorous internal review, was being undertaken at each project stage on every project. The reviews were undertaken by assigning various members of senior staff depending on their skill set (i.e., technical or commercial) to different stages of projects to undertake reviews. This ensured that the quality of PSOs was closely monitored throughout their production. The managing director stated the following:

"We have directors and associates that are skilled in their particular areas that oversee the project at appropriate times. What we don't have, what we haven't had for all these years is a properly documented quality assurance system. It's something that is really because up to a certain size of practice, you can't afford the overhead of people managing or running that piece of the business."

4.4.5.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

Although the technical lead asserted that fee levels influence the quality of PSOs, this was not supported by evidence on the three projects. The technical lead believed that the level of fees on a project directly impacted the resources deployed on the project (i.e., a higher fee would enable the deployment of more skilled and experienced staff on projects). Interestingly, the technical lead also stated that a higher fee would result in more accountability on projects. The technical lead stated the following:

"Fees and quality are completely related. 100% related. The more fees you have, the more accountability you feel and the better resources you can put on a project. When I say better, you know, people with more years' experience or stronger skills, you can allocate more of senior management level to a project which ensures a better output on the project."

The technical lead stated that the level of fees on Project 4B was lower compared to other projects the company was delivering at the time. The technical lead asserted that when fees were lower, less time was spent on the project compared to time spent on projects with higher fees. The technical lead asserted the following:

"So you know, we possibly didn't dedicate as much of our time to it, it does tend to get pushed to one side because the fees are smaller compared to other projects in the office which have larger fees."

Although there was a concern about quality being compromised due to less attention or time being allocated to lower-fee projects, the technical lead dispelled these concerns. The technical lead mentioned that standard practice within the company was to maintain quality standards even if the company was losing money. The technical lead stated the following:

"Quality wasn't compromised, even if we realise that we're losing money on a project, we still make sure that the drawings that are issued from our office are correct and right, even if we have to revise them."

The managing director also agreed that quality of PSOs did not deteriorate even when projects were not profitable. The managing director mentioned that the firm strived to maintain its professional standards regardless of the fees earned on projects, the managing director stated the following:

"You just do the work. If you're a professional, you do it properly and if your reputation counts, then you just do the work regardless of the fee."

The managing director further stated that when fees were underestimated, it placed pressure on the team. However, the firm still delivered the project following professional standards. The managing director believed that professionalism on projects trumped profitability stating:

"If the fee was underestimated then we are acutely aware of the fact that we're not achieving our targets, and it puts us under pressure. I'd like to think that in the main, I don't know if it's true – I think the fact is we generally, we shrug our shoulders and do the work because

professional standards – if you like – it trumps profitability. I mean I can tell you that there are projects where we have lost houses, where we have lost half a million rand – more, sometimes, over the course of the project. So we've paid for the privilege of being part of that project for 2 years. Literally paid!"

The managing director further mentioned that additional fees would allow the company to employ additional resources for activities such as the administration of a quality management system. This shows that the quality management process in the company would benefit from additional fees. The managing director asserted:

"If we could get more fees, we could for example implement and have someone manage quality assurance (QA) using a proper QA procedure, documented QA procedures. Similarly with CAD and BIM, if we had someone full-time, our BIM standards and BIM execution would be better."

4.4.6 Case Study 5 – Quantity Surveying (Company 5)

Table 81 provides a summary of the projects included in Case Study 5.

Table 81: Summary of projects in Case Study 5

	Project 5A	**Project 5B**	**Project 5C**
Project Scope	Providing quantity surveying services (inception to close out) for a new concentrator unit at a platinum mine.	Providing quantity surveying services (inception to close out) for a new chrome recovery plant at a chrome mine.	Providing quantity surveying services (inception to close out) to upgrade mechanical and structural infrastructure at an existing platinum mine.
Approximate construction value	R705 million (excl. VAT)	R750 million (excl. VAT)	R75 million (excl. VAT)
Approximate professional fee value:	Quantity surveying fees: Hourly rates were provided which amounted to approximately 0.5% of the construction value.	Quantity surveying fees: Hourly rates were provided which amounted to approximately 0.8% of the construction value.	Quantity surveying fees: Hourly rates were provided which amounted to approximately 1.5% of the construction value.
Contracting strategy	Design by employer	Design by employer	Design by employer

	Project 5A	**Project 5B**	**Project 5C**
Client Type	Private sector	Private sector	Private sector
Project status	Completed in 2022	Completed in 2021	Completed in 2022

4.4.6.1 Key Factors Influencing the Quality of PSOs

Theme 1: Available information

Quantity surveyors are highly dependent on information from other disciplines to inform their PSOs (e.g., BoQ). A lack of information or clarity about the scope of work adversely impacts the quality of PSOs. Scope definition is an essential part of project development and is critical for all built environment disciplines, especially quantity surveyors. Unclear scope results in unknowns in PSOs produced by quantity surveyors. These unknowns may manifest into bigger cost-related issues during construction. The technical lead stated the following:

"You know, the better the scope, the better the detail, the better the BoQ."

Directly linked to the definition of scope is the level of information available. The technical lead asserted that the provision of information was critical for the quantity surveying team to provide a comprehensive BoQ that fully described and itemised components of projects. Unclear or lack of scope definition leads to a lack of information availability, which impinges on the quantity surveyor's ability to produce quality PSOs. The technical lead was of the firm view that the BoQ was only as good as the information used to produce it. The technical lead stated the following:

"I think that the standard of detail provided by the engineer was a key factor … it's like anything, the better the information that you get, the better the output is, the worse the information that you get, the worse the output. We tend to be very involved with our engineers and we'll go and sit down and agree, if things are not on the drawings, we should put something in."

The quality of PSOs and project outcomes on the three projects showed that wherever the scope was not fully defined (i.e., Projects 5A and 5B) and information was unavailable there were issues with the quality of the BoQ during construction. In contrast, on Project 5C, where the scope was well defined and adequate technical information was available on drawings, there were fewer quality-related issues. The technical lead on Project 5C stated the following:

"I think the definition was really good. It made our life easier … it was as I say probably one of the best jobs that I've worked on, that we finished within budget and within time. Everybody was happy."

4.4.6.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

All projects that were investigated as part of this case study included rates-based appointments. This meant that Company 5 charged the client for their time by assigning each resource an appropriate rate (consisting, for example, of employees' cost to the company, overheads, and profits). As services were being rendered on Projects 5A, 5B and 5C, the client was invoiced for the time that Company 5 spent on the project. The technical lead indicated that the level of fee tendered did not impact the quality of PSOs on all three projects. From a quality perspective, the same level of quality control was undertaken on PSOs produced in Company 5 regardless of fee level.

On all three projects, although junior staff were doing the bulk of the work, there was sufficient oversight by experienced senior staff to ensure that quality was being maintained. The technical lead stated the following:

"At the end of the day, when you look at the size of the job, having two full-time QSs to do the work, and then me just managing it over, you know, as an oversight, the issues that you have is obviously, that the juniors aren't Pr QS. So they can agree the certificates and the cost reports and the letters and stuff, but I have to sign them."

Where the level of fee was insufficient and additional time was required on the project, the technical lead indicated that additional fees were negotiated with the client. This allowed the quantity surveying team to deploy the necessary resources and spend time on the project as required to ensure it was completed to the satisfaction of the client. The technical lead stated the following:

"Look at the end of the day our clients are reasonable. If you have a look at this job on the civils and the electrical, we had an extension of time … because we were on an hourly basis, we then just indicated, listen, Mr Client, you've given the contractor, a three-month extension of time, so then I'm going to need additional three months of my QS."

4.4.7 Case Study 6 – Architectural (Company 6)

Table 82 provides a summary of the projects included in Case Study 6.

Table 82: Summary of projects in Case Study 6

	Project 6A	**Project 6B**	**Project 6C**
Project Scope	Provision of architectural professional services from inception to close out (as per SACAP work stage 1 – 6) for a new municipal building.	Provision of architectural professional services from inception to close out (as per SACAP work stage 1 – 6) for a new municipal building and refurbishment of existing buildings.	Provision of architectural professional services from inception to close out (as per SACAP work stage 1 – 6) for a new building and associated infrastructure in a nature reserve.
Approximate construction value	R14 million (excl. VAT)	R35 million (excl. VAT)	R42 million (excl. VAT)
Approximate professional fee value:	Architectural fees: 6.75% of the construction value related to the architectural scope.	Architectural fees: 6.25% of the construction value related to the architectural scope.	Architectural fees: 6.5% of the construction value related to the architectural scope.
Contracting strategy	Design by employer	Design by employer	Design by employer
Client Type	Public sector	Public sector	Public sector
Project status	Completed in 2015	Completed in 2022	Completed in 2017

4.4.7.1 Key Factors Influencing the Quality of PSOs

Theme 1: Resources

The technical lead mentioned that one of the key factors influencing the quality of PSOs on projects was resources. The technical lead indicated that having sufficient resources available before executing a project was a critical part of ensuring quality PSOs. Company 6 assessed resources before submitting bids to determine if the company had suitable resources for the project being implemented. The managing director stated the following:

"If we tender or go for projects we know at that time with our current resources, we can handle it."

On Project 6A, the technical lead spoke about the importance of having a good team with the necessary resources to execute the project. The team on Project 6A previously worked together

on other projects where the respective team members displayed their skill and competence. This suggested that the team had the necessary experience to successfully deliver Project 6A.

The technical lead stated the following:

"In general, we had a good team on board, which is very, very important. We had all the necessary resources to execute the project. Most of the guys were familiar to me and they have a good reputation within the discipline. We worked with some of them previously and delivered good projects together."

On Project 6B, issues with resources impacted project delivery. The resources deployed by the quantity surveying consultant were not adequate, which resulted in several inaccuracies when measuring for payment certificates. The technical lead stated the following:

"We had a challenge with the quantity surveyor from the outset of the project. That continued despite complaints to the Department from us as Principal Agent's, they kept the guy on the project and then during the construction phase, it was found that his work was inaccurate … eventually, he was taken off the project. But that was a huge cause of problematic issues on this project, which were defined at the early stage, but the Department did not act proactively on this matter."

Theme 2: Competence

One of the important aspects linked to resources was competence. Having competent staff in the architectural field was a key factor in producing quality PSOs. Those developing PSOs must be technically competent with the necessary skills required to produce PSOs. The technical lead indicated that within his firm competent people were available to produce PSOs and execute projects as and when required. The technical lead stated the following:

"We have got professional people. We have got people that do site monitoring that are very competent. We have technical people doing the technical documentation, which includes myself and my partner here that are competent. This assists in producing quality outputs."

The technical lead also bemoaned the lack of competence of some consultants on projects. The technical lead mentioned that in the past the professional teams appointed on projects were more competent than the consultants appointed today.

"But as far as public sector clients are concerned, if I can just give you a little bit of background, in the older days, we had less consultants in the pool and my experience is that

they were, in general, more competent than a lot of people that are appointed on projects these days… On government projects, you get issued a set of consultants and you do not have much control over them."

4.4.7.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

The technical lead indicated that fee levels did not impact the quality of PSOs on the three projects. The fees on the three projects was scale-based. The technical lead stated that if clients were unhappy with the level of fees, they could reduce it. However, some elements of the service would need to be reduced as well. The technical lead indicated that fees were related to the amount of time spent by a company to produce a piece of work. Therefore, a fee reduction would inevitably lead to a reduction in time spent on the project and service. Importantly, quality was not sacrificed instead a mutually agreed reduced service was provided. The technical lead asserted that it was important to communicate this to the client to manage their expectations. The technical lead stated the following:

"I think that's also a matter of one's negotiations with clients. In other words, our fees are related to the amount of work that we do. So, if we do only do, for example, municipal approval, and we leave it at that, we can do that at X amount, you know, if they expect more, we will do it in Y amount. So, if somebody says, look, they think that the fees are a little bit high for their budget and so on, then we can say that we can do a limited service, that will exclude this and it will exclude that. So, it all comes down to communication with your client."

The technical lead further stated that good communication with the client meant no disputes around services provided and payment of fees. The key to this approach was to ensure that the fee and assumption and exclusions related to the fee were clearly understood by all stakeholders and agreed upfront. The technical lead stated the following:

"What we do at the inception of a project is to detail very carefully what is included in the fee and what is excluded and what will be extra … we normally don't have a problem with people paying that because they know ahead of the time exactly what the original fee is based on and what will be extra and what the rate of increased fees will be. So, we have a very open relationship with our clients."

The managing director opined that the level of fees in public sector projects was "too low" and resulted in his company not tendering for public sector projects any longer. He indicated that

quality PSOs could not be produced at the current fee levels. This suggested that the cost to deploy resources on projects exceeded the fees that were being tendered, and hence was not profitable to the company, which resulted in tenders not being submitted. The managing director stated the following:

"As far as public sector things are concerned, we used to tender on projects, but we stopped that completely because it's a total waste of time and money because we never get any tenders. We used to go to tender openings where they open up the tenders and read out prices. People were tendering at 50% of the government fee scale. We cannot produce a quality of work that's expected of us for that fee, and we just never get into consideration."

4.4.8 Case Study 7 – Civil/Structural Engineering (Company 7)

Table 83 provides a summary of the projects included in Case Study 7.

Table 83: Summary of projects in Case Study 7

	Project 7A	**Project 7B**	**Project 7C**
Project Scope	Provision of civil engineering services from inception to close out (as per. ECSA Project Stage 1 – 4) for the extension of an existing ash disposal facility.	Provision of civil engineering services from inception to close out (as per ECSA Project Stage 4 – 6) to extend an existing tailings storage facility at a platinum mine.	Provision of civil engineering services from inception to close out (as per ECSA Project Stage 1 – 6) for the improvement of 12km of a national highway.
Approximate construction value	R1.5 billion (excl. VAT)	R430 million (excl. VAT)	R2.1 billion (excl. VAT)
Approximate professional fee value:	Civil engineering fees: R5 million calculated using hourly rates.	Civil engineering fees: R6 million calculated using hourly rates.	Civil engineering fees: 1.2% of the construction value.
Contracting strategy	Design by employer	Design by employer	Design by employer
Client Type	Public sector	Private sector	Public sector
Project status	Completed in 2018	Completed in 2020	Completed in 2015

4.4.8.1 Key Factors Influencing the Quality of PSOs

Theme 1: Time

The technical lead asserted that one of the key factors influencing the quality of PSOs was the time available to produce PSOs. If there is a lack of time to produce PSOs and sufficient resources are unavailable to compensate for the lack of time, quality can suffer. The technical lead stated the following:

"I think in terms of your overall question. What influences the quality? It is definitely the time frame."

On Project 7A, the technical lead indicated that the review period often resulted in extra time to produce deliverables due to rework associated with addressing comments. This was occasionally circumvented by having internal discussions about reviewer comments and only addressing those that were critical. The technical lead stated the following:

"One professional engineer had to review our design before we presented them to the client. That tended to result in a little bit of rework before presenting it to the client. So we then make a decision to only address critical comments once it's done we can just send it to the client. That saved a lot of time."

Theme 2: Available information

The technical lead indicated that the level of information available on all three projects was one of the key factors influencing the quality of PSOs. On Project 7B, the technical lead indicated that by providing quality information to the design team upfront, the certainty of information in PSOs issued to the contractor is improved hence quality is also improved. Producing quality PSOs is challenging when given insufficient information. The technical lead stated the following:

"The drawings were quite good, but I think the factor that influenced the quality of the documents is the amount of information that you get before you do the drawings, such as the survey, the level of detail in the survey and also the sort of materials that you are going to use in the construction of it … We could do with technical information prior that influences the quality of the drawings as well because you don't have to make decisions during the construction stage."

On Project 7C, the technical lead indicated that the accuracy of the information received impacted the quality of PSOs. The information available on projects is fundamental to project delivery as civil/structural engineers are usually dependent on external information (e.g., surveys and ground investigations) to undertake their designs. The quality of this information

underpins the accuracy of their design and has latent impacts on the construction process. The technical lead stated the following:

"It was also the availability of the information. As I said, like services – to do your designs around those services, and then you get on to site and the services are not where the existing information showed them and then it looks like the quality of the drawings are not as good. But that is not our fault as the existing information that we received was inaccurate."

Theme 3: Experience

Experience of resources was a key theme that was identified during discussions with the technical lead and managing director. In Project 7A, the resource executing the 3D modelling did not have the requisite experience, which resulted in rework to get the model to an appropriate level of quality. The technical lead stated the following on Project 7A:

"In this specific case, we had to do modelling of all the phases – they call it stackers. So that would go in a radial pattern and had to be modelled for each scenario, or for each phase … Our draughtsman at the time was not too clued up with how the modelling works. So the first two attempts were not as accurate as what came out at the end."

Having experienced resources on projects is advantageous especially when projects need to be delivered expeditiously due to programme pressures. Skilled resources can assist in ensuring smoother delivery and efficiencies when producing PSOs. On Project 7C, the technical lead indicated that using knowledgeable and experienced resources assisted in delivering the project within the short programme duration. The technical lead stated the following:

"It was a tight time schedule, but luckily we had quite knowledgeable and experienced resources on the project, at least people that know what they are doing – so that made up for the time constraints."

When delivering multiple projects, adequately staffing the projects is an important aspect of producing quality PSOs. The managing director asserted that matching skilled resources with the complexity of tasks was essential in ensuring the production of quality PSOs. Furthermore, the managing director indicated that it was necessary to have the appropriate number of resources to ensure that multiple projects could be executed effectively.

"Obviously important is skill of staff. When you have a mismatch of a skill required for the task and the skill of the individual allocated to the task then there is a variability that can result in

terms of the quality of the output… From the resourcing point of view, having the levels of skills in the numbers to be able to deliver on a multiple project basis is also very important. So internally those are the key fundamental things."

4.4.8.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

The level of fees for Projects 7A and 7B were based on hourly rates, while the fees for Project 7C were scale-based. In this case study, all projects underwent rigorous screening by the company before they were embarked upon. The company was selective when bidding for projects and only submitted a bid if they could deliver technically (based on their resources and experience) and generate an appropriate profit margin. This assisted in ensuring that projects that were executed by the company were initiated on a solid footing.

The managing director stated the following:

"Because we are a margin business, all of that is built in the planning phase. So if in the assessment, when we do the go or no-go decision-making, we realise that we cannot bid for a project on a price that can be competitive or not, then we don't put in a bid – it is pointless. We are not in the business of staying in business. When we bid for a project, we have already built in the margin, the return and a plan of how we are going to manage that so that we achieve the output that we are looking for both technically, financially and commercially."

The technical lead indicated that the level of fee tendered did not impact the quality of PSOs for the three projects. Interestingly, the technical lead mentioned the importance of professionalism when delivering projects emphasising that fees should not determine the quality of PSOs if people delivering projects work with a level of professionalism. The technical lead shared similar sentiments on Projects 7A, 7B and 7C, stating the following on Project 7A:

"The project was priced quite slim or keenly, as they would say ... however, it did not impact on how we would manage the project. There was a certain level of quality we had to produce whether the money was there or not. So, it's about just being a professional."

4.4.9 Cross-Case Analysis

4.4.9.1 Key Factors Influencing the Quality of PSOs

A cross-case analysis that examined key themes across the seven case studies was undertaken. The results of the cross-case analysis are provided in Table 76.

Table 84: Key themes emanating from the cross-case analysis

Theme	Analysis
Time	The amount of time available to spend on PSOs was cited as a theme in Case Studies 1 and 7. In both cases, having adequate time was cited as a key factor to produce quality PSOs. In Case Study 1, participants mentioned when the time to deliver projects is reduced the first impact is on the level of review that is undertaken. In Case Study 7, the technical lead asserted that the time available to produce PSOs impacted the duration of the review process and the overall quality of PSOs. In Case Study 1, although the time provided to the project team was adequate, the technical lead recognised that shorter delivery timeframes would have detrimental impacts on the quality of PSOs. Participants noted that if time was minimised excessively, it adversely impacted the quality of PSOs.
Quality control	Quality control was highlighted as a theme in Case Studies 1, 3 and 4. Participants acknowledged that the quality control process within Companies 1, 3 and 4 was an essential mechanism to ensure that the quality of projects was maintained. In Case Study 3, the technical lead asserted that quality control processes were beneficial in the civil engineering industry as they reduced quality issues related to "copy and paste" from one document to the next. Quality control processes were seen as a preventative measure to minimise or eliminate quality deficiencies before PSOs were issued to clients or contractors. This was only possible if resources conducting the reviews had the necessary skills, experience and time.
Available information	Available information on projects was highlighted as a theme in Case Studies 5 and 7. In both cases, participants asserted that the level of available information was a key factor influencing the quality of PSOs. In Case Study 5, the technical lead asserted that the level of available information was critical to

Theme	Analysis
	producing a comprehensive BoQ. A lack of information on Project 5B was addressed by making assumptions in the BoQ. However, this manifested in time and cost-related claims during the construction period. The technical lead asserted that the quality of the information received was directly related to the quality of output produced. Project 5C was an example of where good-quality information was provided to inform the BoQ and no major issues were reported during the construction period, the project was completed within time and budget. From a design perspective, the technical lead in Case Study 7 indicated that having sufficient information was critical to ensure that the design produced was fit for purpose. A lack of fundamental base information (e.g., surveys, ground investigations) as shown in Project 7A resulted in designs that were frequently revised, which provided uncertainty to stakeholders on the project.
Experience and Resources	Experience and resources emerged as themes across several case studies (i.e. Case Studies 1, 2, 3, 4, 6 and 7). In Case Study 1, the company director asserted that an assessment of resources and time required to deliver projects was always undertaken before implementing projects. Similarly, in Case Study 7, the managing director mentioned that matching the quantum and skills of resources to project needs was important when delivering a portfolio of multiple projects. In Case Study 4, the technical lead pointed out that consistency of senior resources leading projects was key to producing quality PSOs. The managing director of Company 4 further emphasised that quality of resources and management on projects, which essentially translated to skills and expertise of resources were required for quality PSOs. In Case Study 6, tendering for new projects was only undertaken if the company had adequate resources to deliver prospective projects. In Case Study 7, the

Theme	Analysis
	use of an inexperienced resource on Project 7A resulted in rework to the designs. Similarly, in Case Study 2, having inexperienced resources on Project 2A compromised the quality of the BoQ. In Projects 2A and 7A, the detrimental impact of inexperienced resources on the quality of PSOs was evident. Linked to experience of resources is competence. Since the production of PSOs involves the development of technical information, those developing PSOs must be technically competent with the necessary skills required to produce PSOs. The technical lead in Case Study 7 asserted that having competent resources assisted when producing PSOs within tight time frames.

4.4.9.2 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

Participants in the case studies asserted that fee levels did not impact the quality of PSOs. In Case Study 4, the technical lead asserted that there was a direct link between fees and the quality of PSOs. However, this was not supported by evidence in any of the projects executed in Case Study 4. A few of the participants in Case Studies 2, 4 and 7 mentioned that once they were appointed on projects, they ensured that quality services and good quality PSOs were maintained even if projects were not profitable. In Case Study 7, the technical lead stated that professionals should ideally continue delivering quality PSOs even if projects were not profitable. In Case Study 3, the managing director asserted that technical quality was within the remit of senior technical resources producing and issuing PSOs to the client; hence fees should not influence the quality of PSOs. A few companies (Companies 2 and 7) indicated that they carefully screened prospective projects using a risk-based approach that assessed technical and commercial aspects before bidding for new projects. This approach ensured that companies were comfortable with the level of technical and commercial risks on prospective projects before commencing. This approach also ensured that companies were satisfied that they could execute the project and maintain quality standards with the available fees and profit margin.

Three companies (Companies 1, 3 and 4) used quality control processes as a mechanism to maintain the quality of PSOs. Participants in Companies 1 and 3 asserted that quality-related shortcomings in PSOs should be minimised if PSOs go through the quality control process. However, the managing director of Company 1 stated that the amount of time spent on reviews (a key part of quality control) was inevitably reduced when delivering projects with tight deadlines. The reduced review time may be detrimental to the quality of PSOs. Participants in Case Studies 1 and 5 acknowledged that to deliver projects with a competitive fee, junior resources were used heavily on projects and spent a significant amount of time compared to senior resources. However, senior resources carried out important review and approval functions to ensure that the quality of PSOs was maintained. In Case Study 2, the managing director mentioned that the level of fees tendered by some consultants was simply too low and was not commensurate with the level of effort required to produce quality PSOs. In Company 6, the fees tendered on projects were directly related to the quantum of services and time spent on a project. If the client requested a reduction in the fee, then services rendered, and time spent on the project would need to be reduced accordingly. Importantly, this did not imply that quality would be compromised.

4.5 Conclusion to This Chapter

This chapter presented and analysed results from the three-stage research design (i.e., the industry-wide survey, the survey of industry experts and case studies). The first stage of the research design included an industry-wide survey. Section 1 of the survey contained an open-ended question about key factors influencing the quality of PSOs based on the experience of participants. Factors that were cited by 25% or more of the participants in Section 1 of the survey were added to a preliminary shortlist of key factors influencing the quality of PSOs that were validated during the second and third stages of the research design. The following factors were cited by 25% or more of the participants in Section 1 of the industry-wide survey:

- Architects – Experience, Fees and Time
- Civil/Structural Engineers – Experience, Fees, Project Brief and Time
- Electrical Engineers – Available Information, Experience, Fees, Project Brief and Time
- Mechanical Engineers – Experience, Fees, Project Brief, Project Understanding and Time
- Quantity Surveyors – Available Information, Experience, Fees, Project Brief and Time

The second stage of the research included a survey of industry experts, which included interviews with vastly experienced experts in the South African construction industry. The average duration of each interview was 72 minutes, with participants having an average of 38 years of experience.

The first part of the interview asked industry experts about key factors influencing the quality of PSOs based on their experience (similar to Section 1 of the survey). Industry experts raised experience, fees and time available to produce PSOs as key factors. Several other factors were also raised by industry experts but were not validated with factors in the first stage of the research design.

Subsequent sections of the interview validated factors identified in Sections 2 through 5 of the industry-wide survey. Factors such as "Unrealistic client expectations regarding the time to produce PSOs" (F1), "Project resources that lack technical skills or experience" (F28) and "Appointing consultants based on lowest fee tendered" (F56) were confirmed as key factors by industry experts. Additionally, mechanical engineering industry experts confirmed that the "Quality of project brief provided by the client" (F2) was a key factor influencing the quality of PSOs.

There was consensus among industry experts that the level of fees impacts the quality of PSOs. Industry experts asserted that insufficient revenue and profit due to low fees may impact hiring experienced resources and the quality of PSOs. Furthermore, services such as value engineering were generally omitted when delivering projects at reduced fees due to the need to design more quickly. On the other hand, companies taking on projects with lower fees as a marketing exercise was cited as an example where the level of fee may not impact the quality of PSOs. In these instances, quality PSOs must be produced regardless of the fee to improve the likelihood of getting future work from the client.

Industry experts opined that professionalism in the industry was based on personalities working on projects. However, a few participants asserted that maintaining professionalism was difficult when the profitability and living standards of professionals were being eroded. Another view among participants was that professionalism was often guided by companies where professionals were employed. Many organisations take pride in their outputs and want to deliver quality PSOs regardless of the level of fees. If companies have a culture of producing good-quality PSOs, it will transfer to staff. Views were mixed on whether professionals were motivated by money to produce good-quality PSOs. A perception among industry experts was

that younger professionals were motivated by money. One of the industry experts mentioned that if those in industry were not passionate about their field, professionalism would suffer.

The last stage of the research design included case studies with built environment companies in South Africa. The case studies included interviews with technical leads on projects and a director in the companies being investigated. The projects were used to identify key themes related to the quality of PSOs. A summary of the key themes is presented below:

- Case 1 (Electrical Engineering): Quality Control, Resources (including Experience) and Time
- Case 2 (Mechanical Engineering): Experience and Software
- Case 3 (Civil/Structural Engineering): Quality Control
- Case 4 (Architectural): Resources (including Experience) and Quality Control
- Case 5 (Quantity Surveying): Available Information
- Case 6 (Architectural): Resources (including Experience) and Competence
- Case 7 (Civil/Structural Engineering): Time, Available Information and Experience

Themes such as experience, time available to produce PSOs and available information were validated during earlier stages of the research design. Despite quality control being raised by several disciplines in the case studies, it was not validated as a key factor in previous stages of the research design.

Although many participants acknowledged that fees did impact the time spent on projects and deployment of resources, the quality of PSOs was not impacted by the level of fees on any of the projects investigated. A few participants mentioned that this was due to their company following a quality management system to ensure that PSOs that were produced satisfied the requisite quality standards. Other participants asserted that they do not accept projects if they know that the fees are inadequate to allow an experienced team to work on the project. Generally, it seemed that the level of fees on most of the projects investigated was adequate; hence, participants did not need to cite this as a key factor influencing the quality of PSOs. However, participants stated that if fees were inadequate, professionalism among built environment professionals was essential to ensure quality PSOs were produced.

Chapter 5: Discussion

5.1 Introduction

This chapter examines the outcomes of the three-stage research design. Results were evaluated and contrasted with previous findings in the literature to highlight either congruence or disparities that have been observed in this study. The discussion follows the research questions, namely:

- What are the key factors influencing PSO quality?
- What is the significance of key factors influencing PSO quality among different built environment disciplines in the South African construction industry?
- How and to what extent does the level of fees charged by built environment professionals influence PSO quality?

The discussion comprehensively explores and interprets the research results within the context of existing literature and research questions. It also delves into the significance and implications of the research findings.

5.2 Key Factors Influencing the Quality of PSOs

Several studies assessing factors influencing the quality of PSOs, such as design documents, have been conducted in Australia, Ghana, Japan, Nigeria, Saudi Arabia, South Africa and Syria. Many of the studies included a broad analysis of factors that combined data from different built environment disciplines (e.g., Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Dosumu and Iyagba, 2013; Zidan, 2013; Dosumu *et al.*, 2017; Abu Abu Fatawu *et al.*, 2020). Some of the key factors influencing the quality of PSOs in the literature included low fees (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Slater and Radford, 2012; Zidan, 2013; Akampurira and Windapo, 2018; Abu Fatawu *et al.*, 2020), insufficient time to produce design documents (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Slater and Radford, 2012; Zidan, 2013; Dosumu *et al.*, 2017; Akampurira and Windapo, 2018), last-minute or frequent changes by clients (Darwish, 2005; Zidan, 2013; Dosumu *et al.*, 2017; Abu Fatawu *et al.*, 2020), lack of available documents or information (Zidan, 2013; Abu Fatawu *et al.*, 2020) and designer experience (Busbshait *et al.*, 1999; Dosumu and Iyagba, 2013; Dosumu *et al.*, 2017; Assaf *et al.*, 2018). Interestingly, low fees and insufficient time to produce design documents emerged as key factors in several studies that were conducted internationally. On the other hand, other key factors such as last-minute

or frequent changes by clients, lack of available documents or information and designer information were only raised in studies conducted in the Middle East and Africa.

A rigorous three-stage research design was used to identify and validate key factors influencing the quality of PSOs across several built environment disciplines. Based on data collected across three research stages, the final list of key factors influencing the quality of PSOs includes:

- Architectural: Experience, Fees and Time
- Civil Engineering: Experience, Fees and Time
- Electrical Engineering: Experience, Fees and Time
- Mechanical Engineering: Experience, Fees and Project Brief
- Quantity Surveying: Experience, Fees, Time and Available Information

Key factors identified in this study are congruent with factors outlined in the construction management literature. Low fees, time available to produce PSOs and experience have been mentioned in several studies as key factors influencing the quality of PSOs. On the other hand, available information and project briefs were only cited as key factors in a handful of studies. Interestingly, the key factors outlined in this study were congruent with other studies conducted in the African context (e.g., Dosumu and Iyagba, 2013; Dosumu *et al*., 2017; Akampurira and Windapo, 2018; Abu Fatawu *et al*., 2020).

The similarities in findings from this study and previous research illustrate that factors influencing the quality of PSOs are fairly consistent regardless of the geographic region. The consistency of factors can be attributed to several reasons. Firstly, many of the principles and best practices in the built environment professions are based on universal principles of design, safety, functionality and sustainability. These principles are not limited by geography and apply to projects worldwide. Secondly, clients typically share similar quality and performance expectations for built environment projects, regardless of their location. Meeting these expectations drives consistency in professional practices. Thirdly, professionals in the built environment usually accumulate experience throughout their careers, which informs their understanding of critical factors for achieving quality outcomes. This experiential knowledge has been articulated in previous studies. Lastly, the work of built environment professionals is governed by well-established industry standards, codes, and regulations. These standards provide a common framework and establish expectations for quality, ensuring consistency in the factors that influence it.

In the South African context, all previous studies, with the exception of one (Laryea *et al.*, 2021), asserted that low fees are the primary determinant of PSO quality. This study shows that, although fees were raised as a key factor influencing the quality of PSOs in the South African context, other factors (e.g., experience and time) are also important and, in some cases, more significant than fees. The findings indicate that the prevailing narrative around fees in previous studies, particularly in the civil engineering discipline, is not entirely accurate. The findings underscore the importance of prioritising sufficient time for professional teams to produce PSOs before appointing contractors. However, it is worth noting that project timelines aren't always under the control of the professional team; they are typically dictated by the client. Therefore, clients need to recognise the significance of allocating an appropriate amount of time for PSO production and incorporate this into their project timelines. Additionally, experience emerged as a key factor across all disciplines. This revelation should prompt consultants to re-evaluate team compositions, especially on underperforming projects, to ensure the deployment of appropriately experienced resources. From a client perspective, this emphasises the importance of appointing experienced built environment professionals to deliver infrastructure projects.

Experience

Data suggest that built environment professionals from all disciplines value experience as a key factor in producing good-quality PSOs. This can be expected since built environment professions consist of technical roles, many of which can only be mastered after years in the field. From a client perspective, experience is often one of the most important criteria when evaluating the suitability of consultants for appointment on infrastructure projects. Experience and competence go hand in hand. Competence is defined by the ISO as the “ability to apply knowledge and skills to achieve intended results”. Studies such as Busbshait *et al.*, (1999), Wimalasiri *et al.* (2011), Dosumu and Iyagba (2013), Dosumu *et al.* (2017) and Assaf *et al.* (2018) posited that experience and competence were key factors impacting design or design document quality. Industry experts and data gathered during case studies (specifically Case Studies 1, 2, 4, 6 and 7) demonstrated the importance of having experienced and competent resources to deliver good-quality PSOs on projects. Experienced professionals possess the knowledge, problem-solving skills, and practical insights necessary to tackle complex challenges effectively. They are well-versed in industry regulations and codes, ensuring compliance and safety in their work. Experience fosters efficiency, innovation, and a deep understanding of real-world construction practices, enabling professionals to design and

prepare PSOs that are both theoretically sound and practical to build. Moreover, experienced resources generally excel in interdisciplinary collaboration, inspire confidence in clients, and play vital roles in mentoring and leadership within their respective industries, contributing to the overall quality on projects. An experienced resource has the advantage over less-experienced resources as they can identify and solve technically complex challenges on projects more efficiently. On the other hand, someone who lacks the necessary experience may not be able to identify and solve technically complex challenges, which can adversely impact the quality of PSOs. It is generally accepted that as a person progresses in their career and gains experience, they become more skilled and competent in a particular field. Although this may not be true for everyone, it is reasonable to assume this is the case for most resources in the built environment profession due to the extensive training and mentorship initiatives within the industry. After acquiring sufficient technical experience and knowledge, those in the industry who want to progress their careers seek professional registration with their respective professional council. Registration with a professional council ensures resources have the necessary experience, competence and ethical standards to execute duties as a professional.

An important issue raised by participants was the use of junior or inexperienced staff for the production of PSOs without adequate supervision by senior professionals. This was cited as one of the reasons for poor-quality PSOs, especially where comprehensive reviews of PSOs were not undertaken by experienced professionals. Resources with insufficient site experience managing projects were also highlighted as problematic due to their perceived lack of appreciation of complexities associated with the construction process. As one participant aptly stated, “You can’t be a leading bridge engineer without having designed several bridges.” Many participants linked experience with knowledge. Resources involved in technical work should acquire knowledge about the latest trends in the industry and have either an awareness or ability to use software relevant to their roles to aid in producing good-quality PSOs.

Level of Fees

The level of fees on projects was raised as a key factor among all built environment disciplines. The impact of fees on the quality of PSOs has been contemplated in the construction literature since the late 1980s. In the South African context, there has been considerable debate on the topic after a ruling by the Competition Commission to abolish fee scales. Several studies conducted in the South African civil engineering industry linked the level of fees to the quality of documents or project risks (Liebenberg and Wilson, 2011; Malinda, 2017; Moos, 2017; Okonkwo and Wium, 2018; Akampurira and Windapo, 2018). Therefore, it was not surprising

when fees emerged as a key factor among civil engineers during the industry-wide survey. Similarly, the emergence of fees as one of the key factors among the rest of the disciplines was also unsurprising as many international studies (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Slater and Radford, 2012; Zidan, 2013; Abu Fatawu *et al.*, 2020) suggested that fees were a key factor influencing the quality of PSOs.

Participants mentioned that the level of fees on a project was interwoven with other factors, i.e., resource allocation and time available to produce PSOs, which then impacted the quality of PSOs. Although the relationship among these factors may differ between companies, the predominant viewpoint was consistent: Projects with inadequate fees posed a risk to the quality of PSOs. During subsequent stages of the research design where in-depth discussions were conducted, it became apparent that the relationship between fees and the quality of PSOs in the South African context was further complicated by the public sector procurement system where tenderers with the lowest fee were generally appointed on projects. The discussion of fees and tendering in the construction industry was emotionally charged. Many participants expressed concern about current fee levels and the practice of undercutting fees during competitive tendering, emphasising the negative impact on the profession's sustainability and attractiveness. While there will always be questions about whether it is ethical for a professional to allow the level of fee on a project to affect the quality of PSOs, the reality is that professionals are heavily reliant on fees to adequately resource and deliver projects, run profitable companies and make a living.

Time

The amount of time available to produce PSOs was a key factor raised by all built environment disciplines except mechanical engineers. Several previous studies also identified time as a key factor influencing the quality of PSOs (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Slater and Radford, 2012; Zidan, 2013; Dosumu *et al.*, 2017; Akampurira and Windapo, 2018). During the survey of industry experts, participants mentioned that insufficient time spent on design development in public sector projects was often due to the urgency to construct and spend budgets within a particular financial year. One industry expert asserted that lack of time was often due to clients delaying implementation of projects; when those projects reach the market, they are urgent and need to be delivered rapidly. On the other hand, some participants posited that clients were uninformed about the appropriate duration of tasks. Therefore, they had unrealistic expectations about the time required to produce PSOs.

Production of PSOs during infrastructure projects generally follows a structured process that is documented in a project programme. The sequencing of tasks to produce PSOs varies according to the scope of projects. However, the different processes leading up to the production of PSOs usually require a project-specific minimum time to ensure quality standards are met. The minimum time is generally commensurate with scope, project-specific risks and resources. Having sufficient time on a project allows the project team to fully undertake activities such as design optimisation, coordination, integration and reviews. It allows the team to identify and resolve deficiencies with designs or documents before issuing them to clients. However, as soon as the duration of the project programme reduces, the duration of tasks necessary for the preparation of PSOs also reduces. This generally increases the probability of errors as teams need to improve efficiencies to meet project deadlines. Insufficient time available to produce PSOs on projects places pressure on project teams and can impact employee workloads as team members are expected to do more tasks in a condensed period.

Project Brief

The project brief was highlighted as a key factor among mechanical engineers. Although the mechanical engineering discipline constituted a small sample of participants compared to other disciplines, project brief as a factor was raised during the open-ended section of the industry-wide survey among several other disciplines, i.e., civil/structural engineers, electrical engineers and quantity surveyors. Therefore, since it was validated during the mechanical engineering investigation and raised by other disciplines with significantly larger samples, it was shortlisted as a key factor for the mechanical engineering discipline. Project briefs were previously highlighted as a key factor influencing the quality of documents by Tilley and McFallan (2000) and Abu Fatawu *et al.* (2020). It was also raised in several other studies but not as a key factor influencing design document quality (e.g., Andi and Minato, 2003; Dosumu *et al.*, 2017; Akampurira and Windapo, 2018). Therefore, findings in this study were congruent with previous studies. A project brief is required to comprehensively outline project requirements and client expectations. Participants mentioned that both the client and the consultant should be aware of the requirements in the project brief so there is no misalignment of expectations. Participants stated that an unclear project brief or scope inevitably results in disputes (including disputes around the quality of PSOs), which can have a disruptive effect on the project. The project brief enables companies to plan for projects by allocating appropriately skilled resources and setting aside sufficient time to deliver projects. This planning is critical to ensure

successful delivery of projects. If project briefs fail to appropriately detail project requirements, resources and time allocated to projects by consultants may not meet clients' expectations. Failing to deliver in line with client expectations has a negative bearing on the quality of PSOs.

Available Information

Available information was highlighted as a key factor influencing the quality of PSOs in two previous studies in Ghana (Abu Fatawu *et al*., 2020) and Syria (Zidan, 2013). In this study, the identification of available information as a key factor was specific to the quantity surveying profession. The importance of this factor among quantity surveyors is not surprising. Arguably one of the most important PSOs produced by quantity surveyors is a BoQ. Quantity surveyors are heavily reliant on other disciplines when producing BoQ and procurement documents. When there is a lack of information to inform items in the BoQ, the production of the BoQ becomes challenging and often leads to assumptions to fill gaps in information. This was raised in Case Study 5, where the project technical lead indicated that scope definition and providing as much information as possible were key to producing a good-quality BoQ. One project mentioned during Case Study 5 with a lack of information resulted in several variation orders being issued during the construction period, which caused a significant increase in construction costs. Availability of information was also mentioned by several participants in the architectural and engineering disciplines. In both disciplines, participants stated that available information informed the designs that were produced. The quality of available information also influenced the amount of additional effort required from project teams to undertake background work and obtain necessary information for the production of PSOs. The sentiments of built environment professionals from all disciplines suggest that whenever information is scarce or deficient, it adversely impacts the quality of PSOs. Despite available information being cited by several participants in the architectural and engineering disciplines, it did not make the final shortlist of key factors influencing the quality of PSOs in those disciplines.

5.3 Significance of Key Factors Influencing PSO Quality in the South African Construction Industry

Previous studies in the construction literature did not adequately explain the significance of key factors influencing the quality of PSOs. In this study, the significance of key factors was determined using the frequency with which key factors were cited during the first section of the industry-wide survey, where participants were asked to state the key factors influencing the quality of PSOs without any prompting. Factors cited by more than 25% of survey participants were considered significant.

From the analysis, it was clear that fees and experience were the two common factors among all disciplines. Notably, fees were viewed as the most significant factor in the architectural discipline. This suggests that architects appointed with adequate fees can commit the necessary time and resources to deliver good-quality PSOs. Adequate fees enable architects to perform comprehensive project risk assessments and pre-emptively address potential issues, which not only safeguards project timelines but also reduces the likelihood of disputes and costly revisions during construction. By providing architects with the necessary fees to invest in thorough planning, documentation, and oversight, clients ultimately benefit from a more streamlined and efficient project delivery process. Time and experience, the other two key factors among architects, were the second- and third-most significant factors. Importantly, when assessing the magnitude of the fee variable among architects, it was only cited by 5% and 15% more participants when compared to experience and time, respectively.

Experience, fees and time were key factors that were cited by the civil/structural engineering and electrical engineering disciplines. Experience was the most significant factor among civil/structural engineering participants, closely followed by fees and time. The significance of the three factors fell within a narrow range, with fees and time being cited by 46% and 45%, respectively, while experience was cited by 56% of participants. The prominence of experience as the most significant factor among civil/structural engineers emphasises the need for consultants to identify suitably experienced professionals based on project complexity. Engineers, as the driving force behind infrastructure projects, must be equipped not just with education but also with the hands-on experience that comes from tackling complex challenges in the field. As projects grow in complexity, assembling interdisciplinary teams with complementary expertise becomes essential. The presence of seasoned engineers within these teams ensures that the collective knowledge and problem-solving capabilities are robust, enabling a more holistic approach to project design and execution.

Interestingly, fees and time were the two most significant factors in the electrical engineering discipline, with each being cited by 56% of participants, implying that these factors hold equal levels of significance. The importance of fees and time management is critical for both clients and consultants. Consultants must submit fees that enable them to deploy adequately skilled professionals to produce good-quality PSOs. Additionally, they should optimise project schedules to allocate the necessary time to tasks for delivering good-quality PSOs. Clients involved in electrical engineering projects should be educated about the importance of fees and time management, as these factors have far-reaching implications for overall project outcomes.

Adequate fees are crucial for securing the necessary resources, including experienced engineers. The data suggests that without sufficient fees, it becomes challenging to produce good-quality PSOs. Therefore, educating clients about the direct link between fees and quality PSOs helps set realistic expectations and avoids unrealistic budget constraints that could impact the quality of PSOs. Clients also need to be advised about the significance of effective time management in electrical engineering projects. Rushed projects and PSO delivery can compromise quality by limiting the time available for various tasks. When clients appreciate that sufficient time is essential for engineers to complete these critical tasks, they are more likely to support project timelines developed by the professional team.

For the mechanical engineering discipline, project briefs were cited as the most significant factor by 63% of mechanical engineering participants. The significance of project briefs underscores the necessity for clients to place greater emphasis on crafting well-defined project briefs for mechanical engineering projects if they seek to improve the quality of PSOs. From a consultant's perspective, project briefs lacking sufficient detail should be clarified with the client to define the scope more precisely before submitting fees, to prevent future disputes. Although the number of mechanical engineering participants was low (eight participants), which may have distorted the significance of key factors, it should be noted that project briefs were raised during the survey of industry experts by both mechanical engineering experts (each with over 50 years of experience), which highlights its significance among mechanical engineers. Similarly, experience (the second-most frequently cited factor among mechanical engineers) was cited by 50% of participants and both industry experts. Although fees were raised by mechanical engineering participants as a key factor, they do not appear to be as significant as the project brief and experience.

For quantity surveyors, time and available information were the top two factors influencing the quality of PSOs. Interestingly, time was the most significant factor and cited by more than twice as many participants compared to experience and fees. Available information was the second-most significant factor among quantity surveyors as it was cited by the second-highest number of participants during Section 1 of the industry-wide survey and validated as the only key factor during the case study. Experience and fees were also shortlisted as key factors in Section 1 of the survey and validated by the industry expert. However, it appears that both factors may not be as significant as time and available information. The prevalence of time and available information as the two most significant factors among quantity surveyors has several implications. From a time perspective, delays or inaccuracies in receiving information can lead

to project risks, including budget overruns and delays. Quantity surveyors must actively engage in risk management by identifying information dependencies and potential bottlenecks when producing PSOs. Ensuring that project schedules allocate adequate time is crucial for quantity surveyors to collect, analyse, and verify project information. To optimise available time, efficient data collection and processing procedures should be in place, and quantity surveyors should adopt technologies and tools to enhance productivity and accuracy. The significance of available information highlights the need for effective collaboration among the project team. Quantity surveyors must closely coordinate with architects, engineers, and other professionals to gather accurate and up-to-date project data required for their PSOs. The quality of PSOs (e.g., BoQ) directly depends on the accuracy of data provided by other disciplines. Clear and precise information from architects and engineers is essential to produce an accurate BoQ. Lastly, regarding both time and available information, clients should be educated about the importance of promptly providing complete and accurate project information.

Many previous studies suggested fees were a key factor influencing the quality of PSOs without clearly explaining its significance (e.g., Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Slater and Radford, 2012; Zidan, 2013; Akampurira and Windapo, 2018; Abu Fatawu *et al.*, 2020). However, this study has shown that although fees were a key factor, it is not the only significant key factor influencing the quality of PSOs. In certain cases, other key factors hold greater significance than fees, while in other instances, they hold nearly the same level of significance or even slightly less. The significance of key factors varied according to the different built environment disciplines. This suggests that built environment professionals may need to adopt tailored approaches to quality management that align with the unique factors relevant to their discipline. Additionally, clients should be aware of the different key factors that influence the various built environment disciplines and may need to pay particular attention to the management of these factors during project delivery. In summary, the varying significance of key factors influencing the quality of PSOs across built environment disciplines necessitates a nuanced approach to quality management and building a holistic understanding of quality that considers both discipline-specific and overarching factors which are essential for producing good-quality PSOs.

5.4 How and to What Extent Fees Charged by Built Environment Professionals Influence PSO Quality

Several studies have been conducted in the construction management literature exploring the relationship between fees and the quality of either design documents or services. While some

studies found a link between fees and quality (Bubshait *et al.*, 1998; Gransberg *et al.* 2007; Liebenberg and Wilson, 2011 and Okonkwo and Wium, 2018), others asserted there was no relationship (Hoxley, 2000; Phua, 2005; Awolesi and Ayedun, 2012; Cirelli, 2017; Laryea *et al.* 2021). Some studies assessing factors influencing the quality of design documentation also had different viewpoints, with many citing fees as a key factor (Tilley and McFallan, 2000; Andi and Minato, 2003; Darwish, 2005; Slater and Radford, 2012; Zidan, 2013; Malinda, 2017; Akampurira and Windapo, 2018; Abu Fatawu *et al.*, 2020), while others did not support this notion (Dosumu and Iyagba, 2013; Dosumu *et al.*, 2017). However, previous research failed to illuminate how and to what extent fees impacted the quality of PSOs.

When examining how and to what extent fees influence the quality of PSOs, it is important to consider how most consulting companies operate and deliver projects. Generally, built environment consulting companies employ built environment professionals to render consulting services. Built environment companies generate revenue and profit by selling their employees' time to clients. In most instances, the availability of time and resources deployed on projects is directly related to the fees available: The magnitude of this relationship varies among companies. The close linkage between fees, time and resources highlights an interwoven relationship between these factors. Since fees on projects are an important driver of revenue and profitability in companies, a limited fee may restrict the amount of time that can be spent on projects by team members. Value-added services such as design optimisation or value engineering may be excluded as they require additional time. Similarly, reviews may also be reduced due to the limited time available to produce PSOs. If fees on projects are inadequate to allow comprehensive reviews, this may impact the quality of designs or documents. Where companies try to maintain low fees and profitability without limiting time, more is extracted from staff (i.e., they work longer hours) to deliver the same level of quality. The limited time available on projects due to low fees also impacts the development of resources by reducing the amount of time available on projects for training and mentorship. This has negative consequences on the development of the next generation of built environment professionals in South Africa.

Allocation of resources on projects is also linked to the fees available. Since rates allocated to resources or employees generally increase with resource experience, burdening low-fee projects with "expensive" resources can impact the profitability of those projects. Feedback from participants indicated that many companies were using junior, or less-expensive, resources to undertake large portions of project-related work with time-consuming tasks, while

senior, and thus more expensive resources were responsible for reviews, directing projects and client liaison – tasks that typically demand less time.

Lower fees result in reduced revenues, which affects the level of remuneration that companies can offer prospective employees if they want to maintain profitability. This can hinder companies from appointing competent resources, who are needed to produce good-quality PSOs. There was a perception among a few participants that low fees were responsible for uncompetitive salaries when compared to other professions (e.g., accountants, lawyers), which was ostensibly causing a shrinking talent pool in the construction industry.

The level of fee submitted on projects usually contains significant variation and is dependent on a company's strategic direction. For example, as one industry expert mentioned, a company may decide to submit a low-fee proposal to win work as part of a business development or marketing initiative. The company would need to ensure that PSOs delivered meet the client's quality standards to ensure the success of the business development or marketing initiative. The low fee in this instance is part of a strategic initiative to obtain a project with a new client and showcase a company's services. In other instances, a company may submit low-fee proposals to generate cash flow and then subsidise the project with other more profitable projects. This approach entails a conscious decision to submit low fees; hence, the quality of PSOs may not be jeopardised. The two scenarios described highlight that in some instances projects with low fees can be delivered without adversely impacting the quality of PSOs. In both scenarios, submission of low fees is a strategic decision taken by companies without any intention to diminish the quality of PSOs.

Companies investigated as part of the case studies did not explicitly mention that the level of fees on projects impacted the quality of PSOs. In Case Study 1, for example, interview participants mentioned that there was a certain minimum level of acceptable quality that was delivered on all projects regardless of fee. Similarly, in Case Study 3, the technical lead and managing director asserted that the quality of PSOs on projects were maintained under the company's quality control systems. As such, the level of fee did not impact the quality of PSOs since all PSOs needed to comply with the company's quality management system before being issued. Despite the assertion about providing a minimum level of acceptable quality in Case Study 1, one of the directors in the company stated that senior resources were reserved for projects with higher fees to ensure that profitability on smaller projects was not impacted. The linkage between fees and resource allocation was further validated in Case Study 4, where the

technical project lead mentioned that the amount of fees available had a direct correlation with the experience level of resources deployed on projects. Similarly, in Case Study 5, resources were allocated following client-approved rates that were related to the level of experience of resources allocated to projects.

In Case Study 2, company policy dictated that projects were only accepted if they could be delivered at the stipulated fee without compromising the quality of PSOs. This was similar to Case Study 7, where the company had a policy of conducting risk assessments to evaluate project delivery and financial risks. These assessments helped determine whether an appropriate profit margin could be maintained on prospective projects with a manageable level of risk. In Case Study 6, the company's approach included informing the client that elements of the service would be reduced if fee reductions were required; this ensured that the quality of PSOs was not impacted.

Adams' Equity Theory of motivation (1963) posits that employees adjust their efforts based on the outcomes they receive from their work. In the context of the ongoing debate regarding fees and quality, this theory suggests that employees may compromise on the quality of their work if project fees are insufficient. A few participants in the study mentioned that greater attention was given to projects with higher fees. However, this did not necessarily mean that poor-quality PSOs were produced during lesser-paying jobs. Professionalism among built environment professionals ensured that PSOs with acceptable quality were produced despite the level of fee. The importance of maintaining professionalism on projects was highlighted in Case Studies 2 and 4. Several participants linked professionalism with personalities working on projects and company culture. For instance, certain individuals would not allow poor-quality PSOs to be issued, irrespective of the potential impact on profitability. This study contributes to existing theory by addressing a previously unexplored aspect: the role of fees on built environment professionals as a social grouping. While this research acknowledges that fees play a crucial role across all built environment disciplines, the data suggests that, despite the influence of lower fees, a minimum acceptable level of quality is consistently maintained on projects. The need for built environment professionals to uphold this baseline level of PSO quality, regardless of their remuneration, aligns with the theory of professionalism and the established principles of what it means to be a true professional. Many study participants emphasised that their commitment to professionalism ensured that quality standards remained intact even when fees were reduced. The data further indicates that the influence of fees on the quality of PSOs varies among built environment disciplines. Nevertheless, it was widely recognised that fees

are a key determinant of quality PSOs. The amount of fees directly impacts the allocation of time and resources. In cases of inadequate fees, companies may limit the time allocated to their teams for project work. Similarly, experienced professionals working on lower-paying projects may be constrained in the time they can allocate. Despite these constraints, professionals continue to deliver an acceptable level of quality on projects, even if it may be slightly lower than on higher-paying assignments. This adherence to a necessary standard of care remains a hallmark of professionalism within the industry.

The findings regarding how and to what extent fees influence the quality of PSOs provide clients and project stakeholders with a clearer understanding of the intricate relationship between fees and PSO quality. This knowledge enables them to establish more realistic expectations for project outcomes, taking into account the impact of fees on the quality of PSOs. Furthermore, clients gain an insight into potential impacts when allocating budgets, enabling them to invest more significantly in fees for projects where high-quality PSOs are crucial, while acknowledging that lower fees may result in a slightly diminished but acceptable quality of PSOs. In the context of contract negotiations, both clients and professionals can engage in more informed discussions concerning fees and quality expectations. This facilitates the creation of contracts that strike a balance between affordability and quality. These findings can also serve as a foundation for the development of industry standards and guidelines that acknowledge the fee-quality relationship. Lastly, both clients and professionals can identify and address the risks associated with lower fees, implementing strategies to mitigate potential quality issues and project delays stemming from fee constraints.

5.5 Conclusion to This Chapter

This chapter provided a discussion of the results produced in the study. The study has shown that several key factors identified were congruent with previous studies. Table 85 summarises the findings and implications of this study.

Table 85: Summary of research findings and implications

Research Question	**Findings presented in this study**	**Implications of the findings**
What are the key factors influencing PSO quality?	Researchers have cited several factors that influence the quality of design and document quality. In the literature, the two most commonly mentioned factors are fees and time. Experience, available information, and the project brief were also cited but not as frequently as fees and time. This study challenges the conventional notion in the South African context that fees are the primary determinant of the quality of PSOs among built environment professionals. Instead, the study identifies nuances in the key factors influencing PSO quality among the various built environment professions. The key factors are presented below: • Architectural: Experience, Fees and Time • Civil Engineering: Experience, Fees and Time • Electrical Engineering: Experience, Fees and Time	The study identifies key factors that built environment professionals can control to ensure the production of high-quality PSOs. Additionally, the findings provide key factors that can be critically examined and managed by clients when procuring built environment professional services. Specifically, clients can exercise control over not only fees but also over the allocation of the amount of time available to consultants for producing PSOs and the level of experience among the resources engaged in their projects. The production of adequately detailed project briefs is also within the remit of the client.

Research Question	**Findings presented in this study**	**Implications of the findings**
	• Mechanical Engineering: Experience, Fees and Project Brief • Quantity Surveying: Experience, Fees, Time and Available Information	
What is the significance of key factors influencing PSO quality among different built environment disciplines in the South African construction industry?	The literature did not clearly articulate the significance of key factors influencing the quality of PSOs. This study revealed variations in the significance of key factors across different built environment disciplines. Among architects, fees emerged as the most significant factor, followed by time and experience. In contrast, civil/structural engineers placed the highest significance on experience, with fees and time following closely behind. Electrical engineers identified both fees and time as the most significant factors. For mechanical engineers, the project brief was deemed the most significant factor. Lastly, quantity surveyors pointed to time and the availability of information as their two most significant factors.	The variation in significance among key factors highlights the need for a nuanced approach to control these factors and enhance quality across different disciplines within the built environment. For instance, fees as the most significant factor among architects suggests that clients should ensure that architects are appointed with an adequate fee to increase the likelihood of good-quality PSOs being produced. This approach enables architects to allocate the necessary time and resources to deliver the project effectively. Additionally, architects should ensure that the fees they submit for projects are sufficient to enable the project to be delivered to an acceptable level of quality.

Research Question	Findings presented in this study	Implications of the findings
		In the case of civil/structural engineers, the prominence of experience as the most significant factor underscores the need for consultants to identify suitably experienced professionals for civil/structural engineering projects based on the project's complexity. Clients can also control this aspect through their procurement process by appointing appropriately experienced companies with the relevant resources to undertake projects. Clients should be informed about the significance of fees and time management in achieving good-quality PSOs on electrical engineering projects. Sufficient fees are crucial for securing the necessary resources, including experienced engineers. Additionally, having a project programme with realistic timeframes will allow the team to complete all the tasks needed to produce good-quality PSOs. When planning projects, electrical engineers should ensure that the project programme contains the necessary tasks and durations to enable the team to produce good-quality PSOs.

Research Question	**Findings presented in this study**	**Implications of the findings**
		For mechanical engineering projects, the findings highlight the importance of clients crafting well-defined project briefs to enhance the quality of PSOs. From a consultant perspective, project briefs that are not well defined should be clarified with the client to extract as much detail as possible before a fee is submitted, to prevent potential disputes in the future. Finally, in quantity surveying, both clients and consultants should actively ensure that adequate time is allocated for quantity surveyors to produce PSOs. Furthermore, to optimise available time, efficient data collection and processing procedures should be in place by quantity surveyors. The project manager, client, and the rest of the professional team should also recognise that the quality of quantity surveyors' PSOs relies on the information they receive. Therefore, it is imperative for the professional team to prioritise the timely provision of comprehensive information to quantity surveyors.

Research Question	**Findings presented in this study**	**Implications of the findings**
How and to what extent does the level of fees charged by built environment professionals influence PSO quality?	While some earlier studies asserted that low fees impact the quality of PSOs they did not employ rigorous scientific research designs. What remained notably unexplored in the literature, however, was the extent to which fees influence the quality of PSOs. This study found an interconnected relationship between fees, time, and resources on projects. The strength of this relationship varies among companies and may not apply in all instances. While reduced fees may potentially impact the quality of PSOs, professionals in the industry generally deliver an acceptable level of quality on projects, even if it may be slightly lower than on higher-paying projects. This commitment to maintaining an appropriate standard of care remains a hallmark of professionalism within the industry.	The findings have significant implications for both clients and project stakeholders, offering a fresh perspective on how fees can shape project outcomes. One of the key takeaways from this research is the new found clarity it provides. Clients and stakeholders now possess a more comprehensive understanding of how fees intricately influence the quality of PSOs. This understanding will assist both clients and professionals to proactively identify and manage risks associated with fee constraints. This will enable both parties to navigate the intricate interplay between fees and quality of PSOs, ultimately leading to more successful and efficient projects.

Chapter 6: Conclusion and Recommendations

6.1 Introduction

Since the 1980s, an ongoing debate has persisted within the construction industry regarding the relationship between fees and the quality of PSOs. Previous studies in the construction literature have fallen short in two critical aspects: firstly, they failed to shed light on the key factors influencing the quality of PSOs among different built environment disciplines, and secondly, they did not clearly illuminate how and do what extent fees impact the quality of PSOs. This study was undertaken with the primary aim of resolving this contentious debate. The study sought to identify and evaluate key factors that influence the quality of PSOs in the construction industry and to examine how and to what extent the fees charged by built environment professionals influence the quality of PSOs. To accomplish this, the study employed an inductive approach and followed a rigorous three-stage research design, which included an industry-wide survey, a survey of industry experts, and a series of case studies.

This chapter provides concluding remarks to the study. In Section 6.2, responses are provided to the three research questions presented at the outset of this study. Section 6.3 examines the contributions of this research to academia and industry, while Section 6.4 delineates the inherent limitations of the research. Lastly, Section 6.5 provides an outline of recommendations for future research.

6.2 Addressing the Research Questions

This study investigated the following research question:

What are the key determinants of PSO quality in the South African construction industry and how and to what extent is quality specifically influenced by the level of fees charged by built environment professionals?

Previous literature in this field did not provide comprehensive discipline-specific insights about key factors influencing the quality of PSOs. When assessing factors influencing the quality of design or documents, previous studies provided holistic insights about factors influencing the quality of PSOs, which included a combined analysis of built environment professionals as one grouping of either “designers” or “consultants”. Among these studies, only three offered limited discipline-specific insights into the factors influencing design or document quality.

All studies that were previously undertaken contained a single-stage research design with no strict sampling criteria to exclude those with inadequate experience participating in the study.

This raises questions about the validity of previous studies. Previous studies also failed to explain the complex relationship between fees and the quality of PSOs. Those studies that explored the relationship between fees and quality did not delve deeply into investigating how and to what extent the quality of PSOs was impacted by fees. Consequently, there was a need for a study that could provide a discipline-specific understanding of key factors influencing the quality of PSOs in the construction industry and offer a more comprehensive understanding of the relationship between fees and the quality of PSOs.

This study used a three-stage research design to address the research questions. The first stage involved an industry-wide survey with two sections. The first section contained an open-ended question asking participants to list key factors influencing the quality of PSOs based on their experience. The second section included a list of factors extracted from the literature; the factors were separated into four categories: client, professional, company and industry-related factors. Participants used a five-point Likert scale to indicate their level of agreement that the various factors influenced the quality of PSOs. Importantly, participants in the survey had to satisfy strict criteria for inclusion in the study. This prevented potentially uninformed participants from being included in the study. The second stage of the research design included a survey of industry experts that included interviews to triangulate findings from the industry-wide survey and determine how and to what extent fees influenced the quality of PSOs. The last stage of the research design used case studies to investigate three projects per company from a total of seven built environment consulting companies. This stage aimed to identify and evaluate key factors influencing the quality of PSOs and examine how and to what extent fees influenced the quality of PSOs on those projects.

6.2.1 What are the Key Factors Influencing PSO Quality?

Several studies have previously been undertaken in the construction industry to identify factors influencing the quality of project or design documents. However, previous research failed to provide a discipline-specific analysis of the key factors influencing the quality of PSOs among built environment professionals. Additionally, many of the studies did not clearly identify which factors were considered key. From a South African perspective, only one other study has been conducted to date, investigating the factors influencing the quality of design documentation in the civil engineering discipline. Research on the key factors influencing the quality of PSOs in other major built environment disciplines, such as architecture, electrical engineering, mechanical engineering, and quantity surveying, is notably absent from the South African construction literature.

This study used a multistage research design to identify key factors influencing the quality of PSOs for the major built environment disciplines in South Africa, e.g., architects, civil/structural engineers, electrical engineers, mechanical engineers and quantity surveyors. An industry-wide survey was used as the starting point of the investigation. The factors identified in the first section of the survey, where participants were asked to state the key factors influencing the quality of PSOs without any prompting, were further investigated in subsequent stages of the research design to determine their suitability for inclusion as key factors. A factor needed to be cited by a minimum of 25% of participants in the first section of the industry-wide survey to warrant further investigation as a key factor. Key factors shortlisted in the survey needed to be validated by participants during the survey of industry experts or case studies to be listed as key factors in this study.

Key factors emanating from the first section of the survey had strong congruence with factors identified in previous studies. The factors from Section 1 that were cited by 25% or more of the participants and investigated further are provided below:

- Architects: Fees (50%), Time (45%) and Experience (35%)
- Civil/Structural Engineers: Experience (56%), Fees (46%), Time (45%) and Project Brief (28%)
- Electrical Engineers: Time (56%), Fees (56%), Experience (38%), Project Brief (31%) and Available Information (25%)
- Mechanical Engineers: Project Brief (63%), Experience (50%), Time (25%), Fees (25%) and Project Understanding (25%)
- Quantity Surveyors: Time (67%), Available Information (48%), Fees (33%), Project Brief (26%) and Experience (26%)

Following the industry-wide survey, a survey of industry experts consisting of structured interviews was undertaken with nine built environment professionals with an average of 38 years of experience. None of the industry experts participating in the interviews participated in the industry-wide survey. The survey of industry experts was used to validate factors identified in Section 1 of the survey. Experience and fees were the only two factors that were validated by industry experts in all disciplines highlighting the importance of both factors. The time available to produce PSOs was cited by all disciplines except mechanical engineers, indicating its importance across disciplines. The project brief was validated as a key factor in the mechanical engineering discipline but, interestingly, was not validated by industry experts in

any other discipline. Other factors varied across disciplines. However, these factors were not raised by more than 25% of participants in the first section of the survey. The complete list of key factors identified during the survey of industry experts is provided below:

- Architects: Time, Experience, Fees, Training, BIM and Procurement Strategy
- Civil/Structural Engineers: Time, Experience, Fees, Review, Professionalism, Procurement Strategy, Organisational Structure, Planning
- Electrical Engineers: Experience, Fees, Workload or Time, Review and Shortage of Skilled Professionals
- Mechanical Engineers: Company Culture, Fees, Competence or Experience, Shortage of Skilled Professionals, Project Brief, Training, Coordination, Integration and Communication
- Quantity Surveyors: Fees, Time, Experience, Review and Decline of Professional Standards

The final stage of data validation involved conducting case studies with seven built environment consulting companies covering various disciplines. A summary of key factors from the case studies is provided in Table 86.

Table 86: Summary of key factors from the case studies

Case Study No.	Discipline	Key Factors
1	Electrical Engineering	Quality Control, Resources (including Experience) and Time
2	Mechanical Engineering	Experience and Software
3	Civil/Structural Engineering	Quality Control
4	Architectural	Resources (including Experience) and Quality Control
5	Quantity Surveying	Available Information
6	Architectural	Resources (including Experience) and Competence
7	Civil/Structural Engineering	Time, Available Information and Experience

The final list of key factors influencing the quality of PSOs is provided in Table 87. Experience was one of the key factors highlighted by participants in all disciplines during the three stages of the research design. Similarly, the amount of time available to produce PSOs was mentioned in the industry-wide survey and further validated either during the survey of industry experts or case studies. Interestingly, fees were cited as a key factor despite not emerging as a key

factor in any of the case studies. However, discussions about the influence of fees on the quality of PSOs with some technical leads and directors suggested it was an important variable in the quality of PSOs. In a few of the case studies, fees were carefully determined before submitting proposals, and participants had a good understanding of the risks associated with the fee levels before committing to projects. Additionally, participants emphasised that even in cases where fees may have been a concern on projects, their professionalism ensured that the quality of PSOs was not compromised. It should be noted that fees were cited as a key factor during the industry-wide survey and validated by all disciplines during the survey of industry experts; hence, they appear on the final list of key factors. The remaining two factors, project brief and available information, were only listed as key factors for mechanical engineers and quantity surveyors, respectively. Project briefs were highlighted by mechanical engineers in the industry-wide survey and validated during the survey of industry experts, while available information was cited by quantity surveyors during the industry-wide survey and validated in the case studies. Interestingly, both factors were cited in the survey across a few disciplines.

Table 87: Final list of key factors influencing the quality of PSOs

Discipline	**Key Factors**
Architectural	Experience, Time and Fees
Civil/Structural Engineering	Experience, Time and Fees
Electrical Engineering	Experience, Time and Fees
Mechanical Engineering	Experience, Fees and Project Brief
Quantity Surveying	Experience, Time, Fees and Available Information

6.2.2 What Is the Significance of Key Factors Influencing PSO Quality Among Different Built Environment Disciplines in the South African Construction Industry?

The study highlighted that although fees were a significant factor influencing the quality of PSOs, several other key factors were also significant. The significance of these key factors varied across different disciplines within the built environment. Specifically, among architects, fees emerged as the most significant factor, with time and experience following as the second- and third-most significant factors. Similarly, in the electrical engineering discipline, fees and time took precedence as the two most significant factors, followed by experience. In the civil/structural engineering discipline, experience took the lead as the most significant factor, followed by fees and time. Notably, the significance of experience, fees, and time was

consistent among architects, civil/structural engineers, and electrical engineers in the study. All three factors were frequently cited by a large proportion of participants across the study.

The mechanical engineering discipline regarded the project brief as the most significant factor, followed by experience. While fees were identified as a key factor among mechanical engineers, they did not hold the same level of significance as the project brief and experience. In the quantity surveying discipline, participants highlighted time as the most significant factor. Available information emerged as the second-most significant factor and was raised as the only key factor during the case study with the quantity surveying company (Case Study 5). Fees and experience were also recognised as key factors among quantity surveyors. However, they were not as significant as time and available information.

The varying significance of key factors across built environment disciplines suggests that a one-size-fits-all approach may not be appropriate when managing the factors that influence the quality of PSOs. Clients of built environment professional services should take note of these differences and adopt a nuanced approach, considering the specific key factors and their significance in each discipline. Built environment professionals should also take note of the importance placed on fees, time and experience when planning, bidding and managing projects. Furthermore, when working in multidisciplinary teams, built environment professionals should be aware of the variations in key factors. Specifically, they should recognise the importance placed by quantity surveyors on receiving complete information and having an adequate amount of time to produce high-quality PSOs. Similarly, the emphasis that mechanical engineers place on the project brief highlights its significance when engaging mechanical engineers on projects.

6.2.3 How and to What Extent Does the Level of Fees Charged by Built Environment Professionals Influence PSO Quality?

Previous studies in the construction literature failed to comprehensively examine how and to what extent the quality of PSOs is specifically influenced by the fees charged by built environment professionals. While some studies attempted to address the 'how' aspect of this question, they did not employ rigorous scientific research designs. Furthermore, these studies also failed to explain the extent to which the fees charged by built environment professionals influence the quality of PSOs.

This study showed that fees are closely linked to and interwoven with two other key variables, namely, time and resources. The magnitude of the relationship between fees and time and

resources varies between companies. In cases where the fee is below what is reasonably expected for companies to perform tasks, cover their costs and earn an appropriate profit margin, time spent on projects may be reduced. The reduction in time spent on the project assists in reducing costs as resources spend less time on tasks. This approach can result in the time for tasks being reduced or some tasks being completely removed if they are deemed non-essential. When the duration of tasks is reduced, especially those relating to review, it can negatively impact the quality of PSOs. Resources is the other key variable closely linked to the level of fees on a project. Resource costs on projects are directly related to their cost of employment, company overheads and profit. When allocating resources to projects, senior resources tend to drive up project costs or fees due to their higher rates. On projects with competitive fees, minimising time spent by experienced resources ensures they do not overburden projects with their high costs. This situation can pose challenges for the quality of PSOs, particularly on projects that require substantial input from experienced resources but face time constraints, often due to concerns about project profitability.

Project fees also have a significant impact on revenue generation within companies and the compensation of both existing and new staff. The fees charged and profit margins earned on projects are crucial for ensuring the financial sustainability of companies and their ability to recruit and retain competent staff. When a company's financial sustainability is at risk, it hinders the company's ability to attract and retain the competent resources necessary for project delivery and the production of high-quality PSOs. In some instances, companies choose to consciously price low to either enter a new market, generate cash flow or increase price competitiveness. In these instances, high-quality PSOs may still be delivered despite profitability on projects being minimal or non-existent.

Despite concerns among built environment professionals regarding the impact of insufficient fees on the quality of PSOs, the case studies revealed that, even when faced with perceived low fee levels, the built environment professionals consistently upheld a baseline level of acceptable quality on projects. This commitment to maintaining quality regardless of fee levels underscores the professionalism of built environment professionals, ensuring the consistent production of PSOs to an appropriate standard of care. This unwavering commitment to an appropriate standard of care remains a hallmark of the industry's professionalism, despite challenges related to fees.

The findings on how and to what extent fees influence the quality of PSOs offer clients and project stakeholders a fresh perspective on how fees can shape project outcomes. The findings better equip clients to manage fees and expectations linked to fee levels when delivering projects. Clients are now more conscious of the challenges consultants face with inadequate fees due to the interplay of fees and other variables. The insights in this study can assist clients to proactively manage risks associated with inadequate fees on projects and mitigate potential quality issues.

6.3 Contributions to Knowledge

This study provides contributions to both academia and industry as described below.

6.3.1 Contribution to Academia

This study contained four contributions to academia.

1. A stratified, discipline-specific study and a detailed analysis of key factors influencing the quality of PSOs were notably absent from the construction literature. This study makes a significant contribution to the construction literature by providing a stratified analysis of the key factors influencing the quality of PSOs across different built environment disciplines. To date, this study represents one of the most extensive investigations in terms of the number of participants and offers discipline-specific analyses of the key factors influencing the quality of PSOs. The study encompasses various built environment disciplines, including architects, civil/structural engineers, electrical engineers, mechanical engineers, and quantity surveyors. Previous research predominantly presented combined analyses, grouping professionals as either “consultants” or “designers”. Only three prior studies conducted limited discipline-specific investigations into the factors influencing the quality of design documentation.
2. This study provides a significant contribution to the South African construction literature by researching key factors that influence the quality of PSOs across various major built environment disciplines, including architecture, civil/structural engineering, electrical engineering, mechanical engineering, and quantity surveying. To date, only one other study has been conducted in the South African context, which investigated the factors affecting the quality of design documentation in the field of civil engineering.

3. This study followed a rigorous research design and clearly articulated how and to what extent fees influence the quality of PSOs. Previous international and South African studies have not provided a comprehensive examination of how fees charged by built environment professionals impact the quality of PSOs. Furthermore, the construction literature lacks discourse regarding the extent to which fees influence the quality of PSOs.
4. From a theoretical perspective, this study contributes to motivation theory by addressing a previously unexplored aspect: the role of fees on built environment professionals as a social grouping. While this research acknowledges the crucial role of fees across the different built environment disciplines, the data suggests that, even in the presence of lower fees, a minimum acceptable level of PSO quality is generally maintained. The need for built environment professionals to uphold this baseline level of PSO quality, regardless of their remuneration, aligns with the theory of professionalism and the established principles of what it means to be a true professional.

6.3.2 Contribution to Industry

The primary contribution to the industry is the identification of key factors influencing the quality of PSOs in major built environment disciplines. Project stakeholders can critically assess and control the key factors identified in this study, before and during project implementation, to ensure the production of good-quality PSOs on projects, thereby contributing to successful construction project outcomes.

The contribution, which focuses on the relationship between fees and PSO quality, offers clients and consultants a fresh perspective on how fees can impact PSO quality. This comprehensive understanding can be used by both parties to proactively manage risks associated with inadequate fees on projects and mitigate potential quality issues.

6.4 Limitations of the Research

Limitations of the study are provided below.

- One of the main limitations of this study was the small number of participants from the electrical and mechanical engineering disciplines. Participation from these two disciplines was challenging due to their relatively small representation in the construction industry when compared to other, bigger disciplines such as architects or civil/structural engineers. To compensate for the small sample of mechanical and

electrical engineering participants during the industry-wide survey, the second stage of the research design included a vastly experienced participant (with over 50 years of experience) who served as managing director of a successful mechanical and electrical consulting engineering firm for over 30 years and had in-depth knowledge about project delivery in a consulting engineering environment. The participant was included to improve the validity of the findings.

- Built environment disciplines participating in this study were limited to architects, civil/structural engineers, electrical engineers, mechanical engineers and quantity surveyors.
- Quality in the context of this study was limited to the quality of PSOs. PSOs were defined as project documents used by contractors to construct infrastructure, e.g., BoQ, drawings and technical specifications. The parameters used when considering the concept of quality were limited to accuracy, clarity, completeness, and certainty.
- A causal analysis between the relationship of key variables was not conducted in this study.
- During the data collection phase of this study, a longitudinal time horizon was not employed due to time constraints.

6.5 Recommendations for Future Work

While this study has illuminated key factors influencing the quality of PSOs from the perspectives of built environment professionals, additional research on fees and the quality of PSOs from a client perspective may be necessary. Studies from a client perspective were previously undertaken in the UK (Hoxley 2000; 2007) and Hong Kong (Lam, 2012). However, there is scope for a similar study in the South African context.

Another recommendation for future work involves conducting an analysis of the causal relationships between the key variables identified in this study. This could be followed by the development of a framework for managing these key variables as part of project delivery best practices, thereby improving project outcomes.

6.6 Conclusion to This Chapter

This chapter offers concluding remarks on the study and addresses the research questions established at the beginning of the study. The first question aimed to identify the key factors influencing the quality of PSOs in the construction industry. Key factors for architects, civil/structural engineers, and electrical engineers include fees, experience, and the time

available to produce PSOs. Quantity surveyors added another factor, available information, while the mechanical engineering discipline identified experience, fees, and project briefs as key factors.

This chapter also delves into the second research question, which seeks to explain the significance of these key factors on PSO quality. Notably, it is observed that, for most disciplines, fees do not dominate as the primary factor influencing PSO quality. Instead, fees interact with other key factors and have varying significance among disciplines. The chapter provides a detailed explanation of how fees influence the quality of PSOs produced by built environment professionals. It outlines the intricate interplay between fees, time, and resources. Additionally, it highlights that professionalism within the industry contributes to maintaining a baseline of acceptable quality, even in the face of challenges related to fee levels.

The contribution to knowledge was divided into contributions to academia and industry. The two significant academic contributions are as follows: Firstly, the study provided a discipline-specific analysis of key factors influencing the quality of PSOs in the construction industry, filling a gap in the literature. Secondly, it offered a detailed explanation of how and to what extent fees charged by built environment professionals influence PSO quality. From an industry perspective, the study's findings can be used to assess and control key factors influencing PSO quality, to ensure the production of good-quality PSOs on projects.

Future work in this area should focus on the client's perspective around fees and the quality of PSOs. While built environment professionals advanced several key factors influencing the quality of PSOs (including fees), it will be interesting to obtain perspectives from clients using project-specific data about whether the level of fees has compromised the quality of PSOs on projects. Similar studies were undertaken in the UK and Hong Kong. Nevertheless, gaining a South African perspective on this matter is valuable as it will provide clarity from a client's standpoint about the relationship between fees and the quality of PSOs. Additionally, future work could involve developing a framework for managing the key factors identified in this study as part of project delivery best practice to improve project outcomes.

References

Abdel-Razek, R.H. (1998). *Factors affecting construction quality in Egypt: identification and relative importance*. Engineering, Construction and Architectural Management, 5(3): 220 – 227.

Abu Fatawu, I.A., Sidik, M.A. and Fortunatus, M. (2020). *Assessing the Factors that Cause Poor Quality of Design and Contract Documentation and the Influence on Project Implementation in Ghana*. Civil and Environmental Research, 12(7): 70-83.

Abdul Rehman, A. and Alharthi, K. (2016). *An introduction to research paradigms*. International Journal of Educational Investigations, 3 (8):51-59.

Adams, J. S. (1963). *Towards an understanding of inequity*. Journal of Abnormal and Social Psychology, 67(5): 422–436.

Akampurira, E. and Windapo, A. (2018). *Factors influencing the quality of design documentation on South African civil engineering projects*. Journal of the South African Institution of Civil Engineering, 60(3): 41 – 48.

Ali, A.S. and Au-Yong, C.P. (2021). *Risk factors in the refurbishment design process: the case of Malaysia*. International Journal of Building Pathology and Adaptation, Ahead of print.

Alridge, A. and Levine, K. (2001). *Surveying the social world: Principles and practice in survey research*. Buckingham, Open University Press.

Andi and Minato, T. (2003). *Design documents quality in the Japanese construction industry: factors influencing and impacts on construction process*. International Journal of Project Management, 21(7): 537 – 546.

Assaf, S., Hassanain, M. A., & Abdallah, A. (2018). *Review and assessment of the causes of deficiencies in design documents for large construction projects*. International Journal of Building Pathology and Adaptation, 36(3): 300–317.

Awolesi, J.A.B. and Ayedun, C.A. (2012). *An Assessment of the Effect of Remuneration on the Construction Performances of the Professionals in the Nigerian Building Industry*. Mediterranean Journal of Social Sciences, 3(1): 401–412.

Bauer, B. and Heck, D. (2015). *Price Pressure on Planners' Fees and its Impact on the Planning Quality*. International Structural Engineering and Construction Conference, 1191-1196.

Berry, L.L., Parasuraman, A. and Zeithaml, V.A. (1988). *The Service-Quality Puzzle*. Business Horizons, Sep-Oct: 35-43.

Bonner, S. E., Hastie, R., Sprinkle, G.B., and Young, S.M. (2000). *A review of the effects of financial incentives on performance in laboratory tasks: implications for management accounting*. Journal of Management Accounting Research, 12: 19–64.

Boyatzis, R. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, California: Sage.

Braun, V. and Clarke, V. (2006). *Using thematic analysis in psychology*. Qualitative Research in Psychology, 3: 77–101.

Brinkmann, S. and Kvale, S. (2015). Conducting an interview. Interviews: Learning the craft of qualitative research interviewing. Sage, Thousand Oaks, CA.

Bryman, A. and Bell, E. (2011). *Business Research Methods Third Edition*. Oxford: Oxford University Press.

Bubshait, A.A., Al-Said, F.A. and Abolnour, M.M. (1998). *Design fee versus design deficiency*. Journal of Architectural Engineering, 4(2): 44–46.

Bubshait, A.A., Faroof, G., Jannadi, M.O. and Assaf, S.A. (1999). *Quality practices in design firms.* Construction Management and Economics, 17(6): 799 – 809.

Burati, J. L., Farrington, J. J. and Ledbetter, W. B. (1992). *Causes of quality deviations in design and construction*. Journal of Construction Engineering and Management, 118(1): 34–49.

Carr-Saunders, A. M., and Wilson, P. A. (1933). *The Professions*. Oxford: Clarendon Press.

Cerasoli, C.P., Nicklin, J.M. and Ford, M.T. (2014). *Intrinsic motivation and extrinsic incentives jointly predict performance: A 40-year meta-analysis*. Psychological Bulletin, 140(4): 980 – 1008.

Chen, L., Gopal, Krishnan, G.V. and Yu, W. (2018). *The relation between audit fee cuts during the global financial crisis and earnings quality and audit quality*. Advances in Accounting, 43 (Nov): 14–31.

Cirelli, L. R. (2017). *Impact of design fees and duration of design process on construction quality: implications for quality management.* Doctor of Business Administration Dissertation. Baker College. Michigan.

Climent-Serrano, S., Bustos-Contell, E., Labatut-Serer, G. and Rey-Marti, A. (2018). *Low-cost trends in audit fees and their impact on service quality*. Journal of Business Research, 89 (Aug): 345–350.

Cohen, L., Manion, L. and Morrison, K. (2007). *Research Methods in Education Sixth Edition*. London and New York, Routledge.

Competition Commission South Africa (CCSA). (2016). *Competition Commission South Africa Annual Report 2015/2016.* Competition Commission South Africa: South Africa.

Condly, S.J., Clark, R.E. and Stolovitch, H.D. (2003). *The effects of incentives on workplace performance: A meta-analytic review of research studies.* Performance Improvement Quarterly, 16(3): 46 – 63.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches.* 3rd Edition. Thousand Oaks, California: Sage.

Darwish, M.I. (2005) Factors affecting design and documentation quality in construction industry, MSc thesis, King Fahd University of Petroleum and Minerals, Saudi Arabia.

Deci, E.L. and Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, Plenum Press.

DeFraites, A. A. (1989). *Fee versus Quality*. Journal of Professional Issues in Engineering, 115(2): 125–128.

Department of Public Service and Administration (DPSA). (2013). Guideline on Hourly Fee Rates for Consultants. Department of Public Service and Administration: Pretoria.

Dosumu, O., & Iyagba, R. (2013). *An Analysis of the Factors Responsible for Errors in Nigerian Construction Documents.* Ethiopian Journal of Environmental Studies and Management, 6(1): 49-57.

Dosumu, O., Idoro, G. and Onukwube, H. (2017). *Causes of errors in construction contract documents in Southwestern, Nigeria*. Journal of Construction Business and Management, 1(2): 11-23.

Elliott, P. (1972). The sociology of the professions. London, Macmillan.

Engineering Council of South Africa (ECSA). (2011). *Engineering Profession Act (46/2000): Guideline for Services and Processes for Estimating Fees for Persons registered in terms of the Act*. Gazette No. 34875. Board Notice 206. South Africa: Engineering Council of South Africa.

Engineering Council of South Africa (ECSA). (2017). *Code of Conduct for Registered Persons: Engineering Profession Act (46/2000)*. Gazette No. 40691. Board Notice 142. South Africa: Engineering Council of South Africa.

Evetts, J. (2003). *The sociological analysis of professionalism: Occupational change in the modern world*. International Sociology, 18(2): 395 – 415.

Fellows, R. and Liu, A. (2015). *Research methods for construction*. West Sussex, John Wiley and Sons.

Francis, J.J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M.P. and Grimshaw, J.M. (2010). *What is an adequate sample size? Operationalising data saturation for theory-based interview studies*. Psychology and health, 25(10): 1229-1245.

Garbers, Y. and Konradt, U. (2014). *The effect of financial incentives on performance: A quantitative review of individual and team-based financial incentives*. Journal of Occupational and Organizational Psychology, 87(1): 102 – 137.

Gill, J. and Johnson, P. (2002). *Research methods for managers*. 3rd Edition. London, Sage Publications.

Govender, N., Laryea, S. and Watermeyer. R. (2022). *A framework for assessing quality of tender documents*. Built Environment Project and Asset Management, 12(4):573-589. DOI: https://doi.org/10.1108/BEPAM-07-2021-0094.

Gransberg, D.D., Del Puerto, C.L. and Humphrey, D. (2007). *Relating Cost Growth from the Initial Estimate to Design Fee for Transportation Projects*. Journal of Construction Engineering and Management, 133(6): 404–408.

Grönroos, C. (1984). *A Service Quality Model and its Marketing Implications*. European Journal of Marketing, 18(4): 36 – 44.

Herzberg, F. (1974). *Motivation-hygiene profiles: Pinpointing what ails the organization*. Organizational Dynamics, 3(2): 18-29.

Hoitash, R., Markelevich, A. and Barragato, C. A. (2007). *Auditor fees and audit quality*. Managerial Auditing Journal, 22(8): 761-786.

Hoxley, M. (2000). *Are competitive fee tendering and construction professional service quality mutually exclusive?* Construction Management and Economics, 18(5): 599 – 605.

Hoxley, M. (2007). *The fee tendering and service quality issue revisited*. Property Management, 25(2): 180–192.

Hughes, W. and Hughes, C. (2013). *Professionalism and professional institutions in times of change*. Building Research and Information, 41(1):28-38. doi: https://doi.org/10.1080/09613218.2013.737096

Hughes, W., Champion, R. and Murdoch, J. (2015). *Construction contracts: law and management*. 5th edition. London, Routledge.

International Organization for Standardization (ISO). (2015). *ISO 9000:2015 Quality management systems – Fundamentals and vocabulary*. Geneva: ISO.

Jenkins, G.D., Mitra, A., Gupta, N. and Shaw, J.D. (1998). *Are financial incentives related to performance? A meta-analytic review of empirical research.* Journal of Applied Psychology, 83(5): 777 – 787.

Knight, A. and Ruddock, L. (2008). *Advanced research methods in the built environment.* London, Wiley-Blackwell.

Kohn, A. (1993). *Why incentive plans cannot work.* Harvard Business Review, 71(5): 54 – 63.

Koutsikouri, D., Austin, S., & Dainty, A. (2008). *Critical success factors in collaborative multi-disciplinary design projects*. Journal of Engineering, Design and Technology, 6(3): 198–226.

Kuzel, A. J. (1992). *Sampling in qualitative inquiry*. In B. F. Crabtree & W. L. Miller (Eds.), *Doing qualitative research* (pp. 31–44). Sage Publications, Inc.

Lam, T. Y. M. (2012). *Economic perspective on outsourcing of property management services.* Property Management, 30(4): 318–332.

Laryea, S., Watermeyer. R. and Govender, N. (2021). *The influence of fees on the quality of professional services in South Africa*. Proceedings of the Institution of Civil Engineers - Management, Procurement and Law, 174 (4): 163 - 173.

Leedy, P.D. and Ormrod, J.E. (2015). *Practical Research: Planning and Design*. 11th Edition. Sussex, Pearson Education Limited.

Liebenberg, J.J.E. and Wilson, S.J. (2011). *Tendering for Professional Services: Both Sides of the Coin*. Proceedings, 10th Conference on Asphalt Pavements for Southern Africa, 11-14 September, KwaZulu-Natal, South Africa.

Ling, F. Y. Y. (2004). *Consultancy Fees: Dichotomy between A/E's Need to Maximize Profit and Employers' Need to Minimize Cost.* Journal of Professional Issues in Engineering Education and Practice, 130(2): 120–123.

Lopez, R., Love, P.E.D., Edwards, D.J. and Davis, P.R. (2010). *Design Error Classification, Causation, and Prevention in Construction Engineering*. Journal of Performance of Constructed Facilities, 24(4): 399–408.

Love, P.E.D., Edwards, D.J. and Smith, J. (2006). *Contract documentation and the incidence of rework in projects.* Architectural Engineering and Design Management, 1(4): 247 – 259.

Malinda, M.J.K. (2017). *Quality of project documentation as a major risk source in infrastructure projects in South Africa.* MEng (Civil Engineering) Dissertation. Stellenbosch University.

Marisa, A. and Yusof, N.A. (2020). *Factors influencing the performance of architects in construction projects.* Construction Economics and Building, 20(3): 20–36.

Mason, M. (2010). *Sample size and saturation in PhD studies using qualitative interviews.* In Forum qualitative Sozialforschung/Forum: qualitative social research, 11 (3).

McChesney, K. and Aldridge, J. (2019). *Weaving an interpretivist stance throughout mixed methods research.* International Journal of Research & Method in Education, 42(3): 225-238.

McGrath, J.E., 1981. *Dilemmatics: The Study of Research Choices and Dilemmas.* American Behavioral Scientist, 25(2): 179-210.

Moos, M.F. (2017). *The Impact of the Current Public Sector Procurement System on the Consulting Engineering Industry.* MPhil (Civil Engineering) Dissertation. University of Cape Town.

Okonkwo, P.N. and Wium, J. (2018). *Impact of discounted professional fees on the risk exposure of civil and structural engineering services consultants in South Africa.* Journal of the South African Institution of Civil Engineers, 60(1): 10 – 20.

Oyedele, L.O. and Tham, K.W. (2007). *Clients' assessment of architects' performance in building delivery process: Evidence from Nigeria*. Building and Environment, 42(2007): 2090 – 2099.

Parks, G. A., & McBride, R. R. (1987). *Competitive Bidding for Engineering Services.* Journal of Professional Issues in Engineering, 113(1): 66–76.

Patton, M.Q. (1999). *Enhancing the quality and credibility of qualitative analysis.* Health Sciences Research, 34 (5): 1189-1208.

Patton, M.Q. (2002). *Qualitative Evaluation and Research Methods 3rd Edition*. Thousand Oaks, California: Sage.

Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1985). *A Conceptual Model of Service Quality and its Implications for Future Research.* Journal of Marketing, 49 (4): 41-50.

Philips-Ryder, M., Zuo, J. and Jin, X.H. (2013). *Evaluating document quality in construction projects – Subcontractors' perspective.* International Journal of Construction Management, 13(3): 77 – 94.

Phua, F.T.T. (2005). *Determining the relationship between fee structure and project performance between firms: an empirical study based on institutional and task environment perspectives*. Construction Management and Economics, 23(1): 45-56.

Pink, D. (2009). *Drive: The surprising truth about what motivates us*. New York, The Penguin Group.

Quapp, U. & Holschemacher, A. (2021). *Appropriateness of Fees for Construction Planning Services of Architects and Civil Engineers as a Question of Morality*. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction: 13(2): 04521004.

Saunders, M. & Townsend, K. (2016) *Reporting and justifying the number of interview participants in organization and workplace research*. British Journal of Management, 27: 836–852.

Saunders, M., Lewis, P. and Thornhill, A. (2019). *Research Methods for Business Students Eighth Edition.* Harlow: Pearson Education Limited.

Salehi, M., Komeili, F. and Gah, A.D. (2019). *The impact of financial crisis on audit quality and audit fee stickiness: evidence from Iran*. Journal of Financial Reporting and Accounting, 17(2): 201–221.

Shaw, J.D. and Gupta, N. (2015). *Let the evidence speak again! Financial incentives are more effective than we thought.* Human Resource Management Journal, 25(3): 281 – 293.

Shrestha, P. P., & Mani, N. (2014). *Impact of Design Cost on Project Performance of Design-Bid-Build Road Projects.* Journal of Management in Engineering, 30(3): 04014007.

Slater, R. and Radford, A. (2012). *Perceptions in the Australian building industry of deficiencies in architects' design documentation and the effects on project procurement*. Australasian Journal of Construction Economics and Building, 8(1): 23 – 33.

South African Council for the Quantity Surveying Profession (SACQSP). (2013). *Code of Professional Conduct published in terms of the quantity surveying professions Act 2000 (Act No. 49 of 2000).* South Africa: South African Council for the Quantity Surveying Profession.

Sporrong, J. (2011). *Criteria in Consultant Selection: Public Procurement of Architectural and Engineering Services,* Australasian Journal of Construction Economics and Building, 11(4): 59-76.

Suseno, N.S. (2013). *An empirical analysis of auditor independence and audit fees on audit quality*. International Journal of Management and Business Studies, 3(3): 82–87.

Tilley, P.A. and McFallan, S. L. (2000). *Design and Documentation Quality Survey Comparisons of Designers' and Contractors' Perspectives*. Australia: CSIRO – Building, Construction and Engineering.

Turin, D.A. (1973). *The Construction Industry: Its Economic Significance and its Role in Development*. London, University College Environmental Research Group.

Watermeyer, R. (2018). *Client guide for improving infrastructure outcomes.* University of the Witwatersrand, Johannesburg.

Watermeyer, R. (2020). *Practice note: Control framework for infrastructure delivery management.* University of the Witwatersrand, Johannesburg.

Wells, J. (1987). *The Construction Industry in Developing Countries: Alternative Strategies for Development*. London, Croom Helm Ltd.

Wiley, C. (1997). *What motivates employees according to over 40 years of motivation surveys.* International Journal of Manpower, 18(3): 263–280.

Wilkinson, D. and Birmingham, P. (2003). *Using research instruments: a guide for researchers.* London, Routledge Falmer.

Wimalasiri, V. P., Beesley, N., Cheyne, A. and Daniels, K. (2010). *Social construction of the aetiology of designer error in the UK oil and gas industry: a stakeholder perspective*. Journal of Engineering Design, 21(1): 49–73.

Winch, G., Usmani, A. and Edkins, A. (1998). *Towards total project quality: a gap analysis approach*. Construction Management and Economics, 16(2): 193–207.

Yin, R.K. (2009). *Case study research: Design and methods.* 4th Edition. Thousand Oaks, Sage Publications.

Zidan, A. (2013). *Factors Affecting Design Quality in Construction Industry in Syria.* Damascus University Journal. 29(2): 95-108.

Appendix A: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Govender

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H22/01/05**
PROJECT TITLE	Determinants of Professional Service Output Quality in the Construction Industry
INVESTIGATOR(S)	Mr N Govender
SCHOOL/DEPARTMENT	Construction Economics and Management/
DATE CONSIDERED	28 January 2022
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	27 February 2025

DATE 13 September 2022 **CHAIRPERSON** _____
(Professor J Watermeyer)

cc: Supervisor : Professor S Laryea

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

Neil Govender
_____
Signature

14 / 09 / 2022
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Govender

CLEARANCE CERTIFICATE **PROTOCOL NUMBER: H22/01/05**

PROJECT TITLE Determinants of Professional Service Output Quality in the Construction Industry

INVESTIGATOR(S) Mr N Govender

SCHOOL/DEPARTMENT Construction Economics and Management/

DATE CONSIDERED 28 January 2022

DECISION OF THE COMMITTEE Approved
Phase one of the project has full ethics clearance. Phase two: data collection cannot commence until permission letters are submitted to the HREC Non-Medical Committee for phase two
Risk Level: Minimal

EXPIRY DATE 27 February 2025

DATE 28 February 2022 **CHAIRPERSON** _____
(Professor J Watermeyer)

cc: Supervisor : Professor S Laryea

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Neil Govender

Signature

02 / 03 / 2022

Date

Appendix B: Participation Information Sheets

TO WHOM IT MAY CONCERN

Survey participant information sheet for study entitled "Determinants of Professional Service Output Quality in the Construction Industry"

My name is Neil Govender, I am a registered PhD student at the University of the Witwatersrand. I am conducting a study that seeks to evaluate the key determinants of Professional Service Output (PSO) quality in the construction industry. I am working under the supervision of Professor Samuel Laryea and Dr Ron Watermeyer.

PSOs in the context of this study includes production information (e.g. drawings and specifications) prepared by built environment professionals. Quality relates to PSOs that have a high level of accuracy, clarity and completeness. As part of the first stage of my research design, I prepared a survey to identify factors influencing PSO quality in the construction industry. The survey questions are based on projects that are implemented using a "design by Employer" approach.

As a built environment professional, I would like to invite you to participate in this survey. The information that you provide will be used as part of the data collection for the study. The survey is expected to take no longer than 10 minutes.

There are no other personal costs for you to participate in this research. You will not receive any direct benefits from participation however, your participation will assist in addressing the ongoing debate around PSO quality in the construction industry. There are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. Completing and submitting the survey is taken as consent to participate however, you may withdraw at any time or choose not to answer any questions. The information that you provide will be kept confidential and held securely on a password protected laptop. Please also note that it is possible that information from the survey may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be documented in a thesis which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you. With your permission the data collected from this research project may be used by other researchers in an anonymised format. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Researcher: Mr Neil Govender

Email: 699591@students.wits.ac.za; Telephone: 082 587 4200

Supervisor: Prof Samuel Laryea

Email: samuel.laryea@wits.ac.za; Telephone: 011 717 7657

Co-supervisor: Dr Ron Watermeyer

Email: watermeyer@ioptions.co.za; Telephone: 011 781 2289

TO WHOM IT MAY CONCERN

Dear Participant,

Interview participant information sheet for study entitled "Determinants of Professional Service Output Quality in the Construction Industry"

My name is Neil Govender, I am a registered PhD student at the University of the Witwatersrand. I am conducting a study that seeks to evaluate the key determinants of Professional Service Output (PSO) quality in the construction industry. I am working under the supervision of Professor Samuel Laryea and Dr Ron Watermeyer.

PSOs in the context of this study includes production information (e.g. drawings and specifications) prepared by built environment professionals. Quality relates to PSOs that have a high level of accuracy, clarity and completeness. As part of the second stage of my research design, I have carefully selected consulting companies and projects they have undertaken to form part of this study. The projects undertaken by the consulting companies will be assessed as case studies. The case studies will involve interviewing stakeholders on projects to develop an in-depth understanding of various factors influencing quality of PSOs on those projects.

As part of this study, I would like to invite you to participate in an interview. The information that you provide through the interview will be used as part of the data collection for the study. The interview is expected to take no longer than 30 minutes and will be scheduled at your convenience. Anonymity in the interviews cannot be guaranteed as you may already know or be known to other participants in your project team. Due to the COVID 19 pandemic, it is anticipated that the interview will be conducted using a virtual platform such as Microsoft Teams. With your permission, I would also like to record the audio of this virtual interview.

There are no personal costs for you to participate in this research. You will not receive any direct benefits from participation however, your participation will assist in addressing the ongoing debate around PSO quality in the construction industry. There are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or choose not to answer any questions. The information that you provide will be kept confidential and held securely on a password protected laptop. Please also note that it is possible that the information from the interview may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be documented in a thesis which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you. With your permission, the data collected from this research project may be used by other researchers in an anonymised format. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Researcher: Mr Neil Govender

Email: 699591@students.wits.ac.za; Telephone: 082 587 4200

Supervisor: Prof Samuel Laryea

Email: samuel.laryea@wits.ac.za; Telephone: 011 717 7657

Co-supervisor: Dr Ron Watermeyer

Email: watermeyer@ioptions.co.za; Telephone: 011 781 2289

Appendix C: Industry Wide Survey Questionnaire

General Notes:

1. Professional Service Outputs (PSOs) in the context of this study includes production information (e.g. drawings and specifications) prepared by built environment professionals at tender & construction stage.

2. Quality relates to PSOs that have a high level of accuracy, clarity and completeness.

3. The survey questions are based on projects that are implemented using a "design by Employer" approach.

Section 1 – General Information

Name:	
Qualifications:	
Professional registration:	
Years of experience:	
Occupation:	e.g. Civil Engineer, Architect, Quantity Surveyor, Project Manager.
Employer	e.g. Client, Contractor & Consultant

Based on your experience, list the key factors that influence quality of Professional Service Outputs (PSOs)

Section 2 – Client related factors influencing quality of PSOs

Please select the appropriate box that indicates the extent to which you believe the following factors influence quality of PSOs produced by built environment professionals.

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Unrealistic client expectations regarding the time required to produce PSOs						
The quality of the project brief provided by the client						
Client's project experience/ knowledge						
Client's technical expertise						
Numerous changes to project requirements/ scope by client						
Insufficient and/or missing information supplied by the client						
Provision of wrong or conflicting information by the client						
Client's insistence to commence procurement & construction stages						

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
before completion or signing off detail designs						
No key person from the client that is responsible for coordination and providing information						
Uncertainty regarding implementation of construction due to lack of client funds						
Delay in processing consultant's payments						
Client's inefficiency in decision-making process						
Client type (Public or private)						
Client's quality management system						
Technical criteria developed by the client to procure consultants						
Client's use of preferential procurement criteria (e.g. Broad Based Black Economic Empowerment) to procure consultants						
Client's selection of consultants based on lowest price						
Client's lack of participation on the project						
Client's low priority on professional standards						

Section 3 – Company related factors influencing quality of PSOs

Please select the appropriate box that indicates the extent to which you believe the following factors influence quality of PSOs produced by built environment professionals.

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Quality assurance and control processes either internal or ISO accredited						
Training of project resources						
Project resources overloaded with work						
Lack of relevant software						
High staff turnover						
Mentorship/supervision of junior staff						
Organisational structure						
Profitability on the project						
Project resources that lack technical skills/experience						
Company's professional experience						
Synergies with partner companies on the project team						

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Size of projects						
Complexity of projects						
Identification of project risks						
Inappropriate project management practices						

Section 4 – Built environment professional's (i.e. registered professionals on projects) factors influencing quality of PSOs

Please select the appropriate box that indicates the extent to which you believe the following factors influence quality of PSOs produced by built environment professionals.

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Planning/allocation of time on projects by built environment professional						
Reuse of documents and details from previous projects without fully aligning them to the project						
Conducting due diligence on PSOs before moving to the next project stage						
Professionalism of built environment professional						
Technical knowledge of built environment professional						
Innovation of built environment professional						
Conducting design optimisation/ value engineering						
Integration across design disciplines						
Co-ordination with other disciplines/team members						
Improper use of design software/ technology by built environment professional						
Failure of built environment professional to review the work of subordinates						
Built environment professional's unfamiliarity with construction techniques and materials						
Heavy workload on built environment professional						
Poor communication with the project team						
Built environment professional's failure to understand the client brief						
Built environment professional having experience on similar projects						
Motivation of built environment professional						

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Commitment of built environment professional						
Excessive stress on built environment professional						
Interpersonal skills of built environment professional						
Built environment professional's ability to work harmoniously within project teams						

Section 5 – Industry related factors influencing quality of PSOs

Please select the appropriate box that indicates the extent to which you believe the following factors influence quality of PSOs produced by built environment professionals.

Description of factors	Don't know	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Appointing consultants based on lowest fee tendered compromises quality						
Shortage of skilled professionals in the industry						
Decline of professional standards						
Decline in capability of university graduates						
Poor quality of registered professionals (i.e. registered professionals lacking sufficient technical knowledge)						
Fragmented nature of the industry (e.g. disparity in size, skillset and resources among organisations)						
Frequent statutory changes in regulations and requirements						
Competitive nature of the industry						
Ineffective strategies to procure consultants						
Use of targeted enterprises on projects						

Section 6 – Conclusion

Please indicate if there are any factors that contribute to quality of PSOs that have not been mentioned in the survey. Kindly also rate the extent to which those factors influence quality of PSOs (from strongly agree to strongly disagree).

Appendix D: Interview Guide – Industry Expert Interviews

Industry Expert Interview

Interview start time:

Interview end time:

Interviewee Details

Qualifications: Professional registration: Years of experience: Nature of experience:

Factors influencing quality of Professional Service Outputs (e.g. drawings and technical documents)

Based on your experience, what are the key factors influencing quality of Professional Service Outputs produced by built environment professionals? Please provide practical examples related to projects.

A survey was conducted with various built environment professionals in South Africa. Preliminary findings from the survey have highlighted several factors which are considered important by built environment professionals. Please comment on whether the following factors (identified from the survey) should be considered as key factors influencing the quality of Professional Service Outputs.

Factor grouping	Factor description	Comment by industry expert
Client factors	Client selection of consultants based on low fees	
	Client's insistence to commence procurement and construction stages before signing off detail design	
	Numerous changes to project requirements/scope by client	
	Unrealistic time expectations	
	Poor brief prepared by the client	

Factor grouping	Factor description	Comment by industry expert
Company factors	Project resources that lack skill/experience	
	Project resources that are overloaded	
	Company's professional experience	
	Training of project resources	
Built environment professional factors	Technical knowledge of built environment professional	
	Failure to review work of sub-ordinates	
	Co-ordination with other disciplines	
	Integration with other disciplines	
	Communication amongst the project team	
Industry factors	Appointing consultants based on lowest fee tendered	
	Decline of professional standards	
	Shortage of skilled professionals	
	Ineffective strategies to procure	

Impact of the level of professional fees on quality of Professional Service Outputs produced by built environment professionals

How and to what extent does the level of professional fees impact on quality of Professional Service Outputs?

What challenges arise on projects if the level of professional fees is significantly reduced or "too low"?

Considering the concept of professionalism, please explain if the level of fees should influence quality of Professional Service Outputs?

Do you think that built environment professionals in South Africa/globally are motivated by the level of professional fees to deliver quality Professional Service Outputs?

Appendix E: Interview Guide – Case Studies

Interview Template for Consultants – Technical Lead

Section 1: Background Information

Name:	
Qualifications:	
Years of experience:	
Role on project:	
Scope of project:	
Type of professional services rendered:	

Section 2: Quality of Professional Service Outputs (PSOs) on the project

1. Overall how did the professional team perform? What were the main challenges/issues?
2. Did you have any challenges with the professional team (i.e. related to the issue of deliverables)?
3. Did the Contractor have any issues related to the quality of deliverables?
4. What were the main factors that influenced quality of PSOs on the project?
5. Please substantiate how those factors influenced quality of PSOs?
6. What motivated you and your team to deliver good quality PSOs on the project?

Section 3: The impact of fees on project delivery and quality of PSOs

1. What was the level of fees tendered (as a percentage)?
2. How was the management of the project impacted due to the level of fees tendered?
3. What constraints or challenges did you have due to the level of fees?
4. What aspects of quality on the project was improved/compromised due to the level of fees?
5. Overall, how closely was the level of fees associated with the quality of PSOs on the project?

Interview Template for Consultants – Managing Director

Section 1: Background Information

Name:	
Qualifications:	
Professional registration:	
Years of experience:	
Occupation:	
Built environment profession	e.g. Civil Engineer, Architect, Quantity Surveyor, etc.

Section 2: Approach to tendering and pricing

1. What strategy does your company adopt to get work?
2. What strategy does your company adopt when bidding for work and parameters do you consider when pricing tenders?
3. Does the tendering strategy vary according to Client (i.e. public vs private)?

Section 3: Project implementation

1. How are projects handled/delivered in the firm post award?
2. How are projects managed from a financial perspective after award?
3. What are the key factors that influence quality of deliverables on projects within your firm? Explain.
4. How is quality controlled during projects?
5. How does the project fee influence management and execution of the project?
6. What challenges or constraints does level of fees on a project present?
7. Overall, how closely is the level of fees associated with the quality of PSOs on the project?