



**Examining the drivers and barriers to e-procurement and e-collaboration adoption in
South African Construction- post Covid-19**

by

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ABSTRACT

The uptake of e-procurement in the South African construction industry (SACI) has been generally slow and with no record of e-collaboration uptake. However, the onset of the Covid-19 pandemic presented an opportunity for this to change, due to the new ways of working that had to be adopted as a result of limited in-person contact. This research examines the drivers and barriers of the e-procurement (EP) adoption and e-collaboration (EC) in SACI. It also determines the EC and EP adoption rates and tests whether there are statistically significant differences in the drivers and barriers of EP and EC before versus after the onset of Covid-19.

A questionnaire was compiled using the top drivers and barriers found in the literature review. It was administered online to respondents working for companies listed on the cidb Register of Contractors. This study uses a quantitative research approach and a cross-sectional survey in collecting data. The statistical analysis used is the Paired Sample Sign Test, which calculates the difference between the medians of driver and barrier pairs, consisting of influence levels before and after Covid-19.

This study found that the EP and EC adoption rates increased after the onset of Covid-19, and that Covid-19 itself was a top driver for both EP and EC. The top barriers for EP and EC were (1) unreliable internet service and power supply and (2) benefits to be achieved as a result of EC Software that is not communicated by management, respectively. There is a statistically significant difference in the EP driver 'ease of use of procurement software' and the EP barrier 'unreliable internet service and power supply' before versus after the onset of Covid-19. Thus, the null hypothesis is rejected for this driver and barrier. As for EC, there was a statistically significant difference between the EC driver 'employees' confidence in their technological abilities' and the following five EC barriers: 'benefits ...of EC are not communicated', 'content generated by some employees on EC software is not useful'; 'employees' poor management of multiple tools'; 'the competitive and non-sharing culture ... makes it difficult for EC software to thrive;' and 'employees have limited time during their workday ... before versus after the onset of Covid-19'. Thus, the null hypothesis is rejected for this EC driver and five EC barriers.

The study helps SACI stakeholders to know how they currently fare in terms of EP and EC adoption, and where they should direct efforts to increase it. Increased adoption makes SACI competitive in the global construction space and it also makes their work effective and efficient.

Keywords: *e-procurement, e-collaboration, adoption rate, South Africa, construction, , South African Construction Industry, Covid-19*

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LIST OF ABBREVIATIONS

BIM: Building Information Modelling

B2B: Business-to-Business

B2C: Business-to-Consumer

B2E: Business-to-Employee

B2G: Business-to-Government

C2B: Consumer-to-Business

C2C: Consumer-to-Consumer

cidb: Construction Industry Development Board

CSD: Central Supplier Database

EC: Electronic Collaboration

ECS: Enterprise Collaboration Systems/Software

ECTA: Electronic Communications and Transactions Act

EDI: Electronic Data Interchange

EP: Electronic Procurement

ERP: Enterprise Resource Planning

ESS: Enterprise Social Software

G2B: Government-to-Business

MIS: Mean Item Score

MTEF: Medium Term Expenditure Framework

P2P: Peer-to-Peer

RoC: Register of Contractors

SA: South Africa

SACI: South African Construction Industry

US: United States

CHAPTER ONE

INTRODUCTION

This chapter describes the concepts of electronic procurement and electronic collaboration. It discusses how these concepts evolved and came into existence; how they are intertwined; and their significance for the construction industry. Furthermore, it outlines the background to the study, the problem statement, the knowledge gap, the hypothesis, the research aim, the objectives and the research methodology.

1.1 Background to the study

Electronic procurement, also referred to as e-procurement or supplier exchange, is defined as the procurement of goods, services and works through information technologies – such as Enterprise Resource Planning (ERP) and Electronic Data Interchange (EDI) – that relies on the internet (World Bank, nd, p.8; Farzin & Nezhad, 2010, p.1). Some authors state that e-procurement includes e-tendering, e-catalogue and e-payment (Tran, Nguyen & Nazir, 2016); others add eMRO, web-based ERP, e-sourcing and e- auctioning to the list of EP tools (Chan & Owusu, 2022). Likewise, the United Nations (UN) Procurement Practitioners Handbook (2006) identifies e-tendering to be an aspect of e-procurement that spans only the solicitation and contract award steps of the procurement process. Instead, others like Raju and Feldman (2017) keep e-procurement and e-tendering separate.

The early stages of procurement were based on traditional procurement which was paper-based. Procurement then moved on to adopting electronic systems such as Enterprise Resource Planning (ERP) to support it (UN, 2006). Then after evolving further, internet tools were used to complement traditional procurement, and then finally, these internet tools and platforms are used to fully replace traditional procurement (UN, 2006) in the present day. Some companies have produced EP offerings that are integrated into their ERP software packages (Farzin & Nezhad, 2010).

Electronic collaboration (e-collaboration) is defined as a collaboration that takes place electronically (not limited to a computer device) among participants who are working on the same task (Kock, 2007, p.16). Another term used to refer to e-collaboration is digital collaboration. The name that is commonly given to e-collaboration tools is Enterprise Collaboration Systems/Software (ECS) and these two terms are used interchangeably in this paper. ECS is a

merger of conventional groupware elements, such as emails and calendars with Enterprise Social Software (ESS) like blogs, chatrooms, online databases and social profiles to enable communication, collaboration and data sharing (Greeven & Williams, 2016; Antonius, Xu & Gao, 2015).

Initially, ECS existed as groupware, a tool that enables more collaboration features than those provided by e-mail (Orlikowski, 1995). Groupware is defined as software that is designed to help groups of people work together more effectively ('Groupware', 2022). Electronic collaboration technologies are evolving beyond being just a means for document management (Anumba & Ruikar, 2009). They are also a means of countering the silo approach to working that is characteristic of the construction industry (Merschbrock & Munkvold, 2015), since construction professionals have grappled with coordination and collaboration issues in the design and delivery of projects for decades (Ibrahim, 2013). Web-based collaborative platforms allow users to collaborate; communicate; document, manage, share and retrieve information; coordinate tasks; send instant messages; organise and conduct virtual meetings and conferences; create meeting minutes and tasks; solve problems; and conduct surveys and polls (Costa & Tavares, 2012; Schubert & Glitsch, 2016).

The power of ECS depends on the knowledge, skill and proficiency of the user, because how it can be used and tailored to work for practices are endless (Schubert & Glitsch, 2016). Web-based collaborative platforms are typically managed by owners who control site permissions by granting varying levels of access to different users that depend on contribution and responsibility regarding the project or tasks. Examples of registered EC software used in construction include Microsoft Sharepoint®, Smartsheets®, Asna® and Asite®. Building Information Modelling (BIM) is an example of a process in the construction industry that uses digital collaboration to carry out design work (Merschbrock & Munkvold, 2015).

The burgeoning success of e-commerce retail businesses such as Amazon and eBay inspired businesses in other industries. One of them is construction – exploring the adoption of e-commerce (Raju & Feldman, 2017) to improve business effectiveness and efficiency. The change of a business' processes through digital technology, extending to organizational and cultural change, is termed Digital Transformation (Bikse et al., 2021, p.4). Concepts such as e-commerce form part of the broader digital transformation and its simpler-related concepts of digitization and digitalization agenda.

E-Commerce is defined in different ways. Its most rudimentary definition is that it is the purchasing and selling of goods and services via the Internet (Kamaruzaman et al., 2010, p. 91). On the other hand, Anumba and Ruikar (2002, p. 266) define it from a communication perspective: ‘the electronic delivery of services and information’, and from a business perspective: ‘the automation of business transactions and workflows’. E-commerce consists of the following categories or business models: Business-to-Business (B2B), Business-to-Consumer (B2C) or Consumer-to-Business (C2B), Consumer-to-Consumer (C2C), Business-to-Government (B2G) or Government-to-Business (G2B), Business-to-Employee (B2E), Peer-to-Peer (P2P), and Mobile-Commerce (M-Commerce) (Laudon & Traver, 2014 as cited by Raju & Feldman, 2017). Of these mentioned models, e-procurement is an example of the collective application of B2B, B2E, B2C, and B2G (Gunasekaran et al., 2009), while e-tendering is an example of G2B application (Raju & Feldman, 2017), and e-collaboration is an example of B2E and B2B application.

Out of the identified examples of e-commerce, e-procurement (EP) and e-collaboration (EC) form the focus of this thesis. Both e-procurement and e-collaboration may be used together to carry out construction project work: e-procurement focuses on the procurement stage, while e-collaboration may be used in all the stages of the project lifecycle. The reason for focusing on e-procurement is that its adoption rate in South Africa is very low, 11%, thus this will serve as noted by Iben and Laryea (2015). In addition to that, the number of publications on EP in SA are quite low (Yevu & Yu, 2019). E-collaboration was also chosen as a focus, because it has been touted as a stimulant for improved transparency, integration and productivity in the construction industry (Merschbrock & Munkvold, 2015). However there are little to no published papers about the adoption of EC in the South African Construction Industry (SACI).

Generally, the uptake of EP and EC had been slow, but the onset of the Covid-19 pandemic presented an opportunity for this to change for the better, due to new ways of working that had to be adopted. The first case of the Covid-19 pandemic in SA was detected on 5 March 2020 (National Institute for Communicable Diseases, 2020). As a result of the Covid-19 pandemic, a nationwide lockdown was enforced in SA, which meant that many people – excluding those who were deemed essential – were restricted to their homes and places of work and they could not operate during lockdown level 5 (Disaster Management Act no.57 of 2002, as amended, 2020). Lockdown also meant that in-person meetings or contact for non-essential industries such as construction could not take place. Additionally, people who were infected, or were in contact

with those who had been infected, had to self-isolate. Thus, companies and workers had to adapt to remote working (Ebekoziem & Aigbavboa, 2021; Rehman, Shafiq & Afzal, 2021) and teleworking for work continuation. Teleworking means ‘the act of working from home using the internet and telephone’ (“Teleworking”, 2022), and remote working are closely related as it means ‘the practice of an employee working from a place other than their organization’s place of business’ (“Remote working”, 2022). Olatunji et al. (2021) noted that remote working that was required in the post Covid-19 period, provided an opportune environment to support e-procurement adoption. The same could be said for e-collaboration, since it involves people working together on a task electronically.

The percentage adoption rate of e-procurement in SACI has been documented to be as low as 11% (Ibem & Laryea, 2015) – far lower than in other developing countries. As for e-collaboration, there are limited reported studies on the percentage adoption rate within SACI. This reality is unexpected, given that e-procurement and e-collaboration have been more effective and efficient compared to traditional methods across different studies worldwide. This should have resulted in widespread adoption thereof, but this is not the case. Factors such as unreliable IT infrastructure, high cost of investment, security concerns, lack of management support and fear of job loss (Yevu, Yu & Darko, 2021; Ibem and Laryea, 2015) have been mentioned as some of the barriers for e-procurement adoption. It is worth investigating whether this is still the case.

1.2 Problem Statement

There is a low adoption rate of e-procurement in SACI, due to unreliable IT infrastructure, high cost of investment, security concerns, a lack of management support and fear of job loss. There are limited studies focused on e-procurement in SA, and this does not allow for a comparative review regarding SACI to either validate or refute these studies. Past studies on SACI’s e-procurement were limited to identifying drivers and barriers and technological tools used, while no such studies were done on e-collaboration in SACI.

Furthermore, the onset of the Covid-19 pandemic and its resultant restrictions and lockdowns in SA necessitated remote work and telework in different industries’ work practices, including the construction industry. Therefore, this research examines the influence of the drivers and barriers of e-procurement and e-collaboration adoption in SACI, and whether Covid-19 served as a driver to increase adoption, or as a barrier to the adoption of e-procurement and e-collaboration in SA.

The above-mentioned slackness in uptake and the scarcity of literature necessitates further research.

1.3 Research Aim

The research examines whether there are differences in the drivers and barriers regarding the adoption of e-procurement and e-collaboration in the SA construction industry pre and post the Covid-19 pandemic.

1.4 Research Objectives

- a. Determine the level of e-procurement and e-collaboration used in the construction industry before and after Covid-19.
- b. Identify the drivers and barriers for the adoption of e-procurement before and after Covid-19.
- c. Identify the drivers and barriers for the adoption of e-collaboration before and after Covid-19.
- d. Determine whether Covid-19 is a significant driver for the adoption of e-procurement and e-collaboration in the South African construction industry.
- e. Establish whether there are significant differences in the drivers and barriers for the adoption of e-procurement and e-collaboration in the South African construction industry pre and post Covid-19.

1.5 Research Question

What differences exist in the types of drivers and barriers for the adoption of e-procurement and e-collaboration in the SA construction industry pre and post the Covid-19 pandemic?

1.6 Research Hypothesis

H_A: There are significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

H₀: There are no significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

1.7 Research Methodology

Firstly, a systematic literature review was conducted to gather information on the drivers and barriers for e-procurement and e-collaboration. These drivers and barriers were used to develop a framework. Secondly, a questionnaire was compiled using the top drivers and barriers found in the framework and this was administered online for respondents working for companies listed in the South African Construction Industry Development Board's (cidb) Register of Contractors (RoC). Lastly, the analysis of the data gathered was conducted using Mean Item Score (MIS) and the Paired sample sign test.

1.8 Limitations

The statistical test of choice had to be changed during the course of this study. Initially the study was designed to use the Wilcoxon Signed Rank Test since it would have determined whether there is a statistically significant difference between the drivers and the barriers before and after the onset of Covid-19. The Wilcoxon Signed Rank Test would have provided the magnitude of the differences in the drivers and barriers at the two time points and would have thus been more powerful than the Paired Sample Sign test which only provides the signs of the differences. The reason why the Wilcoxon Signed rank Test could not be used is that the data violated the symmetrical distribution assumption.

1.9 Scope of Study

This study focuses on e-procurement and e-collaboration adoption within the South African construction industry pre and post the onset of Covid-19. To form a framework of drivers and barriers of e-collaboration/ECS, literature on ESS drivers and barriers is also included, because there is a shortage of literature that focuses solely on e-collaboration/ ECS drivers and barriers. To ensure consistency, the same approach is used when reviewing e-procurement drivers and barriers by including literature on e-tendering drivers and barriers. There is a risk of being susceptible to the fallacy of composition – meaning a failure in logic by reasoning that what is true for the part must be true for the whole. For both e-procurement and e-collaboration, however,

this was mitigated by limiting the papers that report on ESS and e-tendering to a maximum of two, and by only taking out the drivers and barriers that agree with literature focused on e-procurement and e-collaboration.

The respondents of this study are construction companies registered on South Africa's cidb Register of Contractors (RoC) – particularly those listed in Grade levels 7–9. The cidb RoC consists of construction companies that have tendered or wish to tender for construction projects in the public sector, thus excluding construction companies that do not necessarily tender for the public sector, as well as those whose scope of work concerns home building (cidb, 2022). Initially, other construction organizations were considered, however, the population was limited to companies listed on the cidb RoC, since their sampling frame was easier to determine, and because the registered construction professionals would most likely work for those companies.

1.10 Significance of the Study

It is important to know how SACI fares post the e-procurement study conducted by Ibem and Laryea (2015) in 2014, in order for stakeholders in SACI to know whether they should be directing more energy towards promoting e-procurement. Should e-procurement, and if applicable e-collaboration, be found to have low adoption rates, this will indicate that SACI will not enjoy the benefits enjoyed by other construction industries worldwide, and thus they will be at risk to be less competitive and obsolete. SACI cannot afford this risk since the global construction industry is in a highly dynamic and competitive phase, where having IT tools (that support e-procurement and e-collaboration) could provide companies with leverage and competitive advantage (Anumba & Ruikar, 2009). In addition to this, globalization has opened up regional construction industries which were once monopolized and shielded to more competitors (Egbu, Vines & Tookey, 2004). Thus, they need that competitive advantage to stand out.

1.11 Structure of the Research report

This report consists of five chapters.

Chapter one: Introduction

This chapter focuses on describing the concepts of electronic procurement and electronic collaboration and how they integrate into the greater e-commerce model. It discusses how they came into existence and how they evolved; how they are intertwined; and their significance to the construction industry. Furthermore, it outlines the background to the study, the problem statement, the knowledge gap, the hypothesis, the research aim, the objectives and the research methodology.

Chapter two: Literature review

This chapter focuses on the importance of procurement and collaboration within the construction industry, as well as how these two concepts are related digitally. It then discusses Covid-19 and the effect it had on the adoption of e-procurement and e-collaboration in different construction industries. It also delves into the different drivers and barriers for e-procurement and e-collaboration, resulting in frameworks created from literature that are later used to create the questionnaire.

Chapter three: Research Methodology

In this chapter, the research approach and philosophy is described, the different categories of the study population are enumerated and the sample size is determined. Furthermore, the methods of data collection, the types of data collected and the methods of data analysis are discussed. Finally, the validity and reliability of the study together with the ethical considerations are also discussed.

Chapter four: Results and Analysis

In this chapter the results of the survey are presented and analysed using the inferential statistics to answer the research question.

Chapter five: Conclusion and Recommendations

This chapter discusses conclusions derived from the analysis of the results, and thereafter offer recommendations on how e-procurement and e-collaboration adoption can be improved. Following this chapter there are also appendices attached and a list of references.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review starts with discussing the importance of EP and EC in SACI and then the digital link between EP and EC. Thereafter, papers that reported on e-procurement and e-collaboration adoption rates worldwide and then within the South African (SA) construction industry are discussed. Following that, papers that reported the effect of Covid-19 on digital transformation and its associated electronic technology are reviewed. Finally, drivers and barriers for e-procurement and e-collaboration identified in literature are discussed.

2.2 The importance of procurement and collaboration in the SA construction industry

To illustrate the importance of public procurement as it relates to the SA construction industry, the 2022 Medium Term Expenditure Framework (MTEF) – which outlines the spending plans of national and provincial government over a three-year period – is estimated at R812.5 billion for public infrastructure spending (National Treasury, 2022). Procurement relates to both public and private sector spending. From 2010 to 2020, public sector infrastructure spending averaged 5.8%, while private sector spending averaged a considerable 11.2% of the Gross Domestic Product (National Treasury, 2022). To illustrate the importance of public procurement, there is a legal act in SA – the Electronic Communications and Transactions Act (ECTA) – that regulates public procurement, but unfortunately, it does not make specific references to EP, even though its title implies that it is meant to cater for electronic transactions (Anthony, 2018).

E-procurement was born out of a need to bring greater transparency, fairness and accountability to the procurement process, in addition to making it more efficient (Chan & Owusu, 2022). E-procurement also plays a part in the fight against corruption in SACI, since the National Treasury has used it to establish an e-tender publication portal, as well as the Central Supplier Database (CSD) where government tenders are published (Anthony, 2018).

Likewise, e-collaboration was born out of a need to deliver big volumes of data without the time delays, big costs incurred as well as difficulties in reaching certain geographical locations as presented by traditional means (Anumba & Ruikar, 2009). The construction industry is

collaborative, because projects are carried out by teams of people, either within the same company or across different companies. This then necessitates different functions and tasks to be coordinated and integrated, which is where e-collaboration comes in.

2.3 The digital ties between e-procurement and collaboration

Beyond just being examples of e-commerce models, literature indicates that EP and EC overlap in some respects, but they also differ in others. For example, EP has been described as consisting of e-MRO (electronic maintenance, repair and operations), web-based ERP, e-sourcing, e-reverse auctioning, e-informing and e-collaboration tools (Knudsen, 2003; de Boer,). This is because EC offers the functionality of collecting and distributing purchase information; correcting and updating data on product versions; and ensuring that the supplier and buyer agree (Knudsen, 2003) – all of which are functions needed for EP. The fact that the functions of EP and EC overlap, indicates that there is a possibility of merging them in software.

A possible challenge to the above proposition is that literature that speaks of integrating ECS with another e-commerce model-related software, compares ECS with ERP (Enterprise Resource Planning), instead of comparing it directly with EP (Merschbrock & Munkvold, 2015; Lin et al, 2021). ERP acts as a portal – like the internet or like EDI - through which EP can be facilitated (Chan & Owusu, 2022). The differences picked up between EP and EC are that ECS and ERP differ by data structure and application; that ECS contains unstructured data while ERP data is more structured; and that ECS supports collaborative work among employees and is less business critical, while ERP is more process-orientated, supporting repeatable business functions (Merschbrock & Munkvold, 2015). In addition to this, Lin et al (2021) mention that users see ERP use as mandatory, whilst ECS is considered voluntary.

Modern collaborative technology such as Smartsheet, however, proves that EC can also use structured data, be organizational, critical and process-orientated. This was proven by a project run by Carnegie Mellon University Libraries, where Smartsheet was used to codify processes, make management tools uniform, formalize the review and management of projects, and facilitate processes for project team collaboration for both IT and projects (Glenn & Rose, 2019).

2.4 Adoption rate of EP and EC in other countries' construction industries vs SACI

E-procurement adoption in the construction industry has historically lagged behind other industries and this has been attributed to the sector's conservative nature (Laryea & Ibem, 2014)

in adopting new technology. Industries like Information Communications Technology have a 70% adoption rate and the electronic sector of the manufacturing industry has an adoption rate of 52% for e-procurement (Batenburg, 2007). In developed countries, rates of e-procurement adoption are as high as 61.7% in Singapore (Teo, Lin & Lai, 2009); 48% among small and medium enterprises on the south coast of Massachusetts, USA (Gunasekaran et al., 2009); 60% for Germany and Britain and 40% for Poland, Spain, France, Italy and Estonia (Batenburg, 2007).

The adoption rates in fellow developing African countries paint a mixed picture. In Nigeria, the use of e-procurement among construction stakeholders was reported to be as high as 69.5% (Ibem et al., 2021) whilst Tanzania reported that 63.4% of companies that were selected to pilot the Tanzanian National e-Procurement System were not using the system despite being trained on it (Shatta, Shayo & Layaa, 2020). Other developing countries such as China reported an EP adoption rate of 39% among firms (Li et al., 2015).

A 2014 study reported that only 11% of SA construction professionals have used e-procurement (Ibem & Laryea, 2015). This compares unfavourably with both the developing and developed countries mentioned above. However, it is worth highlighting that since the figures on SA were captured in 2014, there could have been an increase in subsequent years. This is illustrated in Afolabi et al's (2019) study with Nigerian respondents who had been using e-procurement for a duration of one to five years and who formed the largest percentage of overall users. The future of EP indicates that it is still an evolving phenomenon, and it is likely to introduce more advanced capabilities incorporating artificial intelligence such as smart contracts (Chan & Owusu, 2022). Since EP is still advancing, this presents more prospects for increased adoption as more and more people, companies and governments learn of its added value. There are no studies that reported on the percentage use of e-collaboration in the construction industry of South Africa or other countries.

2.5 Covid-19 and its effect on digital transformation in the construction industry

The onset of the Covid-19 pandemic accelerated the adoption of digital transformation (Kudyba, 2020; Bikse et al., 2021; Rehman, Shafiq & Afzal, 2021) which had been taking place for years, but at a slow pace. In some countries, the Covid-19 pandemic acted as a driver for the adoption of digital technology. It acted as a driver for digital tools and processes such as BIM, cloud-based collaboration and virtual project management in the United Arab Emirates Construction industry (Rehman, Shafiq & Afzal, 2021), and digital solutions in Latvia, which grew by 10% between May–July 2020 compared to the previous year (Bikse et al, 2021).

In contrast, during the pandemic, the use of digital technologies in the Nigerian construction industry was not as successful as that in developed countries (Ebekoziem & Aigbavboa, 2021). Similarly, Latvian SMEs struggled to adapt to the changing economic climate by modernizing their processes and integrating digital transformation at the pace required (Bikse et al, 2021). However, the pandemic did inspire Nigerian construction stakeholders to reconsider the use of digital technologies (Ebekoziem & Aigbavboa, 2021).

There were no studies conducted on the effect of the Covid-19 pandemic on digital transformation, or the adoption of its associated technology such as EP and EC in South Africa. Thus, it is worth investigating the drivers and barriers for EP and EC before the pandemic to gain an understanding of the situation, and to gather data on how they compare post the onset of the pandemic.

2.6 Drivers and barriers influencing e-procurement adoption

A literature review was conducted where papers that focused on the drivers and barriers for e-procurement in the construction industry were searched and analysed. The results are presented in Tables 1 and 2.

Table 1: EP drivers identified from the reviewed literature

Drivers to EP	Driver Category	Authors				No. of times cited
		Rankin et al. (2006)	Ibem and Laryea (2015)	Eadie, Perera and Heaney (2010)	Li et al. (2015)	
D1_Reduce process, transaction and administrative cost	Technology and process	X	X	X		3
D2_Reduce cycle times for process and transaction	Technology and process	X	X	X		3
D3_Improve response, accuracy and flexibility of process	Technology and process	X		X		2
D4_Ease of use of technology	Technology and process		X		X	2
D5_Reduces paperwork	Technology and process	X	X			2
D6_Increase trust, reliability of the process	Technology and process		X			1
D7_Improve quality of the process	Technology and process			X		1
D8_External pressure from business partners	External				X	1
D9_Enhanced inventory management	Project			X		1
D10_Wider access to suppliers	Project	X				1
D11_Gaining competitive advantage	Company			X		1
D12_Compatibility of technology to company goals	Company		X			1
D13_Perceived efficiency gain	Technology and process				X	1
D14_Availability of adequate technology and internet	Technology and process		X			1
D15_Archiving convenience	Project			X		1
D16_Information sharing culture	Company				X	1
D17_Develops technical skills and competence of staff	Project			X		1
D18_Easily integrates with existing processes and systems	Technology and process		X			1
D19_Top management support	Company				X	1
D20_Available staff expertise in technology systems	Individual				X	1
D21_Staff is adaptable & keen to use technology	Individual		X			1
D22_Availability of policies promoting e-procurement	External		X			1

The drivers for e-procurement shown in Table 1 above, have been distributed into category levels: Technology and process, Project, External, Individual and Company as defined by Yevu & Yu (2019) and Li et al (2015). Though other studies (Eadie, Perera & Heaney, 2010; Ibem & Laryea, 2015) also defined categories to split the drivers into, there was either no explanation of what the different categories meant, or the categorization was not well thought through. For example, there was a general category (Eadie, Perera & Heaney, 2010) with some diverse drivers that could have been split into better-defined categories.

Table 1 illustrates that the Technology and process level category has the most drivers. This category describes the benefits that e-procurement brings to the process of procuring projects (Yevu & Yu, 2019). The top five cited drivers are: reduce process, transaction and administrative cost; reduce cycle times for process and transaction; improve response, accuracy and flexibility of process; ease of use of technology; and reduces paperwork (Rankin et al, 2006; Ibem & Laryea, 2015; Eadie, Perera & Heaney, 2010; Li et al, 2015).

The categories with the second most drivers, as illustrated in Table 1, are the Company level and Project level categories. The Company level category, also referred to as the Organizational category (Li et al., 2015), refers to drivers that inspire management to take up e-procurement (Yevu & Yu, 2019), and examples include gaining competitive advantage and compatibility of technology to company goals. The Project level category refers to the benefits that can be enjoyed (at project level) when e-procurement is used (Yevu & Yu, 2019). Examples include archiving convenience and enhanced inventory management (Eadie, Perera & Heaney, 2010). The description of the Project level drivers matches with that given for the Technology and process-level drivers, and the drivers identified in both categories appear to be benefits.

The categories with the third most drivers are the External level and Individual level – each category has two drivers. The External category refers to drivers influenced by external bodies or organizations involved in the promotion of EP (Yevu & Yu, 2019), and examples include external pressure from business partners, and availability of policies promoting e-procurement (Ibem & Laryea, 2015; Li et al., 2015). The Individual category refers to drivers which describe how people are motivated to promote the adoption of e-procurement (Yevu & Yu, 2019), and examples include staff that is adaptable and keen to use technology and available staff expertise in technology systems (Ibem & Laryea, 2015; Li et al., 2015).

As shown in Table 1 above, the top cited drivers for e-procurement in descending order are: Reduce process, transaction and administrative cost; Reduce cycle times for process and transaction; Improve response, accuracy and flexibility of process; Ease of use of technology; and Reduces paper work (Rankin et al., 2006; Iben and Laryea, 2015; Eadie, Perera & Heaney, 2010; Li et al., 2015). It is worth noting that the first three drivers are tied for first place, while the other two remaining drivers are tied for second place. Each of the remaining nine drivers were each cited once, thus, they are all tied for third place and not listed as key drivers for EP.

On the other end are the barriers for e-procurement which were identified through the literature review and captured in Table 2. There were two instances where certain drivers and barriers are the same, but worded differently. For instance the barrier 'internal and external interoperability of e-procurement software' (Eadie, Perera & Heaney, 2010) is synonymous with the barrier 'finding e-procurement software that interfaces with those of customers and suppliers' (Rankin et al. (2006). Gunasekaran et al. (2009) noted 'security concerns' as a barrier, but that descriptor is very broad and it could encompass all four barriers listed in the 'legal and security' category. Thus, all of them are marked as being identified by Gunasekaran et al. (2009) as well

Table 2: EP barriers identified from literature

Barriers to EP	Barrier Category	Authors						No. of times cited
		Rankin et al. (2006)	Laryea and Ibem (2014)	Ibem and Laryea (2015)	Ibem and Laryea (2017)*	Eadie, Perera and Heaney (2010)	Gunasekaran et al. (2009)	
B1_Resistance to change	Cultural		X	X	X	X	X	5
B2_Lack of technical expertise/skills available	Organizational	X	X		X	X	X	5
B3_Affordability/high cost of investment	Organizational	X	X	X	X	X		5
B4_Electronic authentication and authorization issues	Legal and security		X	X		X	X	4
B5_Unreliable internet service and power supply	Technological		X	X	X	X		4
B6_Security & privacy of data transactions	Legal and security	X	X			X	X	4
B7_Lack of trust and confidentiality	Legal and security			X		X	X	3
B8_Possibility of data loss and system errors	Technological		X	X		X		3
B9_Ability to interface with customers' systems	Technological	X				X		2
B10_Lack of management support	Cultural					X	X	2
B11_Low level of employee training	Organizational			X	X			2
B12_Lack of information technology infrastructure and capability	Technological		X	X				2
B13_Lack of legal rules and regulations for e-procurement	Legal and security				X	X		2
B14_Lack of access to eprocurement technology	Technological		X	X				2
B15_Risk to relationships with customers/no personal interactions	Organizational	X	X					2
B16_Finding suitable tech solution for company	Technological	X				X		2
B17_Magnitude of change	Cultural					X		1
B18_Instability due to new technology adoption	Technological	X						1
B19_Attitude and behaviour	Organizational	X						1
B20_Change in workers' responsibilities	Organizational	X						1

B21_Workers reverting to old system	Organizational	X						1
B22_Staff turnover	Cultural					X		1
B23_Lack of understanding of system benefits	Cultural		X					1

The categories with the highest number of barriers are the Organizational and Technological categories with seven barriers each as illustrated in Table 2. Firstly, the organizational category speaks to the difficulty of EP adoption, due to organizational structures (Yevu, Yu & Darko, 2021). Examples with the highest number of citations are lack of technical expertise/skills available and affordability/high cost of investment (Laryea & Ibem, 2014; Ibem & Laryea, 2015; Ibem & Laryea, 2017; Rankin, Chen & Christian, 2006; Eadie, Perera & Heaney, 2010), which happen to be in the top three barriers of the framework in Table 2. The high cost of investment is not only limited to the initial investment, but also to the maintenance, operation and training costs for EP.

Secondly, the Technological category refers to barriers that are related to the characteristics and qualities of e-procurement technology (Yevu, Yu & Darko, 2021), and the most cited examples include unreliable internet service and power supply, and the possibility of information loss and system errors (Laryea & Ibem, 2014; Ibem & Laryea, 2015; Ibem & Laryea, 2017; Eadie, Perera & Heaney, 2010).

The category with the second highest number of barriers is the Cultural category. This category consists of barriers that encompass human behaviour, beliefs and perceptions that limit EP adoption (Yevu, Yu & Darko, 2021). Examples include resistance to change and lack of management support (Laryea & Ibem, 2014; Ibem & Laryea, 2015; Ibem & Laryea, 2017; Eadie, Perera & Heaney, 2010; Gunasekaran et al., 2009).

Lastly, the Legal and security category involves legal and regulatory barriers challenging EP adoption (Yevu, Yu & Darko, 2021), and examples include security and privacy of data transactions and electronic authentication and authorization issues (Laryea & Ibem, 2014; Ibem & Laryea, 2015; Eadie, Perera & Heaney, 2010; Gunasekaran et al., 2009).

As deduced from Table 2, the top cited barriers for EP in descending order are: Resistance to change; Lack of technical expertise/skills available; Affordability/high cost of investment; Electronic authentication and authorization issues; Unreliable internet service and power supply;

and Security & privacy of data transactions (Rankin et al., 2006; Laryea & Ibem, 2014; Ibem & Laryea, 2015; Ibem & Laryea, 2017; Eadie, Perera & Heaney, 2010; Gunasekaran et al., 2009).

2.7 Drivers and barriers influencing e-collaboration adoption

There is limited research on e-collaboration or ECS drivers and barriers. To broaden the results, literature on the drivers and barriers of ESS – one-half of ECS – was included. The sources of the drivers and barriers on ESS are marked with an asterisk (*) to highlight that they were sourced from literature on ESS.

Table 3: EC drivers identified from the reviewed literature

Drivers to EC	Driver Category	Authors					No. of times cited
		Orlikowski (1995)	Schubert and Glitsch (2016)	Greeven and Williams (2016)	Antonius, Xu and Gao (2015)*	Forstner and Nedbal (2017)*	
D1_Knowledge Management	Organizational		X		X		2
D2_Improved team communication	Organizational		X		X		2
D3_Project Organization	Organizational		X				1
D4_Familiarity with social software	Individual				X		1
D5_Confidence in technological abilities	Individual				X		1
D6_Frequency of access to internet use	Individual				X		1
D7_Co-workers in geographically dispersed locations	Organizational				X		1
D8_Employee size	Organizational				X		1
D9_ (Anticipated) changing work tasks	Complexity				X		1
D10_Managing information overload	Complexity				X		1
D11_Organization culture of collectivism	Culture				X		1
D12_ Understanding of knowledge strategy	Knowledge strategy				X		1
D13_Positioning of ESS	Knowledge strategy				X		1
D14_User training	Knowledge strategy				X		1
D15_Accessability of information and help files	Knowledge strategy				X		1
D16_ESS perceived to make work more effective and efficient	Perceived ease of usefulness				X		1
D17_ Easy to learn and operate	Perceived ease of usefulness				X		1

The drivers identified for ECS are knowledge management, project organization and the need for better team communication. Knowledge management speaks to the sharing of knowledge or information (Schubert & Glitsch, 2016). ESS – the one-half of ECS – adoption is driven by: Individual factors (familiarity with social media; confidence in social media use; and frequency of access to internet); Organizational factors (Co-workers in geographically dispersed locations; reliance on knowledge related tasks); Task complexity (managing information overload); Culture

(Collectivism); Knowledge Structure (positioning of ESS; accessibility of information and user files); Perceived usefulness (ESS perceived to make work tasks more effective and efficient); and Perceived ease of use (easy to learn and use) (Antonius, Xu & Gao, 2015). The ESS drivers are incorporated, because if a factor affects ESS, it will also affect ECS in the same way that e-tendering drivers and barriers affect EP.

The literature review conducted and shown in Table 3 indicates that the top cited drivers of e-collaboration are: Knowledge Management and Improved team communication (Schubert & Glitsch, 2016; Antonius, Xu & Gao, 2015). The rest of the drivers were only cited once.

Table 4: EC barriers identified from the reviewed literature

Barriers to EC	Barrier Category	Authors					No. of times cited
		Orlikowski (1995)	Emmanuel et al. (2018)	Greeven and Williams (2016)	Antonius, Xu and Gao (2015)*	Forstner and Nedbal (2017)*	
B1_Lack of processes/standards	Business/Operation		X	X		X	3
B2_Lack of management commitment	Culture			X		X	2
B3_Unwillingness to learn ECS & reliance on other systems	Attitude/Behaviour		X	X			2
B4_Inappropriate or missing goals & benefits	Business/Operation			X		X	2
B5_Misalignment of project & enterprise goals	Business/Operation			X		X	2
B6_Ineffective ECS content	Technology			X		X	2
B7_Poor management of multiple tool use	Technology			X			2
B8_Perceived costs	Benefits		X	X			2
B9_Competitive and individualistic company culture	Culture	X				X	2
B10_ Low priority placed on ECS	Attitude/Behaviour			X			1
B11_Resistance to change	Culture			X			1
B12_Poor competence in ECS	Technology			X			1
B13_Lack of awareness of ECS	Technology			X			1
B14_Misalignment of company hierarchy and software approach	Business/Operation			X			1
B15_Limited employee time	Business/Operation			X			1
B16_Misuse of time and computing resources	Technology			X			1
B17_Perceived lack of security protection	Benefits			X			1
B18_ Sense of missing recognition for ownership of data	Benefits			X			1
B19_Influence of competing systems	Technology					X	1
B20_Software features inadequate	Technology					X	1
B21_Lack of training	Business/Operation		X				1

The barriers to e-collaboration are categorized according to: ‘Attitude/ behaviour’, which refers to the attitude and consequent reaction of employees in response to EC implementation; ‘Culture’ which refers to the values and norms within the company; ‘Business/ Operation’ which speaks to

challenges that result when work is done without clear specifications and objectives; ‘Technology’ which refers to challenges associated with working with the ECS technology itself and ‘Benefits’ which speaks to the arguable benefits of using ECS where the advantages are perceived to be outweighed by the disadvantages (Greeven & Williams, 2016).

Some of the identified barriers for the adoption of e-collaboration or ECS, together with their categories are: lack of management commitment to implementing ECS and employee resistance to change as a result of identifying with what is familiar (Culture); inappropriate or missing goals and lack of standards and processes that govern the use of ECS (Business); poor employee competence in ECS and ineffective ECS content (Technology in use); unrecognized ECS value-add and perceived costs (Benefits); perception that ECS is not part of paid work thus employees prioritize it last; and unwillingness to learn ECS & reliance on other systems (Employee Attitude or Behaviour) (Greeven & Williams, 2016; Forstner & Nedbal, 2017; Emmanuel et al, 2018). Employees will usually choose the easier route of relying on existing systems – especially if they are still made available – to carry out their work instead of taking on the task to learn a new skill. If the structural characteristics of a company, such as rewards systems, and work practices and policies are competitive and reward individualistic behaviour, this can act as a barrier to the implementation of collaborative tools (Orlikowski, 1995). This is in direct contrast to a Collectivism culture that can act as a driver.

The barriers that are the most cited, as shown in Table 4, in descending order are Lack of processes/standards; Lack of management commitment; Unwillingness to learn ECS & reliance on other systems; Inappropriate or missing goals & benefits; Misalignment of project & enterprise goals; Ineffective ECS content; Poor management of multiple tool use; Perceived costs; and Competitive and individualistic company culture.

2.8 Key Drivers and barriers of the adoption of E-Procurement and E-Collaboration

The key drivers identified in literature are reduced process, transaction and administrative cost, and reduced cycle times for process and transactions (Yevu & Yu, 2019). The top-ranking drivers for EP adoption in South Africa specifically are: Greater speed of transaction; Lower cost of transaction; and Ease of consultants and contractors to respond electronically to job requirements (Ibem & Laryea, 2015). Overall, it can be summarized that the key drivers have to do with reduced cost and reduced time (or greater speed) for processes and transactions related to EP.

Resistance- to change attitude and behaviour and a lack of trust and confidentiality have been identified as the most prominent barriers to EP, since they have interrelationships with many other drivers (Yevu, Yu & Darko, 2021). In another study that differentiated between developed and developing economies, resistance-to-change attitude and behaviour, unreliable internet and power supply and lack of e-contract enforcement were identified as the key barriers to EP in developing economies (Yevu et al., 2022). The top barriers to EP in South Africa specifically are unreliability of IT infrastructure, which includes power supply interruptions, poor network reception, or no proof that data has been received by the intended recipient and cultural issues. This includes a lack of personal interaction between sender and recipient, resistance to change, and no understanding of benefits to be achieved from EP (Laryea & Ibem, 2014).

The top drivers for e-collaboration are knowledge management and enterprise, or team communication (Schubert & Glitsch, 2016). The key barriers to EC are unclear or misaligned benefits and usability issues (Forstner & Nedbal, 2017).

The reviewed literature on the drivers of e-procurement and e-collaboration adoption consisted of papers that were published prior to the onset of the Covid-19 pandemic in March 2020. Thus, there has been no mention of Covid-19 as a driver to e-procurement or e-collaboration adoption specifically. However, as mentioned in Section 2.5 above, it was identified as a driver for the broader adoption of digital technology. It still remains to be determined whether Covid-19 is a driver for EP and EC adoption. Thus, one of the objectives of this study is to determine whether Covid-19 is indeed a significant driver for either EP or EC adoption.

2.9 Chapter Summary

E-procurement is important to the SA economy since procurement contributes significantly to the GDP, and it has been used as a tool to fight corruption. Meanwhile e-collaboration has been born out of a need for more effective and efficient project management with far less time, cost and geographical constraints. The last reported adoption rate for EP in SACI was 11%, but there is no reported adoption rate for EC.

The key drivers for EP adoption as identified in literature are reduction of transaction, process and administrative cost, and reduced cycle times for procurement processes and transactions.

Meanwhile, the top barriers for EP adoption identified in literature are employees' resistance to change attitude and behaviour, unreliable internet and power supply, lack of trust and confidentiality, and no understanding of benefits to be achieved from EP, among others.

The key drivers for EC adoption are knowledge management and improved team communication. The key barriers for EC adoption are unclear or misaligned benefits and usability issues. The literature shows that e-procurement and e-collaboration share some similar drivers and barriers. The reviewed literature did not mention whether Covid-19 was a driver for either e-procurement or e-collaboration specifically, but instead noted that Covid-19 was a driver for the broader digital transformation agenda. This study seeks to address this gap in literature by determining whether there were significant differences in the drivers and barriers to e-procurement and e-collaboration before the onset of Covid-19 as compared to afterwards.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research approach used; the study population; sampling sizes and techniques; methods of data collection; types of data collected; methods of data analysis; validity and reliability; and ethical considerations.

3.2 Research Approach and Philosophy

Research is conducted to either test and confirm an existing theory or develop a new theory (Saunders, Lewis & Thornhill, 2009). The literature review was used to identify drivers and barriers to both EP and EC in order to test whether there were difference in these drivers and barriers before and after the onset of Covid-19. This implies a deductive approach because the researcher starts with a theory, develops a hypothesis for that theory, gathers and analyses data to test the theory and finally accepts or rejects the hypothesis. This differs from an inductive approach where the researcher explores a phenomenon, identifies a pattern, develops a tentative hypothesis and thereafter develops a theory (Saunders, Lewis & Thornhill, 2009).

The deductive approach is better suited for this study since it makes use of a structured method, in the presence of a clear research question, to analyze data objectively and it uses quantitative methods like statistical analysis to test the theory. The inductive approach would not allow for this statistical analysis since it uses more qualitative methods which are more flexible to allow for new findings where the research question is unclear (Saunders, Lewis & Thornhill, 2009).

The selected quantitative research approach allowed the research objective to be tested by inspecting the relationship between variables (Creswell, 2009). This is also informed by the post positivist worldview, also known as the scientific method that is adopted by the researcher. The post positivist view is based on empirical measurement, observation and theory validation (Creswell, 2009, Saunders, Lewis & Thornhill, 2009).

3.3 Area of the Study

The study examines the drivers and barriers for e-procurement and e-collaboration (digital technology) adoption within the SA construction industry. Thus, the area of study is

interdisciplinary as it combines Construction Economics and Management, and the Internet of Things.

3.4 Study population, sample frame, sample technique and sample size

This section details the study population, sampling technique and sampling size used in the study.

3.4.1 Study population (N) and sample frame

The population – denoted with the capital N – targeted for this research, constitutes active SA construction organizations listed in grades 7–9 on the Construction Industry Development Board (cidb) Register of Contractors (RoC). The register also contains grades lower than 7, but particular focus is cast on companies in grades 7–9, because they are the ones with the greatest turnover and available capital, and thus they are the most likely to be able to afford EP and EC software. Limiting the population to these grades ensures that the data gathered is more consistent, as it is directed to respondents who are able to answer presumably.

Table 5 below shows the minimum turnover, minimum available capital and population numbers across Grades 7 to 9 on the cidb RoC. Some companies carry more than one grading level – for example a company may be graded 7 for electrical works, 8 for general building works and 9 for fire prevention – thus, it was important to ensure that companies do not appear more than once when filters are applied for each grade. To ensure that this was not the case, and to get an accurate study population number, the data from the cidb register was copied to Excel, thus forming the sampling frame. When a company had more than one grading, it was discovered that the cidb had only counted it in the category of its highest grading. The sampling frame may be accessed in Appendix F.

Table 5: Details of active construction companies with the grading 7– 9

Company grade level	Annual turnover	Available capital	No. of active companies
7	R20 000 000	R4 000 000	1197
8	R65 000 000	R13 000 000	561
9	R200 000 000	R40 000 000	227
Total population			1985

Source: cidb (2022)

3.4.2 Sample technique and sample size (n)

Since it is impossible to survey the entire population, a sample needs to be extracted from the population, and this sample is meant to be a representation of the entire population (Sharma, 2017). There are two types of sampling techniques: probability and non-probability sampling (Creswell, 2009; Sharma, 2017). In probability sampling, everyone in the population has an equal chance to be selected, while in non-probability sampling not all members of the population will have an equal chance to be included (Sharma, 2017).

This research uses probability sampling, since all registered and active contracting companies in Grades 7–9 have an equal chance to be selected through a random sampling technique. This is done by using the list of registered and active construction companies with Grades 7–9 as a sample frame and aligned to the quantitative research approach.

It is necessary to calculate the minimum sample size that is required. The sample size is determined, firstly, by calculating the sample size for an infinite population as depicted by Equation 1 below

$$n = \frac{z^2 p(1-p)}{e^2} \quad \text{Equation 1 (Saunders, Lewis & Thornhill, 2009)}$$

where

n is the minimum sample size required

z is the z value corresponding to the level of confidence required (see Table 6 below)

p is the expected prevalence or proportion belonging to the category studied, expressed as a decimal

e is the margin of error, expressed as a decimal.

Below is Table 6 which depicts the different levels of confidence and associated z values needed in the formula above.

Table 6: Levels of confidence and associated z values

Level of confidence	Z value
90% certain	1.65
95% certain	1.96
99% certain	2.57

Source: Saunders, Lewis and Thornhill (2009)

For this study, the chosen confidence level is 95%, and this is the value that researchers commonly use (Saunders, Lewis & Thornhill, 2009). The corresponding z value is 1.96. A proportion amount – p-value of 50% or 0.5 – is assumed. The margin of error is chosen to be 5%, because a margin of error of between 3%–5% is usually used in studies of this nature when using a confidence interval of 95% (Saunders, Lewis & Thornhill, 2009). Thus the values discussed are plugged into Equation 1:

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2}$$

$$= 384.16$$

The above calculation shows that the minimum sample size has 384 participants, but this has to be corrected by the actual population numbers. Thus, the adjusted minimum sample size becomes

$$n' = \frac{n}{1 + \frac{n}{N}} \quad \text{Equation 2 (Saunders, Lewis & Thornhill, 2009)}$$

where n' is minimum adjusted

sample size n is the minimum

sample size

N is the population size

Thus when the known variables are plugged into Equation 2, the adjusted sample size is calculated as 322 as shown below.

$$= \frac{384.16}{1 + \frac{384.16}{1985}}$$

= 321.87

Thus, 322 random registered contracting companies listed in Grades 7–9 of the cidb RoC were selected from the cidb register, and the questionnaire was sent to these companies.

3.4.3 Questionnaire response rate

A high response rate ensures that the sample is more representative of the population and that the results are less likely to be influenced by non-response bias (Saunders, Lewis & Thornhill, 2009). However, in reality, there is likely to be non-responses. Thus, it is suggested that data from non-responses should still be collected to check for bias (Saunders, Lewis & Thornhill, 2009). The responses fell into different response categories, as depicted in Table 7, where the different categories were defined by the Survey Monkey platform.

Table 7: Table depicting the sample apportionment across the different response categories

Response category	Category definition	Original Number (and %) within category
Bounced invitations & Opted out (Unreachable)	0% emails reached respondents and 0% questions answered	121 (37.6%)
Complete refusal	Emails reached respondents but 0% questions answered	126 (39.1%)
Partial response	0% < questions answered <100%	52 (16.1%)
Complete response	100% of questions answered	23 (7.1%)

As seen in column 3 of Table 7, the sample (n=322) was split up into those whose invitations bounced, and those who opted out of participating in Survey Monkey surveys, thus making them unreachable (37.6%); those who did not respond at all to the survey (39.1%); those who responded and partially completed the survey (16.1%); and finally those who completed the full survey (7.1%). All partial responses were used to the point that the surveys were completed.

Thus, the following equations are used to calculate the response rate. The equation uses the terms ‘ineligible respondents’ and ‘unreachable respondents’. An ineligible respondent is defined as a respondent who was selected as part of the sample, but does not meet the requirements of the

research (Saunders, Lewis & Thornhill, 2009) as they are disqualified by certain questions in the questionnaire. An unreachable respondent is one who is selected for a sample, but cannot be located or reached, either because they opted out of receiving survey requests from the Survey Monkey platform, or because their email boxes are no longer active.

Equations 3 and 4 show the total response rate (the total number of responses divided by the total sample number after excluding ineligible respondents) and the active response rate (the total number of responses divided by the total sample number after excluding both ineligible and unreachable respondents).

$$\text{total response rate} = \frac{\text{total number of responses}}{\text{total number in sample}-\text{ineligible}} \quad \text{Equation 3}$$

$$\begin{aligned} &= \frac{75}{322-0} \\ &= 23.3\% \end{aligned}$$

$$\text{active response rate} = \frac{\text{total number of responses}}{\text{total number in sample}-(\text{ineligible}+\text{unreachable})} \quad \text{Equation 4}$$

$$\begin{aligned} &= \frac{75}{322-121} \\ &= 37.3\% \end{aligned}$$

The lower total response rate of 23.3% is in line with the typical construction industry surveys and the higher active response rate of 37.3% surpasses it, thus, this survey is considered to be adequate. Saunders, Lewis and Thornhill (2009) found that postal questionnaires tend to have response rates in the region of 10%–30% . Construction specific surveys such as Akintoye and Main (2007) achieved a 25.2% response rate and Nadim and Goulding (2009) achieved a 20% response rate.

3.5 Methods of data collection

There are various methods of data collection, namely observations, interviews, focus groups, questionnaire surveys and secondary data, among others (Saunders, Lewis & Thornhill, 2009). The chosen method for this study is an online questionnaire survey, because it firstly offers access to the members of the cidb in a convenient way. Secondly, most people consider it to be

authoritative and it is relatively simpler to explain and understand (Saunders, Lewis & Thornhill, 2009). Finally, it is suited because the study is based on a quantitative research approach and positivist philosophy. This section outlines the questionnaire design, administration and collection, as well as the response rate.

3.5.1 Questionnaire design

The questionnaire consists of four sections. The first section is on demographics of the respondents and it is kept to the minimum. This included questions on profession, years of experience, highest education level and location of office, as these were the ones deemed applicable for this study. The second section consists of two questions on the use of EP and EC before and after the onset of Covid. These required ‘yes’ and ‘no’ responses, as well as another two questions on whether Covid caused EP and EC adoption to increase, decrease or stay the same. The third and fourth sections concentrated on the drivers for EP and EC and the barriers for EP and EC, respectively.

Initially, a framework was created from a review of literature. It has four different sections which detailed the following: drivers of e-procurement adoption; barriers of e-procurement adoption; drivers for e-collaboration adoption, and barriers for e-collaboration adoption as depicted in the literature review section of this study. The four sections collectively contained 82 drivers or barriers – an average of 21 each. It would have been impractical to use all 82 to formulate questions, as this would have rendered the questionnaire to be too lengthy and risked the respondents not completing it. The researcher decided to choose a few drivers and barriers from EP and EC, and developed questions about the drivers and barriers in such a way that respondents would be able to express their perceptions about their influence on EP and AC adoption, using responses on a 5-point Likert scale ranging from 1 (no influence) to 5 (strong influence). The respondents had to pick a response from the Likert scale before and after the onset of Covid.

The questionnaire was sent to the supervisor, screened and sent back with comments of required modifications to make the questions clearer. This was to reduce misinterpretation from the respondents and to add certain questions. The questionnaire was revised accordingly. The final questionnaire used is in Appendix B.

3.5.2 Questionnaire administration and collection

After obtaining questionnaire and ethics approval, the questionnaire was administered through the internet on a survey platform called Survey Monkey. The questionnaire was accompanied by a cover letter (Appendix C) and invitations were sent to 322 randomly selected companies listed

in Grades 7– 9 of the cidb RoC. The questionnaire was posted for 6 weeks from 28 September 2022 to 11 November 2022, and reminders to complete the questionnaire were sent to the collectors twice a week.

3.6 Types of data collected

This study is based on primary data gathered through the online survey questionnaire. The data is split into different types in accordance with the set-up of the questionnaire.

3.6.1 Descriptive/Nominal data

The first section of the questionnaire consists of demographic questions which have answers that are unambiguous and that could not be ranked or quantified. This is called descriptive or nominal data. Even though the data is descriptive, the aim was to count the frequency of responses across the different categories (Saunders, Lewis & Thornhill, 2009).

3.6.2 Dichotomous data

The next section of the questionnaire sought to determine the use of e-procurement and e-collaboration before and after Covid-19. Thus, two responses were required from each question in each case – either a ‘yes’ or ‘no’. The fact that responses could only belong to one of the two categories makes this data dichotomous (Saunders, Lewis & Thornhill, 2009).

3.6.3 Ordinal data

The next two sections of the questionnaire make use of ranked or ordinal data which was gathered by way of Likert scales. The first of these uses a 3-point Likert scale to determine whether Covid-19 caused e-procurement and e-collaboration – decrease, stay the same or increase.

The last section made use of a 5-point Likert scale ranging from 1 (no influence) to 5 (major influence) to gauge the perception of respondents on the influence of certain drivers and barriers on EP and EC adoption before and after the onset of Covid-19.

3.7 Methods of data analysis

The study uses data analysis methods such as descriptive and inferential statistics.

3.7.1 Descriptive Statistics

Descriptive analysis was the very first analysis conducted to create a summary from the data obtained about the sample and to describe it. Some of the descriptive data was analyzed by frequency and percentage in each category, and for the drivers and barriers the mean item score (MIS) was calculated to rank the responses received. This score is shown in Equation 5 below.

$$MIS = \frac{5M5+4M4+3M3+2M2+1M1}{M5+M4+M3+M2+M1} \quad \text{Equation 5}$$

Additionally, the dichotomous data was also analyzed by using percentages to compare with the previous study conducted by Ibem and Laryea (2015) on EP use in SA, and then to also newly report on EC use in SA.

3.7.2 Inferential Statistics

Inferential analysis was also used in the study, as it allowed sample data for generalizations about the entire population, and this could not have been possible with just Descriptive Analysis (Saunders, Lewis & Thornhill, 2009). The type of Inferential Statistics that is used is the Paired sample sign test, using SPSS which is suitable for analysing if there are median differences in sample pairs (Laerd Statistics, nd). This test is used instead of a t-test or a Wilcoxon signed-rank test, because the distribution of the median difference is neither normal nor symmetrical, respectively (Laerd Statistics, nd). In this study the Paired Sample Sign Test is used to compare the differences between drivers and barriers for EP and EC before and after the onset of Covid-19. The test uses a binomial distribution to compute the significance value (p-value) and the formula is indicated below:

$$P(x \text{ successes}) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x} \quad \text{Equation 6 (Laerd Statistics, nd)}$$

where

P = binomial probability

n= number of trials

x = number of times for a specific outcome within n trials

p = probability of success on a single trial

The Paired Sample Sign test requires that certain assumptions should be passed before it can be used. The first assumption is that the dependent variable should be on an ordinal or continuous scale. The second assumption is that the independent variable should consist of two categorical matched pairs, where each participant's feedback was measured on two occasions on the same dependent variable. The third assumption is that the matched observations from each respondent should be independent (Laerd Statistics, nd).

The sign test produces negative differences, positive differences and ties. The negative differences are the pairs of drivers and barriers where the influence value before Covid-19 was higher than the influence value afterwards. The positive differences are the pairs of drivers and barriers where the influence value before Covid-19 was lower than the influence value afterwards. The ties are the driver and barrier pairs where the influence value before and after Covid-19 was the same. The p-value is calculated by SPSS, and if it was done manually, it would be using Equation 6. If the p-value is less than the alpha value – also known as the level of significance, which is $\alpha=0.05$ – there is a statistically significant difference between the variable pair. If it is more than the alpha value, then there is no statistically significant difference between the variable pairs.

3.8 Reliability

Reliability refers to the way in which the data collection techniques and processes used in this study would produce the same results if they are replicated on a different occasion or by a different researcher (Saunders, Lewis & Thornhill, 2009). The following reliability factors have been considered: the research instrument was reviewed by the supervisor and revised accordingly so questions are not open to misinterpretation; participant bias was also reduced by conducting the survey online; assuring participants of anonymity and the Cronbach's Alpha test was used to determine the level of reliability. The Cronbach Alpha test determines the level of internal consistency among individual responses to questions on a scale. A value of 0.7 or above indicates high reliability (Saunders, Lewis & Thornhill, 2009).

In this case there are nine scales as shown in Table 8, together with the Cronbach Alpha values for those scales, as well as the number of items in that scale. All Cronbach Alpha values are above 0.7 and therefore indicate high reliability.

Table 8: The Cronbach Alpha reliability results for different scales

Scale	Cronbach's alpha	Cronbach's Alpha based on standardized items	Number of items
Covid-19 influence on EP and EC adoption	0.864	0.881	2
EP drivers before Covid-19 onset	0.942	0.942	8
EP drivers after Covid-19 onset	0.953	0.953	8
EP barriers before Covid-19 onset	0.906	0.912	8
EP barriers after Covid-19 onset	0.941	0.942	8
EC drivers before Covid-19 onset	0.928	0.929	6
EC drivers after Covid-19 onset	0.938	0.940	6
EC barriers before Covid-19 onset	0.932	0.933	7
EC barriers after Covid-19 onset	0.950	0.951	7

3.9 Validity

There are different forms of validity. Construct validity refers to the extent to which a study measures the concept it is supposed to measure (Saunders, Lewis & Thornhill, 2009). To ensure construct validity, the questionnaire questions were formulated from a framework of drivers and barriers of EP and EC adoption that were developed from an extensive literature review. Internal validity refers to the extent to which findings are caused by interventions rather than mistakes in the research design (Saunders, Lewis & Thornhill, 2009). In this research this is demonstrated when proved scientifically that the result of the set of questions have a specific outcome.

3.10 Ethical considerations

In accordance with the Ethics requirements for the Engineering and Built Environment faculty at the University of Cape Town, ethics clearance has to be sought. A pre-screening questionnaire was completed which established that full ethics clearance was needed for this study as it involved human participants. Thereafter, a full ethics application had to be completed on the eRA (Electronic Research Administration) platform, and this required submission of additional documentation. One of the documents required was the Data Management Plan, and this was created using UCT DMP. This outlines the project details, data management, data security and confidentiality, and data sharing (See Appendix E). Other documents required were the ethics cover letter which outlines the research objectives and was issued to potential respondents (Appendix C); the clearance form (Appendix D); and the questionnaire (Appendix B). Ethics

approval was provisionally granted on 15 September 2022 (See Appendix A), with a formal approval on 24 October 2022.

3.11 Chapter summary

This chapter outlined how this study is categorized as a quantitative research method based on the deductive approach used. It also delved into justifying the research approach used and the research data collection method which uses a questionnaire, and data analysis methods which use descriptive and inferential statistics through the Paired Sample Sign test. The total and active response rates are 23.3% and 37.3%, respectively. Ethics considerations, and validity and reliability considerations were also presented.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the results gleaned from the questionnaire responses, the analysis of these results, and finally a discussion on the findings.

4.2 Data Presentation

4.2.1 Demographic data of respondents and representative companies

The purpose of the first part of the questionnaire was to determine the demographic background of the respondents to determine whether they represent the target population. Table 9 presents the responses in terms of the respondents' job title, construction industry experience, and their highest academic qualification. Table 9 indicates that the highest percentage of respondents (49.33%) identified themselves as contractors; the majority (31.88%) have more than 20 years of experience; and most respondents (34.78%) have a diploma.

Table 9: Demographic details of the questionnaire respondents

Demographic category	Response	
	Number	Percentage
1. Job title		
Contractor	37	49.33%
Construction Project Manager	10	13.33%
Construction Manager	6	8%
Quantity Surveyor or Cost Manager	6	8%
Engineer	5	6.67%
Other (Construction related)	8	10.67%
None of the above	3	4%
Total	75	
2. Number of years in construction		
Less than 5 years	6	8.7%
6-10 years	6	8.7%
11-15 years	16	23.19%
16-20 years	17	24.64%
More than 20 years	22	31.88%
None of the above	2	2.9%
Total	69	
3. Highest academic qualification		
Matric/Senior certificate	8	11.59%
Diploma	24	34.78%
Bachelor's degree	16	23.19%
Honors degree	9	13.04%
Master's degree	8	11.59%
Doctoral degree	1	1.45%
Other	3	4.35%
Total	69	

Table 10 presents the responses related to the construction companies for which the respondents work, such as company (head) office location and annual turnover. Table 10 indicates that the highest number of respondents (34.78%) work for companies that are located in Gauteng, and the majority of the companies (44.93%) have an annual turnover of less than R20 million.

Table 10: Demographic details of the companies that the respondents represent

Demographic category	Respondents	
	Number	Percentage
4. Company (head) office location		
Gauteng	24	34.78%
Western Cape	10	14.49%
Limpopo	5	7.25%
Kwa Zulu Natal	13	18.84%
Mpumalanga	8	11.59%
North West	1	1.45%
Northern Cape	1	1.45%
Eastern Cape	5	7.25%
Free State	2	2.90%
Total	69	
5. Company annual turnover		
Less than R20 million	31	44.93%
R20 – R65 million	21	30.43%
R65 – R200 million	7	10.14%
More than R 200 million	10	14.49%
Total	69	

4.2.2 EP and EC adoption rate before and after the onset of Covid-19

In this section, the study sought to know the level of e-procurement and e-collaboration before and after the onset of Covid-19.

Table 11: E-procurement and E-collaboration adoption rates before and after Covid-19

Options	Yes	No	Total
E-procurement use before Covid-19 onset	45.10% 23	54.90% 28	51
E-procurement use after Covid-19 onset	60.78% 31	39.22% 20	51
E-collaboration use before Covid-19 onset	29.41% 15	70.59% 36	51
E-collaboration use after Covid-19 onset	41.18% 21	58.82% 30	51

The findings presented in Table 11 indicate that 45.10% of respondents used e-procurement before the onset of Covid-19 and that figure increased to 60.78% post the onset of Covid-19. Similarly, the use of e-collaboration also increased from 29.41% before the onset of Covid-19, to 41.18% after the onset of Covid-19.

4.2.3 The shift of EC and EP adoption rates post the onset of Covid-19

In this section, the study sought to determine the respondents' perception of how e-procurement and e-collaboration adoption rates shifted, post the onset of the Covid-19 pandemic. The data collected is presented in Table 12.

Table 12: EP and EC adoption rates post the onset of Covid-19

Options	Decrease 1	Stay the same 2	Increase 3	Total
E-procurement adoption post Covid-19	22.45% 11	34.69% 17	42.86% 21	49
E-collaboration adoption post Covid-19	16.33% 8	42.86% 21	40.82% 20	49

Table 12 shows that the majority of respondents (42.86%) believe that there was an increase in the adoption of e-procurement post the onset of Covid-19, while a lesser number (34.69%) believed that there was no change to the adoption of e-procurement. For e-collaboration on the other hand, a majority of respondents (42.86%) believe that there was no change to the adoption

of e-collaboration, while a lesser number (40.82%) believed that there was an increase in the adoption of e-collaboration post the onset of Covid-19

4.2.4 Perceived influence of Covid-19 as a driver for EP and EC adoption

Respondents were also asked to indicate their level of agreement regarding the influence that the Covid-19 pandemic had on e-procurement and e-collaboration adoption. They were presented with a 5-point Likert scale to indicate their views, ranging from strongly disagree (indicating that they thought Covid-19 had no influence) to strongly agree (indicating that they thought it had great influence) that the Covid-19 pandemic was influential on EP and EC adoption. A majority of respondents (52.95% and 64.71%) indicated that they agreed that Covid-19 was influential on EP and EC adoption respectively, as shown in Table 13. Due to the fact that Covid-19 was assessed as a driver for EP and EC, the MIS and ranking of Covid-19 as a driver for EP and EC is included in Tables 15 and 19, respectively.

Table 13: Covid-19 influence on EP and EC adoption

Options	Strongly disagree 1	Disagree 2	Neither agree nor disagree 3	Agree 4	Strongly agree 5	Total
Covid-19 was influential on e-collaboration adoption	2.94% 1	2.94% 1	8.82% 3	64.71% 22	20.59% 7	34
Covid-19 was influential on e-procurement adoption	5.88% 2	8.82% 3	11.76% 4	52.95% 18	20.59% 7	34

4.2.5 Surveyed drivers influence on EP adoption pre and post the onset of Covid-19

In this section, the opinions of respondents on the effects of different drivers on the adoption of e-procurement are presented. Table 14 indicates the effects of the drivers on EP before the onset of Covid-19. The findings indicate that respondents believe that before the onset of Covid-19 ‘improved flexibility’ and ‘improved response time’ were the greatest drivers for e-procurement. The drivers with the least perceived effect on EP adoption before the onset of Covid-19 were ‘ease of use of e-procurement software’ and ‘reduction of paper’.

Table 14: The effect of surveyed drivers on EP adoption before the onset of Covid-19

E- procurement drivers	No influence 1	Limited Influence 2	Moderate influence 3	High influence 4	Very high influence 5	Total Response	Total Score	MIS Score	Rank
Improved flexibility of the procurement process by making it easier either for the client to communicate changing supply requirements or for the contracting company to react to them	8	6	10	5	4	33	90	0.545	1
Improved response time (from either client to bidding company or bidding company to client) during the procurement process	10	5	11	5	3	34	88	0.517	2
Reduction in cycle times for processes and transaction	10	6	10	2	5	33	85	0.515	3
Improved accuracy of the procurement process since e-procurement minimizes errors	10	5	11	5	2	33	83	0.503	4
Availability of policies promoting e-procurement	10	6	10	4	3	33	83	0.503	4
Reduction in process, transaction and administrative cost	9	10	6	6	2	33	81	0.490	5
Reduction of paper work within the contracting or client company	9	7	9	3	4	32	78	0.488	6
Ease of use of eprocurement software	12	8	8	3	2	33	74	0.448	7

Table 15 indicates the effects of the surveyed drivers of e-procurement adoption post the onset of Covid-19. The findings indicate that the following drivers had the greatest perceived effect on EP adoption post the onset of Covid-19: Covid-19 was influential to e-procurement adoption, and reduction of paperwork. The drivers with the least perceived effect on EP adoption were reduction in process, transaction and administrative cost, and improved accuracy of the procurement process.

Table 15: The effect of surveyed drivers on EP adoption after the onset of Covid

After the onset of covid-19									
E- procurement drivers	No influence 1	Limited Influence 2	Moderate influence 3	High influence 4	Very high influence 5	Total Response	Total score	MIS	Rank
Covid-19 was influential on e-procurement adoption	2	3	4	18	7	34	127	0.747	1
Reduction of paper work within the contracting or client company	9	4	5	0	9	27	77	0.570	2
Improved flexibility of the procurement process by making it easier either for the client to communicate changing supply requirements or for the contracting company to react to them	7	6	4	4	6	27	77	0.570	3
Improved response time (from either client to bidding company or bidding company to client) during the procurement process	9	5	3	5	5	27	73	0.541	4
Availability of policies promoting e-procurement	9	5	4	6	3	27	70	0.519	5
Reduction in cycle times for processes and transaction	10	5	4	5	3	27	67	0.496	6
Ease of use of e-procurement software	12	3	3	5	4	27	67	0.496	6
Improved accuracy of the procurement process since e-procurement minimizes errors	10	6	3	2	5	26	64	0.492	7
Reduction in process, transaction and administrative cost	9	7	4	4	3	27	66	0.489	8

4.2.6 Surveyed barriers' influence on EP adoption pre and post the onset of Covid-19

In this section, the effects of different barriers on the adoption of e-procurement are presented.

Table 16 indicates that 'unreliable internet service and power supply' and 'lack of legal rules and regulations for e-procurement' are the barriers with the greatest perceived effect on EP adoption before the onset of Covid-19. The barriers with the least perceived effect on EP adoption before

the onset of Covid-19 are ‘issues with security and privacy of data transactions’; ‘high cost of investment’; and ‘lack of management support’.

Table 16: The effect of surveyed barriers on EP adoption before the onset of Covid-19

Before the onset of covid-19									
E- procurement barriers	No influence 1	Limited influence 2	Moderate influence 3	High influence 4	Very high influence 5	Total Response	Total score	MIS	Rank
Unreliable internet service and power supply within your company	6	5	10	6	2	29	80	0.552	1
Lack of legal rules and regulations for e-procurement within the South African construction industry	6	9	8	5	2	30	78	0.520	2
Lack of technical skills & expertise (digitizing the company’s procurement process, competency in using e-procurement software) needed for e-procurement adoption among employees	6	6	14	4	0	30	76	0.507	3
Resistance to change by employees within your organization	7	7	12	3	1	30	74	0.493	4
Difficulty in finding e-procurement tools that are suitable for your company	10	5	6	5	3	29	73	0.487	5
Lack of management support from within your company (either as the client or contracting company)	10	5	9	5	1	30	72	0.480	6
High cost of investment linked to e-procurement adoption	9	7	9	3	2	30	72	0.480	6
Issues with security and privacy of data transactions	8	9	10	1	2	30	70	0.467	7

Table 17 shows the perceptions of the respondents as they relate to the influence of the surveyed barriers on EP adoption after the onset of Covid-19. The barriers with the highest perceived effect on EP adoption post Covid-19 are ‘unreliable internet service and power supply’; ‘issues with security and privacy of data transactions’ and ‘lack of technical skills & expertise’. The barriers

with the least perceived impact on EP adoption post the onset of Covid-19 are ‘Difficulty in finding e-procurement tools that are suitable for your company’ and ‘High cost of investment linked to e-procurement adoption’.

Table 17: The effect of surveyed barriers on EP adoption after the onset of Covid

After the onset of covid-19									
E- procurement barriers	No Influence 1	Limited influence 2	Moderate Influence 3	High influence 4	Very high influence 5	Total Response	Total Score	MIS	Rank
Unreliable internet service and power supply within your company	3	3	4	7	4	21	69	0.657	1
Issues with security and privacy of data transactions	5	4	5	6	2	22	62	0.564	2
Lack of technical skills & expertise (digitizing the company’s procurement process, competency in using e-procurement software) needed for e-procurement adoption among employees	4	4	7	6	1	22	62	0.564	2
Resistance to change by employees within your organization	4	5	6	6	1	22	61	0.555	3
Lack of legal rules and regulations for e-procurement within the South African construction Industry	5	5	5	4	3	22	61	0.555	3
Lack of management support from within your company (either as the client or contracting company)	6	4	4	6	2	22	60	0.545	4
High cost of investment linked to e-procurement adoption	6	3	6	6	1	22	59	0.536	5
Difficulty in finding e-procurement tools that are suitable for your company	10	3	4	4	1	22	49	0.445	6

4.2.7 Surveyed drivers influencing EC adoption pre and post the onset of Covid-19

In this section, the influence of drivers on e-collaboration adoption before the onset of Covid-19 is presented in Table 18 below. The drivers with the greatest perceived impact on EC adoption

before Covid-19 are ‘frequency of employees’, ‘access to internet use’, and ‘perceived to make work more effective and efficient’. The drivers with the least perceived impact on EC adoption before Covid-19 are ‘electronic collaboration software assists with managing information overload’ and ‘improvement of project team communication’.

Table 18: The effect of surveyed drivers on EC adoption before the onset of Covid-19

Before the onset of covid-19									
E- collaboration drivers	No influence 1	Limited influence 2	Moderate influence 3	High influence 4	Very high influence 5	Total responses	Total score	MIS	Rank
Frequency of employees’ access to internet use	7	7	6	8	5	33	90	0.546	1
Perceived to make work more effective and efficient	6	10	9	5	2	32	83	0.519	2
Improved knowledge management (creating, organizing, using and sharing data) in an organization	8	7	11	3	3	32	82	0.513	3
Employees’ confidence in their technological abilities	7	8	12	5	0	32	79	0.494	4
Improvement of project team communication	8	9	9	7	0	33	81	0.491	5
Electronic Collaboration Software assists with managing information overload	11	7	9	5	1	33	77	0.467	6

The study investigated the e-collaboration drivers after the onset of Covid-19. This data is presented in Table 19. The drivers with the highest effect on EC adoption after the onset of Covid-19 are 'Covid-19 was influential to e-collaboration adoption' and 'Frequency of employees' access to internet use'. The drivers with the lowest effect on EC adoption after the onset of Covid19 are 'Electronic Collaboration Software assists with managing information overload' and 'Improvement of project team communication'.

Table 19: The effect of surveyed drivers on EC adoption after the onset of Covid-19

After the onset of covid-19									
E- collaboration drivers	No influence 1	Limited influence 2	Moderate influence 3	High Influence 4	Very high influence 4	Total responses	Total score	MIS	Rank
Covid-19 was influential on e-collaboration adoption	1	1	3	22	7	34	135	0.794	1
Frequency of employees' access to internet use	5	3	3	6	9	26	89	0.685	2
Perceived to make work more effective and efficient	5	3	8	8	2	26	77	0.592	3
Employees' confidence in their technological abilities	5	6	3	11	0	25	70	0.560	4
Improved knowledge management (creating, organizing, using and sharing data) in an organization	6	3	9	4	3	25	70	0.560	4
Improvement of project team communication	4	7	7	5	2	25	69	0.552	5
Electronic Collaboration Software assists with managing information overload	7	6	4	9	0	26	67	0.515	6

4.2.8 Surveyed barriers influencing EC adoption pre and post the onset of Covid-19

Table 20 shows that respondents perceived that the barriers with the highest effect on EC adoption before the onset of Covid-19 are 'misalignment of company hierarchy and software approach (the way the technology is taught)' and 'employees have limited time during their workday which

restricts their ability to learn how to use e-collaboration tools'. The barriers with the lowest effect on EC adoption before the onset of Covid-19 are 'the competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive' and 'benefits to be achieved as a result of E-Collaboration Software are not communicated by management'.

Table 20: The effect of surveyed barriers on EC adoption before the onset of Covid-19

Before the onset of covid-19									
E- collaboration barriers	No influence 1	Limited influence 2	Moderate influence 3	High Influence 4	Very high influence 5	Total response	Total score	MIS	Rank
Misalignment of company hierarchy and software approach (the way the technology is taught)	5	7	11	6	1	30	81	0.540	1
Employees have limited time during their workday which restricts their ability to learn how to use e-collaboration tools	7	9	4	8	2	30	79	0.527	2
Lack of processes/standards that govern and guide e-collaboration use in your company	7	8	8	6	1	30	76	0.507	3
Employees' poor management of multiple tools to be used for e-collaboration software	6	9	11	2	2	30	75	0.500	4
Content generated by some employees on e-collaboration software is not useful (ineffective) for their colleagues' work because it is not the type of content they need to carry out their work.	9	6	10	3	2	30	73	0.487	5
The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive as its success is based on sharing of information	8	9	8	4	1	30	71	0.473	6
Benefits to be achieved as a result of E-Collaboration Software are not communicated by management for employees to understand and buy into e-collaboration	9	6	11	3	1	30	71	0.473	6

Table 21 indicates that the barriers with the highest influence on EC adoption after the onset of Covid-19 are ‘Benefits to be achieved as a result of EC Software are not communicated by management’ and ‘Employees have limited time during their workday which restricts their ability to learn’. The barriers with the lowest influence on EC adoption after the onset of Covid-19 are ‘The competitive and non-sharing culture in your company makes it difficult for EC Software to thrive’; ‘Lack of processes/standards that govern and guide e-collaboration use’; and ‘Content generated by some employees on e-collaboration software is not useful’.

Table 21: The effect of surveyed barriers on EC adoption after the onset of Covid-19

After the onset of Covid-19									
E- collaboration barriers	No influence 1	Limited Influence 2	Moderate Influence 3	High influence 4	Very high influence 5	Total responses	Total score	MIS	Rank
Benefits to be achieved as a result of E-Collaboration Software are not communicated by management for employees to understand and buy into e-collaboration	4	6	5	4	4	23	67	0.583	1
Employees have limited time during their workday which restricts their ability to learn how to use e-collaboration tools	7	3	2	5	5	22	64	0.582	2
Employees' poor management of multiple tools to be used for e-collaboration software	6	4	6	4	3	23	63	548	3
Misalignment of company hierarchy and software approach (the way the technology is taught)	6	5	3	8	1	23	62	0.539	4
Content generated by some employees on E-Collaboration Software is not useful (ineffective) to their colleagues' work because it is not the type of content they need to carry out their work.	7	3	6	5	2	23	61	0.530	5
Lack of processes/standards that govern and guide e-collaboration use in your company	8	3	4	5	3	23	61	0.530	5
The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive as its success is based on sharing of information	8	5	4	4	2	23	56	0.487	6

4.3 Data analysis

In this section the previously presented data is analyzed to test the research hypotheses which state that:

H_A: There are significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

H₀: There are no significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

4.3.1 Assumption testing before the Paired Sample Sign Test

The Paired Sample Sign Test requires that three assumptions should pass the test before it can be used. The first assumption is passed because the dependent variable (the difference in the drivers and barriers) is on an ordinal scale. The second assumption is passed because the independent variable consists of two categorical matched pairs, that result from asking each respondent for pre and post Covid-19 feedback on drivers and barriers. The third assumption is passed because one participant's feedback does not influence another, since all respondents gave feedback individually through an online-administered survey (Laerd Statistics, nd).

4.3.2 Paired Sample Sign Test for EP drivers and barriers pre and post Covid-19

The Paired Sample Sign Test was run in SPSS and the frequency of the respondents' feedback for the drivers and barriers for EP is recorded in Table 22.

Table 22: Frequencies of differences between EP driver and barrier pairs

Frequencies		N
Q10.2a Reduction in process transaction and administrative cost AFTER Covid - Q10.1a Reduction in process transaction and administrative cost BEFORE Covid...	Negative Differences	2
	Positive Differences	8
	Ties	17
	Total	27
Q10.2b Reduction in cycle times for processes and transactions AFTER Covid - Q10.1b Reduction in cycle times for processes and transactions BEFORE Covid	Negative Differences	1
	Positive Differences	7
	Ties	19
	Total	27
Q10.2c Improved response time during the procurement process AFTER Covid - Q10.1c Improved response time during the procurement process BEFORE Covid	Negative Differences	2
	Positive Differences	9
	Ties	17
	Total	28
Q10.2d Improved accuracy of the procurement process since e-procurement ... AFTER...- Q10.1d Improved accuracy of the procurement process since e-procurement ...BEFORE...	Negative Differences	3
	Positive Differences	6
	Ties	18
	Total	27
Q10.2e Improved flexibility of the procurement process AFTER Covid 19 onset - Q10.1e	Negative Differences	1
	Positive Differences	7

Improved flexibility of the procurement process BEFORE Covid-19 onset	Ties	19
	Total	27
Q10.2f Ease of use of e-procurement software AFTER Covid-19 onset - Q10.1f Ease of use of e-procurement software BEFORE Covid19 onset	Negative Differences	1
	Positive Differences	8
	Ties	18
	Total	27
Q10.2g Reduction of paperwork within the contracting or client company AFTER... - Q10.1g Reduction of paperwork within the contracting or client company BEFORE...	Negative Differences	2
	Positive Differences	7
	Ties	18
	Total	27
Q10.2h Availability of policies promoting e-procurement AFTER Covid-19 onset - Q10.1h Availability of policies promoting e-procurement BEFORE Covid-19 onset	Negative Differences	3
	Positive Differences	8
	Ties	17
	Total	28
Q13.2a Issues with security and privacy of data transactions AFTER Covid-19... - Q13.1a Issues with security and privacy of data transactions BEFORE Covid-19...	Negative Differences	1
	Positive Differences	7
	Ties	14
	Total	22
Q13.2b Resistance to change by employees within your organization AFTER Covid-19... - Q13.1b Resistance to change by employees within your organization BEFORE Covid-19...	Negative Differences	3
	Positive Differences	6
	Ties	13
	Total	22
Q13.2c High cost of investment linked to e-procurement adoption AFTER Covid... - Q13.1c High cost of investment inked to e-procurement adoption BEFORE Covid19...	Negative Differences	1
	Positive Differences	5
	Ties	16
	Total	22
Q13.2dLack of technical skills and expertise needed for e-procurement adoption AFTER... - Q13.1d Lack of technical skills and expertise needed for e-procurement adoption BEFORE...	Negative Differences	0
	Positive Differences	4
	Ties	18
	Total	22
Q13.2e Unreliable internet service and power supply within your company AFTER... - Q13.1e Unreliable internet service and power supply within your company BEFORE...	Negative Differences	0
	Positive Differences	6
	Ties	15
	Total	21
Q13.2f Lack of management support from within your company AFTER Covid-19... - Q13.1f Lack of management support from within your company BEFORE Covid-19...	Negative Differences	1
	Positive Differences	5
	Ties	16
	Total	22
Q13.2g Lack of legal rules and regulations for e-procurement within the South African construction Industry BEFORE... - Q13.1g Lack of legal rules and regulations for e-procurement within the South African construction Industry AFTER...	Negative Differences	0
	Positive Differences	4
	Ties	18
	Total	22
Q13.2h Difficulty in finding e-procurement tools that are suitable to your company BEFORE... - Q13.1h Difficulty in finding e-procurement tools that are suitable to your company AFTER...	Negative Differences	3
	Positive Differences	3
	Ties	16
	Total	22

The statistical significance (p-value) of the sign tests are shown in Table 23 below. The driver pairs ‘ease of use of procurement software’ and the barrier pair ‘unreliable internet service and power supply’, produced p-values that are less than the alpha value at $p=0.039$ and $p=0.031$, respectively. All the other driver and barrier pairs had p-values which were greater than the alpha value.

Table 23: P-values of the sign tests for EP driver and barrier pairs

	Exact Sig. (2-tailed)
Q10.2a Reduction in process transaction and administrative cost AFTER Covid - Q10.1a Reduction in process transaction and administrative cost BEFORE Covid	0.109 ^b
Q10.2b Reduction in cycle times for processes and transactions AFTER Covid - Q10.1b Reduction in cycle times for processes and transactions BEFORE Covid	0.070 ^b
Q10.2c Improved response time during the procurement process AFTER Covid - Q10.1c Improved response time during the procurement process BEFORE Covid	0.065 ^b
Q10.2d Improved accuracy of the procurement process ...AFTER - Q10.1d Improved accuracy of the procurement process ...BEFORE	0.508 ^b
Q10.2e Improved flexibility of the procurement process AFTER Covid19 onset - Q10.1e Improved flexibility of the procurement process BEFORE Covid19 onset	0.070 ^b
Q10.2f Ease of use of e-procurement software AFTER Covid19 onset - Q10.1f Ease of use of e-procurement software BEFORE Covid19 onset	0.039 ^b
Q10.2g Reduction of paperwork within the contracting or client company AFTER... - Q10.1g Reduction of paperwork within the contracting or client company BEFORE...	0.180 ^b
Q10.2h Availability of policies promoting e-procurement AFTER Covid19 onset - Q10.1h Availability of policies promoting e-procurement BEFORE Covid19 onset	0.227 ^b
Q13.2a Issues with security and privacy of data transactions AFTER Covid19 - Q13.1a Issues with security and privacy of data transactions BEFORE Covid19	0.070 ^b
Q13.2b Resistance to change by employees within your organization AFTER Covid - Q13.1b Resistance to change by employees within your organization BEFORE Covid	0.508 ^b
Q13.2c High cost of investment linked to e-procurement adoption AFTER Covid - Q13.1c High cost of investment linked to e-procurement adoption BEFORE Covid	0.219 ^b
Q13.2d Lack of technical skills and expertise needed for e-procurement adoption AFTER... - Q13.1d Lack of technical skills and expertise needed for e-procurement adoption BEFORE...	0.125 ^b
Q13.2e Unreliable internet service and power supply within your company AFTER - Q13.1e Unreliable internet service and power supply within your company BEFORE	0.031 ^b
Q13.2f Lack of management support from within your company AFTER Covid19 - Q13.1f Lack of management support from within your company BEFORE Covid19	0.219 ^b
Q13.2g Lack of legal rules and regulations for e-procurement within the South... AFTER - Q13.1g Lack of legal rules and regulations for e-procurement within the South...BEFORE	0.125 ^b
Q13.2h Difficulty in finding e-procurement tools that are suitable ...AFTER - Q13.1h Difficulty in finding e-procurement tools that are suitable...BEFORE	0.910 ^b

4.3.3 Paired Sample Sign Test for EC drivers and barriers pre and post Covid-19

The sign tests for the drivers and barriers of EC were carried out in SPSS, and the frequencies are recorded in Table 24.

Table 24: Frequencies of differences between EC driver and barrier pairs

Frequencies		N
Q11.2a Improved knowledge management in an organization AFTER Covid19 onset - Q11.1a Improved knowledge management in an organization BEFORE Covid19 onset	Negative Differences	1
	Positive Differences	7
	Ties	17
	Total	25
Q11.2b E-Collaboration Software assists with managing information overload AFTER... - Q11.1b E-Collaboration Software assists with managing information overload BEFORE...	Negative Differences	1
	Positive Differences	7
	Ties	18
	Total	26
Q11.2c Improvement of project team communication AFTER Covid19 onset - Q11.1c Improvement of project team communication BEFORE Covid19 onset	Negative Differences	1
	Positive Differences	7
	Ties	17
	Total	25
Q11.2d Perceived to make work more effective and efficient AFTER Covid19 onset - Q11.1d Perceived to make work more effective and efficient BEFORE Covid19 onset	Negative Differences	1
	Positive Differences	7
	Ties	18
	Total	26
Q11.2e Employees' confidence in their technological abilities AFTER Covid... - Q11.1e Employees' confidence in their technological abilities BEFORE Covid...	Negative Differences	1
	Positive Differences	9
	Ties	15
	Total	25
Q11.2f Frequency of employees' access to internet use AFTER Covid19 onset - Q11.1f Frequency of employees' access to internet use BEFORE Covid19 onset	Negative Differences	1
	Positive Differences	6
	Ties	19
	Total	26
Q14.2a Misalignment of company hierarchy and software approach AFTER... - Q14.1a Misalignment of company hierarchy and software approach BEFORE...	Negative Differences	2
	Positive Differences	3
	Ties	18
	Total	23
Q14.2b Benefits to be achieved as a result of E-Collaboration Software are not...AFTER... - Q14.1b Benefits to be achieved as a result of E-Collaboration Software are not...BEFORE...	Negative Differences	0
	Positive Differences	9
	Ties	14
	Total	23
Q14.2c Content generated by some employees on e-collaboration software is not...AFTER... - Q14.1c Content generated by some employees on e-collaboration software is not...BEFORE...	Negative Differences	1
	Positive Differences	8
	Ties	14
	Total	23
Q14.2d Employees' poor management of multiple tools to be used on e-collaboration AFETR - Q14.1d Employees' poor management of multiple tools to be used on e-collaboration BEFORE...	Negative Differences	1
	Positive Differences	8
	Ties	14
	Total	23

Q14.2e The competitive and non-sharing culture in your company makes it difficult...AFTER... - Q14.1e The competitive and non-sharing culture in your company makes it difficult...BEFORE...	Negative Differences	0
	Positive Differences	6
	Ties	17
	Total	23
Q14.2f Lack of processes and standards that govern and guide e-collaboration use AFTER... - Q14.1f Lack of processes and standards that govern and guide e-collaboration use BEFORE...	Negative Differences	1
	Positive Differences	3
	Ties	19
	Total	23
Q14.2g Employees have limited time during their workday which restricts ...AFTER... - Q14.1g Employees have limited time during their workday which restricts...BEFORE...	Negative Differences	0
	Positive Differences	8
	Ties	14
	Total	22

The statistical significance (p-value) of the sign tests for EC are shown in Table 25 below. The driver pair ‘employees confidence in their technological abilities’ produced a p-value that is less than the alpha value at $p=0.021$. The barrier pairs ‘benefits to be achieved as a result of e-collaboration are not communicated’; ‘content generated by some employees on e-collaboration software is not useful’; ‘employees’ poor management of multiple tools’; the competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive; and ‘Employees have limited time during their work day’, produced p-values that are less than the alpha value at $p=0.004$, $p=0.039$, $p=0.039$, $p=0.031^b$ and $p=0.008^b$, respectively. All the other driver and barrier pairs had p-values which were greater than the alpha value.

Table 25: P-values of the sign tests for EC driver and barrier pairs

	Test Statistics ^a
Q11.2a Improved knowledge management in an organization AFTER Covid19 onset - Q11.1a Improved knowledge management in an organization BEFORE Covid19 onset	0.070 ^b
Q11.2b E-Collaboration Software assists with managing information overload AFTER... - Q11.1b E-Collaboration Software assists with managing information overload BEFORE...	0.070 ^b
Q11.2c Improvement of project team communication AFTER Covid19 onset - Q11.1c Improvement of project team communication BEFORE Covid19 onset	0.070 ^b
Q11.2d Perceived to mak ework more effective and efficient AFTER Covid19... - Q11.1d Perceived to make work more effective and efficient before Covid19...	0.070 ^b
Q11.2e Employees' confidence in their technological abilities AFTER Covid19... - Q11.1e Employees' confidence in their technological abilities BEFORE Covid19...	0.021 ^b
Q11.2f Frequency of employees' access to internet use AFTER Covid19 onset - Q11.1f Frequency of employees' access to internet use BEFORE Covid19 onset	0.125 ^b
Q14.2a Misalignment of company hierarchy and software approach ...AFTER... - Q14.1a Misalignment of company hierarchy and software approach...BEFORE...	0.904 ^b
Q14.2b Benefits to be achieved as a result of E-Collaboration Software...AFTER... - Q14.1b Benefits to be achieved as a result of E-Collaboration Software...BEFORE...	0.004 ^b
Q14.2c Content generated by some employees on e-collaboration software... AFTER... - Q14.1c Content generated by some employees on e-collaboration software...BEFORE...	0.039 ^b
Q14.2d Employees' poor management of multiple tools to be used... AFTER ... - Q14.1d Employees 'poor management of multiple tools to be used ... BEFORE...	0.039 ^b
Q14.2e The competitive and non sharing culture in your company makes ...AFTER... - Q14.1e The competitive and non sharing culture in your company makes ...BEFORE...	0.031 ^b
Q14.2f Lack of processes and standards that govern and guide e-collaboration ...AFTER... - Q14.1f Lack of processes and standards that govern and guide e-collaboration ...BEFORE...	0.625 ^b
Q14.2g Employees have limited time during their workday which restricts ...AFTER... - Q14.1g Employees have limited time during their workday which restricts ...BEFORE...	0.008 ^b

4.3.4 Difference in the MIS rankings for EP drivers and barriers before and after Covid-19

The difference in the ranking of drivers for EP before and after the onset of Covid-19 is shown in Table 26 below. The table captures the difference in the top and bottom two EP drivers before and after the onset of Covid-19.

Table 26: Comparison of ranking of the top and bottom EP drivers before and after the onset of Covid-19

EP driver before Covid-19 onset	EP driver after Covid-19 onset	Rank
Improved flexibility of the procurement process ...	Covid-19 was influential to e-procurement adoption	1
Improved response time ... during the procurement process ...	Reduction of paperwork ...	2
Reduction of paperwork ...	Improved accuracy of the procurement process.	7
Ease of use of e-procurement software	Reduction in process, transaction and administrative cost	8

The difference in the ranking of barriers for EP before and after the onset of Covid-19 is shown in Table 27. The table captures the difference in the top and bottom two EP barriers before and after the onset of Covid-19.

Table 27: Comparison of ranking of the top and bottom barriers for EP before and after the onset of Covid-19

EP barrier before Covid-19 onset	EP barrier after Covid-19 onset	Rank
Unreliable internet service and power supply...	Unreliable internet service and power supply...	1
Lack of legal rules and regulations for e-procurement ...	Issues with security and privacy of data transactions	2
	Lack of technical skills and expertise	
Lack of management support from within your company (either as the client or contracting company)	High cost of investment ...	6
High cost of investment linked to e-procurement adoption		
Issues with security and privacy of data transactions	Difficulty in finding e-procurement tools that are suitable for your company	7

4.3.5 Difference in the MIS rankings for EC drivers and barriers before and after Covid-19

The difference in the ranking of drivers for EC before and after the onset of Covid-19 are shown in Table 28 – the top and bottom two EC drivers before and after the onset of Covid-19.

Table 28: Comparison of ranking of the top and bottom EC drivers before and after the onset of Covid-19

EC drivers before Covid-19 onset	EC drivers after Covid-19 onset	Rank
Frequency of employees' access to internet use	Covid-19 was influential on e-collaboration adoption	1
Perceived to make work more effective and efficient	Frequency of employees' access to internet use	2
Improvement of project team communication	Improvement of project team communication	5
Electronic Collaboration Software assists with managing information overload	Electronic Collaboration Software assists with managing information overload	6

Regarding barriers, Table 29 shows the difference in the ranking of the top and bottom two barriers for EC before and after the onset of Covid-19.

Table 29: Comparison of ranking of the top and bottom EC barriers before and after the onset of Covid-19

EC barrier before Covid-19 onset	EC barrier after Covid-19 onset	Rank
Misalignment of company hierarchy and software approach (the way the technology is taught)	Benefits to be achieved as a result of EC Software are not communicated by management	1
Employees have limited time during their workday which restricts their ability to learn how to use e-collaboration tools	Employees have limited time during their workday which restricts their ability to learn how to use e-collaboration tools	2
Content generated by some employees on e-collaboration software is not useful	Lack of processes/standards that govern and guide e-collaboration use	5
	Content generated by some employees on E-Collaboration Software is not useful	
Benefits to be achieved as a result of E-Collaboration Software are not communicated by management	The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive	6
The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive		

4.4 Discussion of findings

This section of the report focuses on comparing the empirical findings to previous research in the area and discuss it according to the research objectives.

4.4.1 Level of EP and EC adoption in the construction industry before and after Covid-19

In both the EP and EC adoption rates an increase was noticed from pre Covid-19 figures that were also collected in this study. EP adoption increased from 45.10% to 60.78%, while EC adoption increased from 29.41% to 41.18%. The last reported EP adoption rate based on the SA

construction industry was 11%, based on data collected in 2014 (Ibem & Laryea, 2015). This indicates that there is progress with EP uptake. A similar study recently reported EP adoption in Nigeria at 69.5% (Ibem et al., 2021). Thus, at 60.78%, SA is now comparable with fellow developing countries. There was no data found on EC adoption rates from published studies, thus, no comparison can be made.

4.4.2 Identified drivers and barriers for the adoption of EP before and after Covid-19 onset

There was a change in the strongest and weakest drivers for EP adoption before the onset of Covid-19, compared to afterwards. A noteworthy change is how ‘reduction of paperwork’ moved from one of the weakest drivers before to one of the strongest after Covid-19. This is expected, because there was very little to no in-person contact immediately after the onset of the pandemic, as work processes moved online due to the lockdown, thus there was no room for physical transmission of paperwork as employees would have to transmit data online. Previous studies indicated that reduction in paperwork was the most identified driver to EP system adoption (Yevu & Yu, 2019). This adds value to companies that have environmental sustainability goals, since it contributes towards environmental sustainability (Yevu & Yu, 2019).

Moreover, Covid-19 itself was identified as the strongest driver for EP adoption after its onset. This may be because companies were forced by the pandemic to adopt EP, since in-person contact was reduced and thus procurement processes such as submitting tenders and issuing request for quotations would have to move online for the sake of business continuity. The lowest ranking drivers also changed from ‘Ease of use of e-procurement software’ to ‘reduction in process, transaction and administrative cost’, which is unexpected, since it has been identified in literature as one of the two most significant drivers for EP adoption (Yevu & Yu, 2019).

There is moderate change in the strongest and weakest barriers for EP adoption before and after the onset of Covid-19. ‘Unreliable internet service and power supply’ features as the strongest barrier both pre and post the onset of Covid-19. This is expected as it relates to the problem of power cuts in SA, which also influence internet connectivity. South Africa has had issues with rolling blackouts and dubbed load shedding since the end of 2007, and this issue has advanced in recent years (Bashe, Shuma-Iwisi & van Wyk, 2016) up to the present day. Therefore, it makes sense that unreliable internet service and power supply feature in both periods. ‘High cost of investment’ features as one of the weakest barriers in both time periods, and this could be an indication that EP software is either not as expensive as it was formerly believed to be, or the cost is not viewed as that big of a barrier (Yevu, Yu & Darko, 2021). There is agreement to some

extent with previous studies which ranked ‘Unreliable internet service and power supply’ as a top barrier in the infrastructure category, specifically for developing countries. ‘High cost of investment’ ranked lowest in the financial and skill category (Yevu et al., 2021), albeit these rankings are within specific categories and not an indication of overall ranking among all barriers in that study.

Another noteworthy change is that ‘Issues with security and privacy of data transactions’ moved from being the weakest barrier before the onset of Covid-19 to being the second strongest barrier after the pandemic. The fact that this barrier now ranks higher is in agreement with existing literature which rank ‘lack of trust and confidentiality’– a barrier which is synonymous with ‘issues with security and privacy of data transactions’– as one of the two most prominent barriers for EP (Yevu, Yu & Darko, 2021). ‘Lack of technical skills and expertise’ was also in second place, and this speaks to employers and employees to be aware that there are very few to no people who are knowledgeable and competent in using EP software and tools.

4.4.3 Identified drivers and barriers for the adoption of EC before and after Covid-19

There was minimal change in the drivers before the onset of Covid-19, compared to afterwards, because the only difference is Covid-19 became a top driver after its onset, and it overtook ‘frequency of employees’ access to internet use’. Before the onset of Covid-19, the drivers with the greatest perceived impact on EC adoption were ‘frequency of employees’ access to internet use’ and ‘perceived to make work more effective and efficient’. Those with the least perceived impact on EC adoption before Covid-19 were ‘electronic collaboration software assists with managing information overload’ and ‘improvement of project team communication’.

After the onset of Covid-19, the drivers with the highest perceived influence on the adoption of EC are ‘Covid-19 was influential to e-collaboration adoption’ and ‘Frequency of employees’ access to internet use’. The drivers with the lowest effect on EC adoption after the onset of Covid-19 are ‘Electronic Collaboration Software assists with managing information overload’ and ‘Improvement of project team communication’. The reason ‘frequency of employees access to internet’ remained one of the top drivers post Covid, is because most people adopted working remote during this period and they had to make use of technology to connect (Zito et al., 2021). Therefore, as people used the internet to carry out their work, this drove the use of e-collaboration more. Covid itself was an influential driver to EC, because the circumstances surrounding the

pandemic demanded more remote work, which probably inspired companies to adopt EC software.

Regarding barriers, the top barrier changed from being ‘misalignment of company hierarchy and software approach (the way the technology is taught)’ to ‘benefits to be achieved as a result of EC Software are not communicated by management’. The reason for this change could be that the misalignment issue was solved in most companies post Covid-19, since EC adoption did grow. Thus, there was a new top barrier which stood in the way of a higher adoption rate. The reason why management could have failed to communicate benefits, could be because the adoption of EC was hurried after the onset of Covid-19, and management assumed that employees would understand the importance and added-value of EC, given the remote work that the pandemic necessitated. The bottom barrier and the second strongest barrier remained the same, and there were minor changes in the second lowest barriers.

4.4.4 Determining whether Covid-19 is a driver of EP and EC adoption in SACI

As discussed in Sections 4.4.2 and 4.4.3 and indicated in Tables 15 and 19, Covid-19 was found to be a driver for both e-procurement and e-collaboration, respectively. Covid-19 was not only found to be a driver, but was actually a top driver in both instances, and by a great margin when its mean item scores were compared to the second top drivers. This result was expected, because the pandemic forced the construction industry of other countries such as the UAE to adopt technologies (Rehman, Shafiq & Afzal, 2021) which could include EP and EC software.

4.4.5 Determining significant differences in the EP and EC drivers and barriers in SACI

The paired sample sign test was used to analyze the differences in the perceived influence of the driver and barrier pairs of EP and EC before compared to after the onset of Covid-19. For EP, there is a statistically significant difference in the driver ‘ease of use of procurement software’ and the barrier ‘unreliable internet service and power supply’ before versus after the onset of Covid-19. Thus, the null hypothesis is rejected for this driver and barrier only. There is no statistically significant difference between all other drivers and barriers to EP before versus after the onset of Covid-19. Thus, the null hypothesis fails to be rejected for all other drivers and barriers of EP.

For EC, there is a statistically significant difference in the perceived influence of the driver

‘employees confidence in their technological abilities’ before versus after the onset of Covid-19. Additionally there is a statistically significant difference in the perceived influence of the following barriers: ‘benefits to be achieved as a result of e-collaboration are not communicated’; ‘content generated by some employees on e-collaboration software is not useful’; ‘employees’ poor management of multiple tools’; ‘the competitive and non-sharing culture in your company makes it difficult for EC software to thrive’; and ‘employees have limited time during their workday’, before versus after the onset of Covid-19. Thus, the null hypothesis is rejected for the aforementioned driver and barriers. There is no statistically significant difference between all other drivers and barriers for EC before versus after the onset of Covid-19, therefore, the null hypothesis fails to be rejected for them.

4.5 Chapter summary

Post the onset of the pandemic, both EP and EC adoption increased. There were notable differences in the top ranking drivers and barriers identified before versus after the onset of Covid-19 for both EP and EC adoption. Covid-19 was found to be the most influential driver for both EP and EC adoption. There was a statistically significant difference in one driver and barrier of EP, while one driver and five barriers of EC had statistically significant differences before, compared to after Covid-19.

5 CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter links the research aim, objectives and hypothesis with the findings in the summary to confirm that the research question has been answered. The conclusion drawn from the research is discussed and recommendations and areas for further study are also noted.

5.2 Reiteration of research aim, objectives and hypothesis

The aim of this research was to examine the drivers and barriers to the adoption of e-procurement and e-collaboration in the SA construction industry before and after the onset of the Covid-19 pandemic. The following objectives were set:

- a. Determine the level of use of e-procurement and e-collaboration in the construction industry before and after Covid-19.
- b. Identify the drivers and barriers for the adoption of e-procurement before and after Covid-19.
- c. Identify the drivers and barriers for the adoption of e-collaboration before and after Covid-19.
- d. Determine whether Covid-19 is a significant driver of the adoption of e-procurement and e-collaboration in the South African construction industry.
- e. Find out whether there are significant differences in the drivers and barriers for the adoption of e-procurement and e-collaboration in the South African construction industry, pre and post Covid-19.

The research hypothesis stated: There are significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

5.3 Summary of findings

The study achieved its stated objectives. Below is a statement of each objective together with the findings associated with it. Thereafter, the null hypothesis is either rejected or failed to be rejected.

5.3.1 EP and EC adoption rate before and after the onset of Covid-19

Both the EP adoption and EC adoption rates experienced an increase since pre Covid-19 that were also collected in this study. Additionally, the EP rates are also higher than those reported for the South African Construction Industry in published studies. This indicates an upward trend for e-procurement adoption. This was expected, since studies from fellow developing countries such as Nigeria indicated that the biggest uptake in adoption rates occurred five years prior to the study. The evolving nature of EP is also an indicator that adoption will still be on an upward trend for a few years, as the incorporation of innovative artificial intelligence grows and increases EP's value.

There were no published studies on e-collaboration's adoption rate. However, there was a reported increase based on the surveyed adoption rates before and after the onset of the pandemic. This indicates an upward trend which can also be sustained if improvements are done to EC tools and software.

5.3.2 Identified drivers and barriers for EP in SACI

From a ranking perspective, the drivers for e-procurement after the onset of Covid-19 are, in descending order of influence, 'Covid-19 was influential to e-procurement adoption'; 'Reduction of paper work'; 'Improved flexibility of the procurement process'; 'Improved response time'; 'Availability of policies promoting e-procurement'; 'Reduction in cycle times for processes and transaction'; 'Ease of use of e-procurement software'; 'Improved accuracy of the procurement process'; and 'Reduction in process, transaction and administrative cost'. The ranking order for the top drivers differs slightly from literature.

From a ranking perspective, barriers to electronic procurement after the onset of Covid-19 are, in descending order of influence: 'Unreliable internet service and power supply'; 'Issues with security and privacy of data transactions'; 'Lack of technical skills and expertise'; 'Resistance to change'; 'Lack of legal rules and regulations for e-procurement'; 'Lack of management support';

‘High cost of investment’; and ‘Difficulty in finding e-procurement tools that are suitable for your company’. The ranking from the study also differs from findings in literature.

5.3.3 Identified drivers and barriers for EC in SACI

From a ranking perspective, the drivers for e-collaboration in descending order of influence are ‘Covid-19 was influential to e-collaboration adoption’; ‘Frequency of employees’ access to internet use’; ‘Perceived to make work more effective and efficient’; ‘Employees’ confidence in their technological abilities’; ‘Improved knowledge management’; ‘Improvement of project team communication’; and ‘Electronic Collaboration Software assists with managing information overload’. There were notable differences between the surveyed and reviewed drivers.

From a ranking perspective the barriers to e-collaboration in descending order of influence are ‘Benefits to be achieved as a result of E-Collaboration Software are not communicated by management’; ‘Employees have limited time during their workday’; ‘Employees’ poor management of multiple tools’; ‘Misalignment of company hierarchy and software approach’; ‘Content generated by some employees on e-collaboration software is not useful’; ‘Lack of processes/standards’; and ‘The competitive and non-sharing culture in your company’. There is a notable difference between the surveyed and reviewed barriers for EC, indicated by the fact that the top three surveyed barriers have nothing in common with the top three reviewed barriers found in literature.

5.3.4 Differences in EP drivers’ and barriers’ rankings pre and post the onset of Covid-19

‘Unreliable internet service and power supply’ features as the strongest barrier both pre and post the onset of Covid-19, according to its rank. The literature review identified this as the second least cited driver. However, previous studies ranked it as a top barrier within the infrastructure category, specifically for developing countries. ‘Issues with security and privacy of data transactions’ moved from being the weakest barrier before the onset of Covid-19 to the second strongest barrier after the pandemic, and this is in agreement with the review, because it was the second-most cited barrier in the literature review.

5.3.5 Differences in EC drivers’ and barriers’ rankings pre and post the onset of Covid-19

The only difference between the top drivers before and after the onset of Covid-19 is that ‘Frequency of employees’ access to internet use’, moved from the most influential driver to EC before the pandemic, to the second most influential after the pandemic. The most influential driver after the onset of the pandemic was Covid-19 itself. As with EP, this was expected, because the

literature review indicated that Covid-19 brought about accelerated digital transformation. ‘Frequency of employees’ access to internet use’ did not show up as one of the most cited drivers in the literature review, but due to the remote work necessitated by the pandemic, it is understandable that it was a top driver.

5.3.6 Revisiting the Research Hypothesis

The study tested the research hypothesis below, and the corresponding null hypothesis is thus rejected or failed to be rejected.

H_A: There are significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

H₀: There are no significant differences in the drivers and barriers for EC and EP adoption before and after the onset of Covid-19.

It was found that there is a statistically significant difference in the EP driver ‘ease of use of procurement software’ and the EP barrier ‘unreliable internet service and power supply’, before versus after the onset of Covid-19. Thus, the null hypothesis is rejected for this driver and barrier. This means that the null hypothesis is accepted for all the other EP drivers and barriers, indicating that there is no difference in their perceived influence before versus after Covid-19.

Regarding EC, it was found there was a statistically significant difference between the EC driver ‘employees confidence in their technological abilities’ and the following five EC barriers: ‘benefits to be achieved as a result of EC are not communicated’; ‘content generated by some employees on EC software is not useful’; ‘employees’ poor management of multiple tools’; ‘the competitive and non-sharing culture ... makes it difficult for EC software to thrive’; and ‘Employees have limited time during their workday, before versus after the onset of Covid-19. Thus, the null hypothesis is rejected for this EC driver and five EC barriers.

5.4 Conclusion

Based on these findings, the study concludes that even though EP and EC have increased adoption, there is still room for greater improvement if certain barriers for these technologies can be mitigated or overcome. Further improvement is needed for the overall SACI to be competitive in the globalized construction space, and to be more effective and efficient. The statistically significant difference of the influence of some drivers and barriers pre and post the onset of

Covid-19, could be the reason for this improvement. However, the drivers and barriers which did not have statistically significant differences, indicate that the onset of Covid-19 did not alter their influence on EP and EC adoption. On the other hand, Covid-19 itself with the changes it brought to the working world, proved to be a driver for both EP and EC adoption, and it could thus be another reason for increased adoption.

The study provided ranked barriers and drivers, thus, attention should be given to the top most influential drivers and barriers to take steps to increase or decrease their influence over EP and EC adoption. For instance, ‘Frequency of employees’ access to internet use’, is the strongest driver to EC, which indicates that the more employees are exposed to and use the internet, the more they are likely to use EC and its adoption will grow. The strongest barrier for EP adoption is ‘Unreliable internet service and power supply’, and this should inspire companies to invest in alternative stable power supply if they have the capital to do so.

The work world has already adapted to work after the onset of Covid-19. Thus, the pandemic may not continue to influence further adoption of EP or EC. The data on adoption figures, drivers and barriers contribute necessary literature for e-collaboration in South Africa, as there is no previous study done on SACI. It also provides updated figures for EP to monitor trends in the uptake of these technologies.

5.5 Recommendations

The following recommendations are made:

- Government departments such as the Department of Public Works – which offers tenders for many public projects in South Africa – should move tender submission online. This will enable companies that tender to reduce paperwork, and it will provide them with exposure to e-tendering.
- Construction company management should ensure that employees who handle the administration side of construction to be exposed to the internet more. For example, starting with simple tasks such as storing their documents in the cloud. This will ensure the reduction of their fear of using the technology, and they can be more receptive to using e-collaboration tools when the opportunity arises.

- Construction companies should invest in alternate energy solutions such as solar power or inverters when there is a power failure, and for stable power and internet supply to be available to support EC use.
- Construction company management should take it upon themselves to raise awareness about EC software and the benefits that can be realized by the company and by individual employees, e.g. employee work performance improvement, employee empowerment, and easy availability of data which is not restricted by location or time.

5.5 Areas for further research

The figures determined in this study for e-collaboration are new for SACI and may be used by future studies to compare them to the data they may collect. Future studies could also explore cause and effect relationship between the EP and EC drivers and barriers and the EP and EC adoption rates. Furthermore, the interrelationships between the drivers or barriers of either EP or EC can be investigated. This will help EP or EC practitioners to come up with comprehensive strategies to increase adoption, since drivers and barriers do not influence EP or EC in isolation.

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APPENDICES

Appendix A: Provisional Ethics Approval

Re: CON5023Z ETHICS CLEARANCE

Manya Mooya <manya.mooya@uct.ac.za>

Thu 9/15/2022 9:08 AM

To: Kgomotso Sekgoele <SKGKGO002@myuct.ac.za>

Dear Kgomotso

You can deem your ethics application as approved, and proceed with your research accordingly.

If there are issues arising they shall be dealt with after the fact.

Kind regards

Manya



Manya M. Mooya

BSc (Copperbelt) MPhil (Cambridge) PhD (Pretoria)

Associate Professor & Head of Department

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[Google Scholar](#)



Appendix B: Final Ethics Approval

Information: Application approved

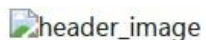
era@uct.ac.za <era@uct.ac.za>

Mon 10/24/2022 11:00 AM

To: Kgomotso Sekgoele <SKGKGO002@myuct.ac.za>

Status change comment:

Ethics application approved by Chair

header_image


Dear Kgomotso Sekgoele ,

The following ethics application with EBE/02022/2022 has been **APPROVED** and is now marked as **ACTIVE**:

[Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African Construction – post Covid-19](#)

- An outcome letter is available on the eRA platform.

Regards,
Engineering & Built Environment Committee

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Appendix C: Questionnaire

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

1. Demographic questions

Top of Form

Question Title

*** 1. What is your job title?**

- Contractor
- Construction Manager
- Construction Project Manager
- Quantity Surveyor or Cost Manager
- Engineer
- Health and Safety Agent
- Other (must be construction related)

- None of the above

Question Title

*** 2. How long have you been working in the construction industry?**

- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years

- More than 20 years
- None of the above

Question Title

*** 3. What is your highest academic qualification?**

- Matric/ Senior Certificate
- Diploma
- Bachelors degree
- Honours degree
- Masters degree
- Doctoral degree
- Other (please specify)

Question Title

*** 4. Please specify the location of your company's office within South Africa**

- Gauteng
- Western Cape
- Limpopo
- Kwa-Zulu Natal
- Mpumalanga
- North West
- Northern Cape
- Eastern Cape
- Free State

None of the above

Question Title

*** 5. Please indicate your company's annual turnover**

Less than R 20 million

R 20 million - R 65 million

R 65 million - R 200 million

Greater than R 200 million

2. Electronic procurement and electronic collaboration use

Question Title

*** 6. Have you made use of electronic procurement (e-procurement) BEFORE and/or AFTER the onset of Covid-19?**

BEFORE Covid -19 onset		AFTER Covid-19 onset	
Yes	No	Yes	No

Question Title

*** 7. Have you made use of electronic collaboration (e-collaboration) BEFORE and/or AFTER the onset of Covid-19?**

BEFORE Covid -19 onset		AFTER Covid-19 onset	
Yes	No	Yes	No

3. Covid-19 and changes on e-procurement and e-collaboration use

Question Title

8. Did Covid-19 cause e-procurement use in your company to increase, decrease or stay the same?

- Increase
- Decrease
- Stay the same

Question Title

9. Did Covid-19 cause e-collaboration use in your company to increase, decrease or stay the same?

- Increase
- Decrease
- Stay the same

4. Drivers to e-procurement and e-collaboration

Question Title

10. Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following drivers' influence on the adoption of e-Procurement (EP) before versus after the onset of Covid-19

	BEFORE Covid -19 onset					AFTER Covid-19 onset				
	1	2	3	4	5	1	2	3	4	5
a) Reduction in process, transaction and administrative cost										
b) Reduction in cycle times for processes and transactions										
c) Improved response time (from either client to bidding company or bidding company to client) during the procurement process										

d) Improved accuracy of the procurement process since eprocurement minimizes errors		
e) Improved flexibility of the procurement process by making it easier either for the client to communicate changing supply requirements or for the contracting company to react to them		
f) Ease of use of e-procurement software		
g) Reduction of paper work within the contracting or client company		
h) Availability of policies promoting e-procurement		

Question Title

11. Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following drivers' influence on the adoption of e-Collaboration (EC) before versus after the onset of Covid-19

	BEFORE Covid -19 onset					AFTER Covid-19 onset				
	1	2	3	4	5	1	2	3	4	5
a) Improved knowledge management (creating, organizing, using and sharing data) in an organization										
b) Electronic Collaboration Software assists with managing information overload										
c) Improvement of project team communication										

d) Perceived to make work more effective and efficient		
e) Employees' confidence in their technological abilities		
f) Frequency of employees' access to internet use		

6 Covid-19 as a driver to e-procurement and e-collaboration

Question Title

12. Please indicate on a scale of 1-5 (where 1 = strongly disagree and 5 = strongly agree), your perception of Covid-19 itself as a driver to e-procurement and/or e-collaboration

	BEFORE Covid -19 onset					AFTER Covid-19 onset				
	1	2	3	4	5	1	2	3	4	5
a) Covid-19 was influential to eprocurement adoption										
b) Covid-19 was influential to ecollaboration adoption										

6. Barriers to e-procurement and e-collaboration

Question Title

13. Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following barriers' influence on the adoption of e-Procurement (EP) before versus after the onset of Covid-19

	BEFORE Covid -19 onset					AFTER Covid-19 onset				
	1	2	3	4	5	1	2	3	4	5
a) Issues with security and privacy of data transactions										

b) Resistance to change by employees within your organization		
c) High cost of investment linked to e-procurement adoption		
d) Lack of technical skills & expertise (digitizing the company's procurement process, competency in using e-procurement software) needed for e-procurement adoption among employees		
e) Unreliable internet service and power supply within your company		
f) Lack of management support from within your company (either as the client or contracting company)		
g) Lack of legal rules and regulations for e-procurement within the South African construction Industry		
h) Difficulty in finding eprocurement tools that are suitable to your company		

14. Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following barriers' influence on the adoption of e-collaboration (EC) before versus after the onset of Covid-19

	BEFORE Covid -19 onset					AFTER Covid-19 onset				
	1	2	3	4	5	1	2	3	4	5
a) Misalignment of company hierarchy and software approach (the way the technology is taught)										

<p>b) Benefits to be achieved as a result of E-Collaboration Software (such as employee work performance improvement, employee empowerment , easy availability of data which is not restricted by location or time) are not communicated by management in order for employees to understand and buy into e-collaboration</p>		
<p>c) Content generated by some employees on e-collaboration software is not useful (ineffective) to their colleagues' work because it is not the type of content they need to carry out their work.</p>		
<p>d) Employees' poor management of multiple tools to be used on ecollaboration software</p>		
<p>e) The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive as its success is based on sharing of information</p>		
<p>f) Lack of processes /standards that govern and guide e-collaboration use in your company</p>		
<p>g) Employees have limited time during their workday which restricts their ability to learn how to use ecollaboration tools</p>		

Appendix D: Ethics Cover letter



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

CONSTRUCTION ECONOMICS AND MANAGEMENT DEPARTMENT

Kgomotso Sekgoele (MSc Project Management student)
University of Cape Town
Level 1.07, Snape Building
Upper Campus
Rondebosch, 7701
Cape Town
Cell: +27 (0)66 252 6231
Email: SKGKGO002@myuct.ac.za

ETHICS COVER LETTER

Purpose of Study:

The adoption of electronic procurement and e-collaboration within the South African construction industry (SACI) has been slow- despite studies showing benefits enjoyed by peer construction industries worldwide- and there has been very little literature that reports on this. The onset of the Covid-19 pandemic –together with remote working- presented an opportune environment to grow the adoption rate in order for the SACI to be more competitive. This research examines whether there are differences in the drivers and barriers to the adoption of e-procurement and e-collaboration in the SACI pre and post the onset of the Covid-19 pandemic.

Objectives of the study:

The objectives of this study are to : determine the level of use of e-procurement (EP) and e-collaboration (EC) in the SACI before and after Covid-19; identify the drivers and barriers to the adoption of EP and EC before and after the onset of Covid-19; establish whether Covid-19 has been a significant driver of the adoption of EP and EC in the SACI and lastly, to find out whether there are significant differences in the drivers and barriers to the adoption of e-procurement and e-collaboration in the SACI, pre and post the onset of Covid-19.

Confidentiality:

This research does not pose any known risks and does not request any sensitive information. Ethical issues that may arise from this research include concerns of confidentiality, anonymity, and informed consent. These will be treated by ensuring that the e-mails, phone numbers and names of the participants are not disclosed to a third party and the researcher is held accountable by the consent form signed by themselves and the respondent. Also, participation in the survey

will be voluntary.

Signed by candidate

Kind Regards

Kgomotso Sekgoele (Researcher/ MSc Project Management student)

Appendix E: Ethics clearance form

Application for Approval of Ethics in Research (EIR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

ETHICS APPLICATION FORM


Please Note:

Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form before collecting or analysing data. The objective of submitting this application prior to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the EBE Ethics in Research Handbook (available from the UCT EBE, Research Ethics website) prior to completing this application form: <http://www.ebe.uct.ac.za/ebe/research/ethics1>

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant	Kgomotso Mapula Sekgoele	
Department	Construction Economics and Management	
Preferred email address of applicant:	skgkgo002@myuct.ac.za	
If Student	Your Degree: e.g., MSc, PhD, etc.	Msc Project Management
	Credit Value of Research: e.g., 60/120/180/360 etc.	60
	Name of Supervisor (if supervised):	Mochelo Lefoka
If this is a research contract, indicate the source of funding/sponsorship	N/A	
Project Title	The adoption of e-procurement and e-collaboration in SA construction industry: before vs after Covid-19	

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

APPLICATION BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Kgomotso Mapula Sekgoele		09/ 02/ 2022
SUPPORTED BY	Full name	Signature	Date
Supervisor (where applicable)			
APPROVED BY	Full name	Signature	Date
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section 1; and for all Undergraduate research (Including Honours).			
Chair: Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the questions in Section 1.			

Appendix F: Data Management Plan

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African Construction – post Covid-19

A Data Management Plan created using UCT DMP

Creator: Kgomotso Sekgoele

Affiliation: University of Cape Town

Template: UCT Student Generic DMP

Project abstract:

The uptake of e-procurement and e-collaboration within the construction industry had been slow and a study conducted on e-procurement within the SA construction industry showed that its uptake was lower than that in other developing countries. The low adoption rate of e-procurement in the SACI has been attributed to unreliable IT infrastructure, high cost of investment, security concerns, a lack of management support and fear of job loss. There are limited studies focused on e-procurement in SA and this doesn't allow for a comparative review within the SACI to either validate or refute these studies. Past studies done on the SACI's e-procurement were limited to identifying drivers and barriers and technological tools used, while e-collaboration within the SACI has not been studied in this manner. The onset of the Covid-19 pandemic presented an opportunity for adoption to change for the better due to the new ways of working- remote and teleworking- that had to be adopted. Therefore, this research will examine the influence of the drivers and barriers on e-procurement and e-collaboration adoption within the SACI and whether Covid-19 served as a driver to increase adoption or has had no effect on e-procurement and e-collaboration in SA. This will be done using Ordinal Logistic Regression

ID: 3203

Start date: 14-02-2022

End date: 15-12-2022

Last modified: 03-08-2022

Grant number / URL: N/A

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African Construction – post Covid-19 - Student Full DMP

1. Project Details

PROJECT NAME - Replicate the title of your project, dissertation or thesis exactly as it appears in your proposal document.

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African Construction – post Covid-19

PERSONAL DETAILS - Indicate the name(s) and student number(s) of the student(s) who will be involved in this project, dissertation or thesis.

Kgomotso Mapula Sekgoele (SKGKGO002)

SUPERVISOR(S) DETAILS - Indicate who will supervise this project, dissertation or thesis. If you do not yet have a supervisor, leave this section blank.

Mochalo Lefoka Prof Abimboia Windapo

2. Project Summary

RESEARCH SUMMARY - Briefly summarise your study. Include the study's objectives, design, and methods.

The uptake of e-procurement and e-collaboration within the construction industry had been slow and a study conducted on e-procurement within the SA construction industry showed that its uptake was lower than that in other developing countries. The low adoption rate of e-procurement in the SACI has been attributed to unreliable IT infrastructure, high cost of investment, security concerns, a lack of management support and fear of job loss. There are limited studies focused on e-procurement in SA and this doesn't allow for a comparative review within the SACI to either validate or refute these studies. Past studies done on the SACI's e-procurement were limited to identifying drivers and barriers and technological tools used, while e-collaboration within the SACI has not been studied in this manner. The onset of the Covid-19 pandemic presented an opportunity for adoption to change for the better due to the new ways of working- remote and teleworking- that had to be adopted. Therefore, this research will examine the influence of the drivers and barriers on e-procurement and e-collaboration adoption within the SACI and whether Covid-19 served as a driver to increase adoption or has had no effect on e-procurement and e-collaboration in SA. This will be done by collecting primary data gathered through an online questionnaire on Survey Monkey. Thereafter SPSS software will be used to analyze the data using descriptive and inferential statistics.

3. Description of the Data

DATA REUSE DESCRIPTION - If you re-used data from third-party sources in your study, record pertinent details here such as the source of the data, the extent of the data, usage rights or restrictions pertaining to the data, and how it was incorporated into your study.

- I have used existing data in my study.

I used data on the different Contractors that are registered with the Construction Industry Development Board (cidb) of South Africa. This data is readily available to the public on the cidb's Register of Contractors which is found on their website. I filtered the Register for Active Contractors who fell within grades 7-9 and the number of these contractors informed the sample size, while the list itself became my sample frame.

DATA DESCRIPTION - Describe the data you have gathered for your study. Briefly describe the nature, scope and scale of the data you have produced.

The research approach that will be adopted is a quantitative research approach because the research objective will be tested by inspecting the relationship between variables. This study is based on primary data gathered through an online survey questionnaire. The data is split into different types in accordance with the setup of the questionnaire: descriptive, dichotomous and ordinal data. The minimum sample size required is 322 contracting companies which is calculated from the total sample frame consisting of 1985

contracting companies who fall within grades 7-9. This sample frame is recorded on an Excel spreadsheet.

4. Formats and Quality Control

QUALITY CONTROL - Describe what measures you took to ensure the data you collected were of high-quality.

For the sampling frame, I filtered for contracting companies whose registration status was still active. For the questionnaire, respondents will be asked again which grade their companies fall within, in order to verify the data from the sample frame. Another way to ensure data validity was to restrict respondent companies to those within grades 7-9 since they are likely to be the ones with enough capital to invest in e-procurement and e-collaboration software and will thus be better suited to provide feedback on it.

FILE FORMATS - Indicate the formats in which your data will be collected and processed. Clarify whether these formats require specialised proprietary software to access or if they will be produced in or converted to more open, accessible formats for long-term accessibility and preservation. In the case of physical data objects (such as artworks or models) indicate whether these will be digitised or otherwise preserved for accessibility.

The data will be collected through the Survey Monkey platform and will be exported to Microsoft Excel which is more accessible. SPSS will be used to process it.

5. Data Management, Documentation and Curation

CURATION (MANAGING AND STORING) DATA - Describe how you organise and manage your data. Specify any file-naming conventions or community data standards you have adopted.

There will be no naming conventions used. The sample frame is contained in a Microsoft Excel document titled "CIDB List of Grade 7-9 contracting companies". The questionnaire responses will also be exported to a Microsoft Excel document titled "Responses_ Examining the drivers and barriers to e-procurement and e-collaboration adoption in SA Construction – post Covid-19"

BACKUP AND STORAGE - Describe how your data is being stored and backed-up. If you are using a data service provider, provide details on for how long they will retain the data.

The data will be stored on the researcher's personal laptop and will be backed up on UCT's Net Storage. The data will only be kept for the duration of the research period and thereafter, when the research is marked and the marks are communicated, it will be destroyed by being deleted from the laptop and from Net Storage

METADATA STANDARDS AND DATA DOCUMENTATION - Articulate what metadata and documentation you have produced about the data you have generated, collected or re-used.

To be confirmed

6. Data Security and Confidentiality of Potentially Disclosive Information

SECURITY - Indicate to what extent your data can be considered sensitive or at-risk. Describe how you will control access to your data. Indicate whether you anticipate a need for encryption or password-controlled access, and if so, how you will enforce that access.

My data is not considered to be sensitive however there is an agreement to keep respondent companies' identities confidential by using numbers as identifiers instead of their actual names

ETHICS AND PRIVACY - Describe, as per your Ethics Clearance form or other similar documentation, any ethical or privacy issues that your data are subject to (if any). Summarise the main risks to the confidentiality and security of information related to human participants, the level of risk, and how this risk will be managed. If your project did not require ethical clearance, you may ignore this section.

The identity of the responding companies will be kept anonymous and no companies will be singled out or named in the thesis.

7. Data Sharing and Open Access

DATA OWNERSHIP - If you have used existing datasets, note down any restrictions the data providers have indicated regarding data sharing. Otherwise, leave blank.

- I have used existing data in my study and I have noted down the relevant restrictions as pertains to data sharing(details below).

I have used an existing dataset which is the Register of Contractors found on the cidb's website, as my sample frame. This register is available for public access and there are no communicated restrictions on its use. I will be referencing the cidb as the source and may assign numerical names to the companies if advised by my Supervisor.

DATA LICENCE - Indicate under which licence you intend to share your research data. If you are not sharing your data, provide the appropriate justification as per the UCT Research Data Management guidelines.

- CC BY

My data will be shared through the UCT Creative Commons license

DATA PUBLICATION - Indicate where you intend to publish your research data at the end of your project.

I will share my data on ZivaHub at the end of my project

8. Relevant Institutional or Study Policies

Indicate the relevant departmental, unit, or institutional policies that influence your data management activities.

The following policies apply to my research management: UCT Intellectual Property Policy, UCT Open Access Policy and the UCT Research Data Management Policy

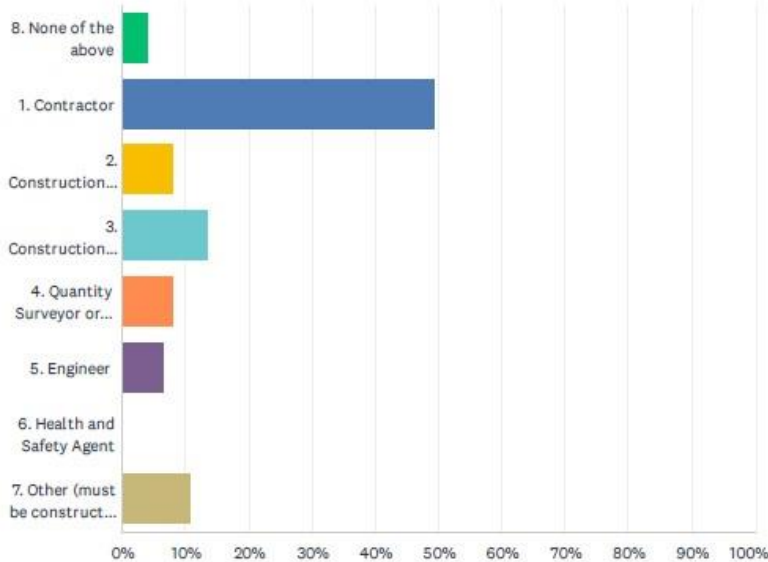
Appendix G: Questionnaire responses

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

SurveyMonkey

Q1 What is your job title?

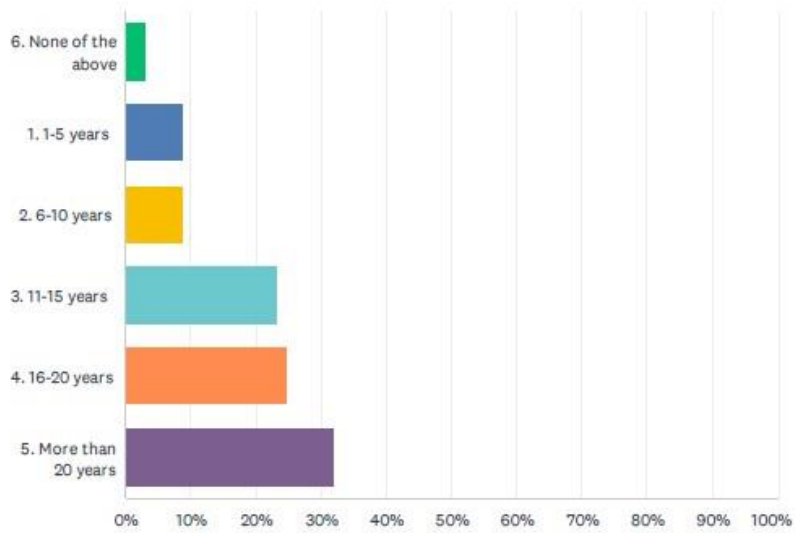
Answered: 75 Skipped: 0



ANSWER CHOICES	RESPONSES	
8. None of the above	4.00%	3
1. Contractor	49.33%	37
2. Construction Manager	8.00%	6
3. Construction Project Manager	13.33%	10
4. Quantity Surveyor or Cost Manager	8.00%	6
5. Engineer	6.67%	5
6. Health and Safety Agent	0.00%	0
7. Other (must be construction related)	10.67%	8
TOTAL		75

Q2 How long have you been working in the construction industry?

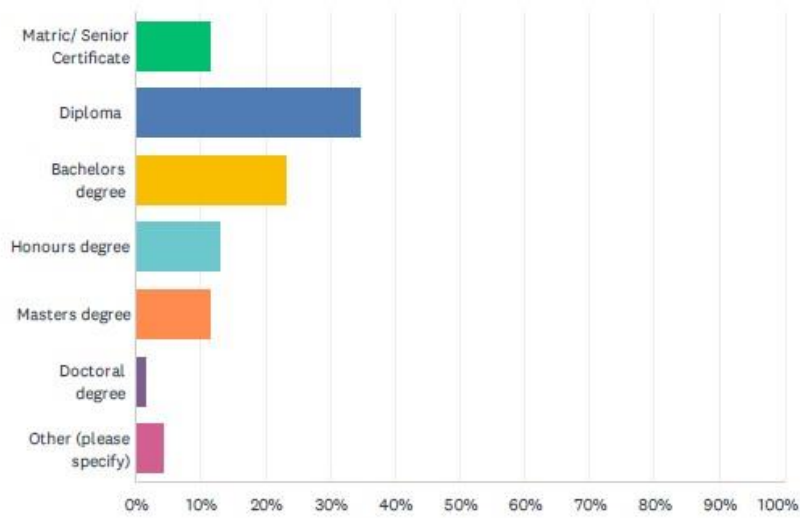
Answered: 69 Skipped: 6



ANSWER CHOICES	RESPONSES	
6. None of the above	2.90%	2
1. 1-5 years	8.70%	6
2. 6-10 years	8.70%	6
3. 11-15 years	23.19%	16
4. 16-20 years	24.64%	17
5. More than 20 years	31.88%	22
TOTAL		69

Q3 What is your highest academic qualification?

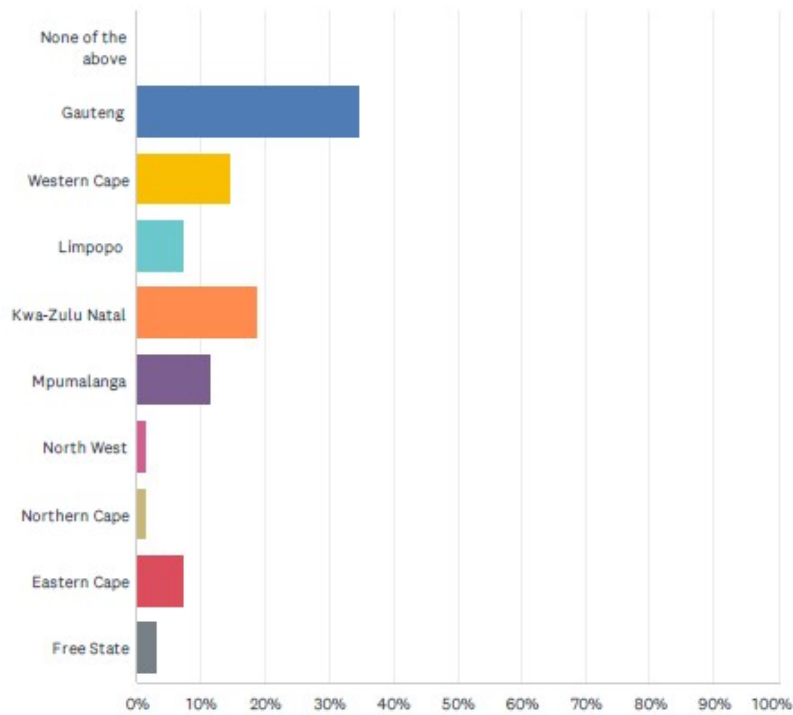
Answered: 69 Skipped: 6



ANSWER CHOICES	RESPONSES	
Matric/ Senior Certificate	11.59%	8
Diploma	34.78%	24
Bachelors degree	23.19%	16
Honours degree	13.04%	9
Masters degree	11.59%	8
Doctoral degree	1.45%	1
Other (please specify)	4.35%	3
TOTAL		69

Q4 Please specify the location of your company's office within South Africa

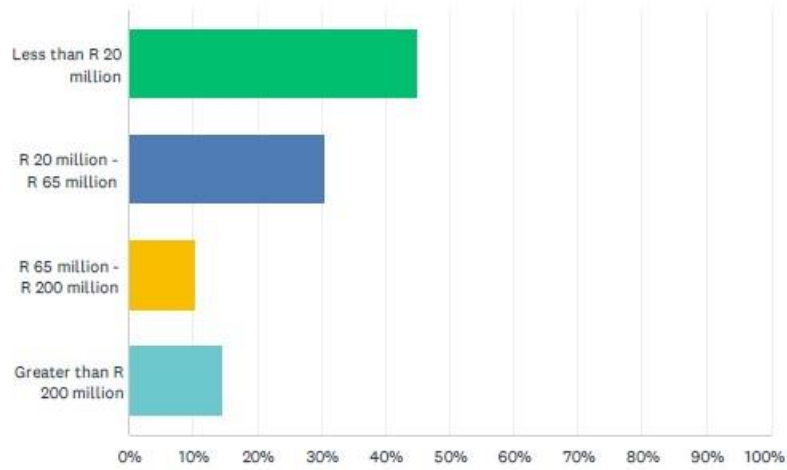
Answered: 69 Skipped: 6



ANSWER CHOICES	RESPONSES	
None of the above	0.00%	0
Gauteng	34.78%	24
Western Cape	14.49%	10
Limpopo	7.25%	5
Kwa-Zulu Natal	18.84%	13
Mpumalanga	11.59%	8
North West	1.45%	1
Northern Cape	1.45%	1
Eastern Cape	7.25%	5
Free State	2.90%	2
TOTAL		69

Q5 Please indicate your company's annual turnover

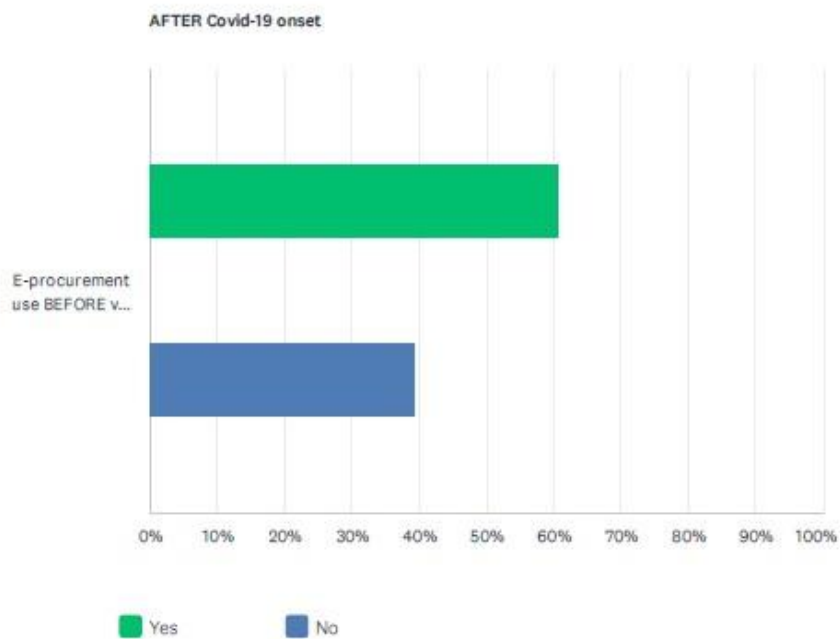
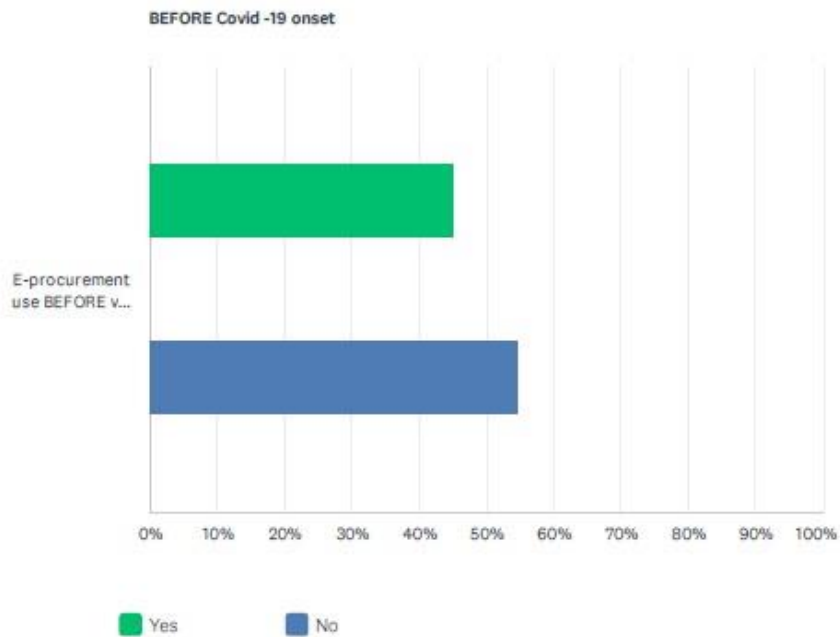
Answered: 69 Skipped: 6



ANSWER CHOICES	RESPONSES	
Less than R 20 million	44.93%	31
R 20 million - R 65 million	30.43%	21
R 65 million - R 200 million	10.14%	7
Greater than R 200 million	14.49%	10
TOTAL		69

Q6 Have you made use of electronic procurement (e-procurement) BEFORE and/or AFTER the onset of Covid-19?

Answered: 51 Skipped: 24



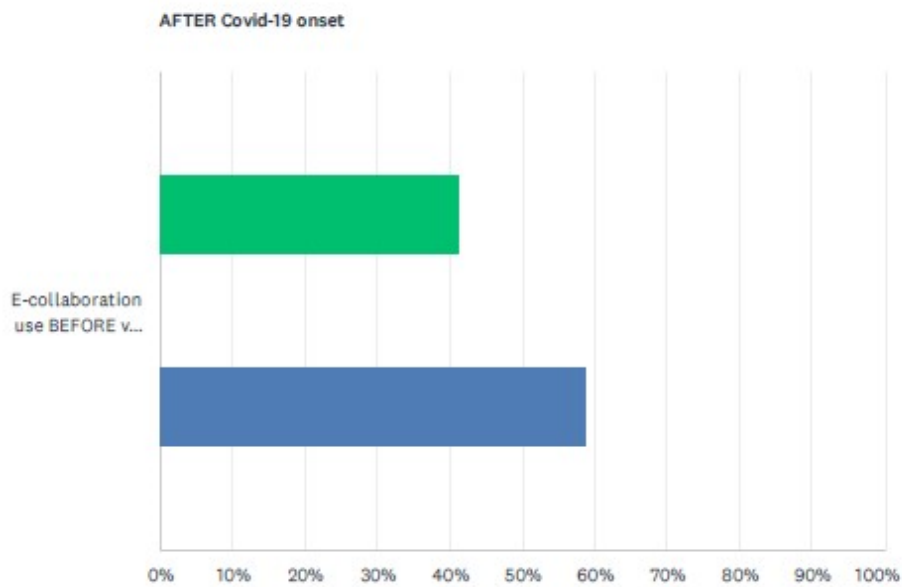
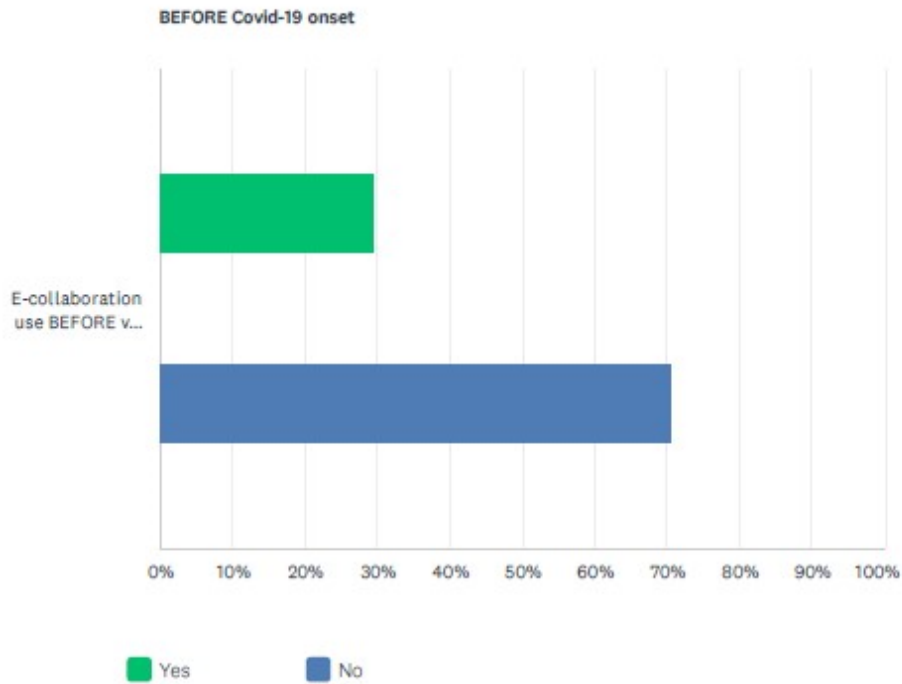
Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

SurveyMonkey

BEFORE Covid -19 onset			
	YES	NO	TOTAL
E-procurement use BEFORE vs AFTER Covid-19 onset	45.10%	54.90%	51
	23	28	
AFTER Covid-19 onset			
	YES	NO	TOTAL
E-procurement use BEFORE vs AFTER Covid-19 onset	60.78%	39.22%	51
	31	20	

Q7 Have you made use of electronic collaboration (e-collaboration) BEFORE and/or AFTER the onset of Covid-19?

Answered: 51 Skipped: 24



Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

SurveyMonkey

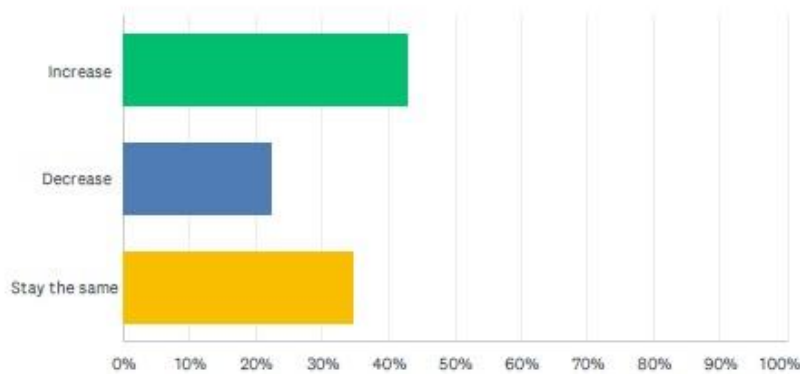
BEFORE Covid-19 onset			
	YES	NO	TOTAL
E-collaboration use BEFORE vs AFTER Covid-19 onset	29.41%	70.59%	
	15	36	51
AFTER Covid-19 onset			
	YES	NO	TOTAL
E-collaboration use BEFORE vs AFTER Covid-19 onset	41.18%	58.82%	
	21	30	51

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

SurveyMonkey

Q8 Did e-procurement use in your company increase, decrease or stay the same post Covid-19?

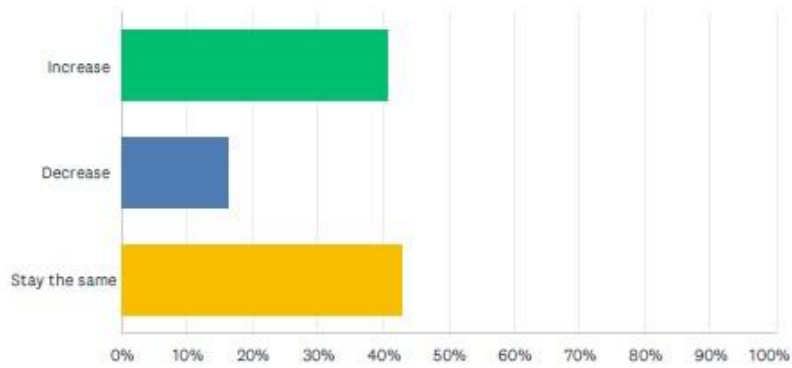
Answered: 49 Skipped: 26



ANSWER CHOICES	RESPONSES	
Increase	42.86%	21
Decrease	22.45%	11
Stay the same	34.69%	17
TOTAL		49

Q9 Did e-collaboration use in your company increase, decrease or stay the same post Covid-19?

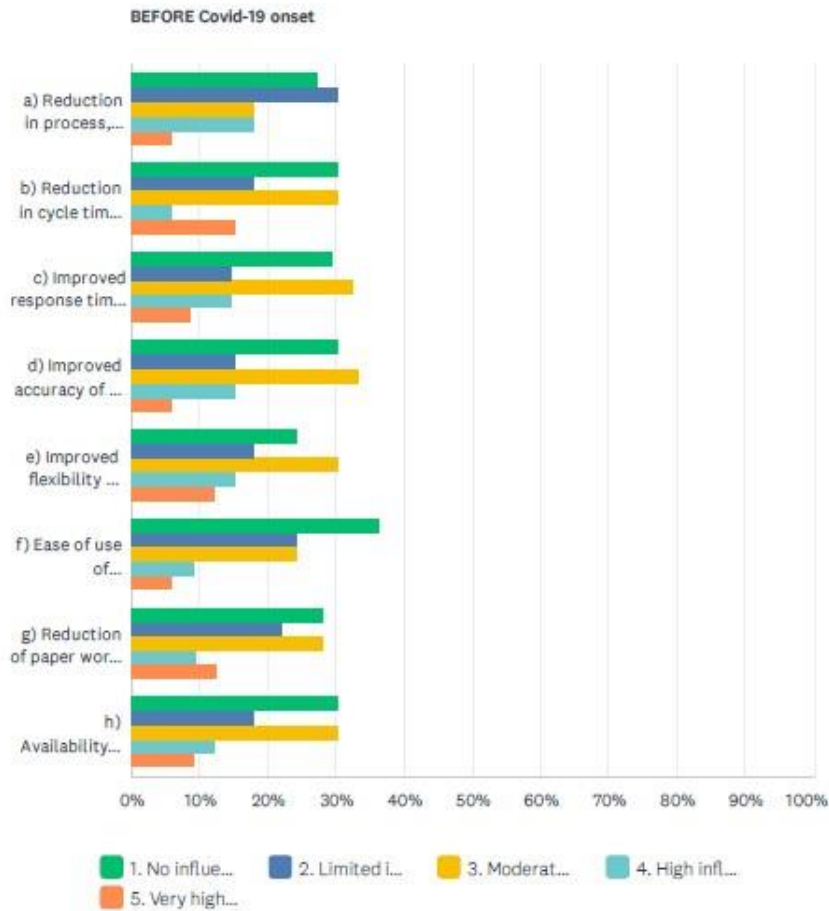
Answered: 49 Skipped: 26

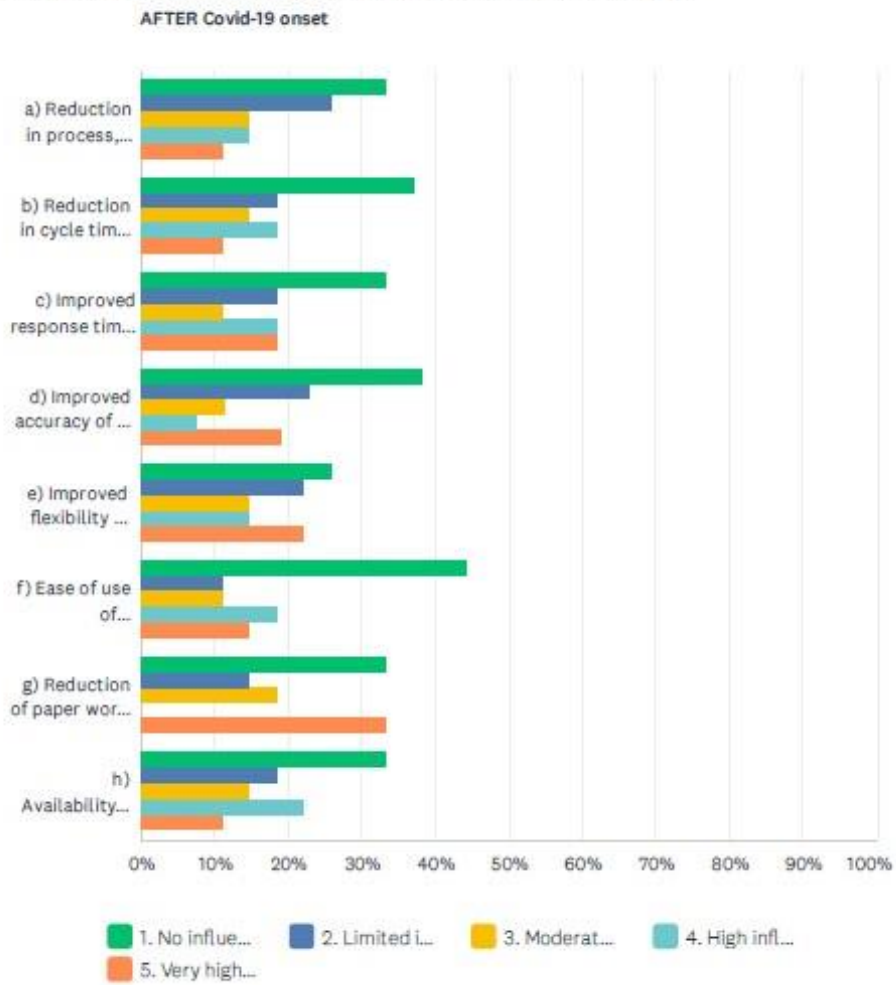


ANSWER CHOICES	RESPONSES	
Increase	40.82%	20
Decrease	16.33%	8
Stay the same	42.86%	21
TOTAL		49

Q10 Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following drivers' influence on the adoption of e-Procurement (EP) before versus after the onset of Covid-19

Answered: 34 Skipped: 41





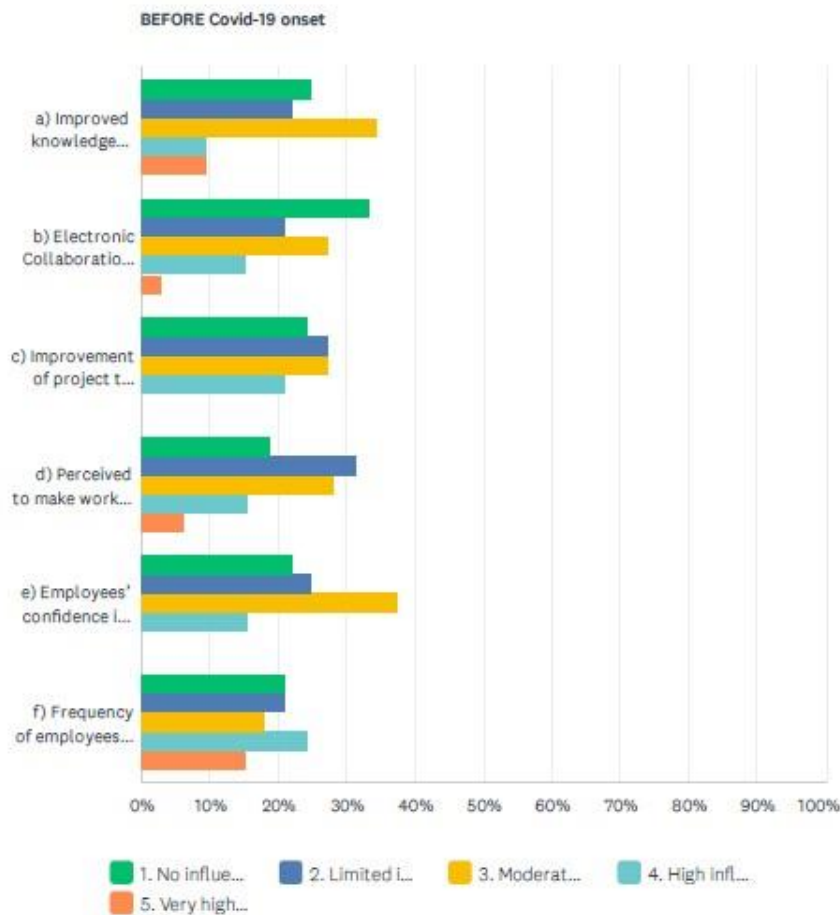
Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

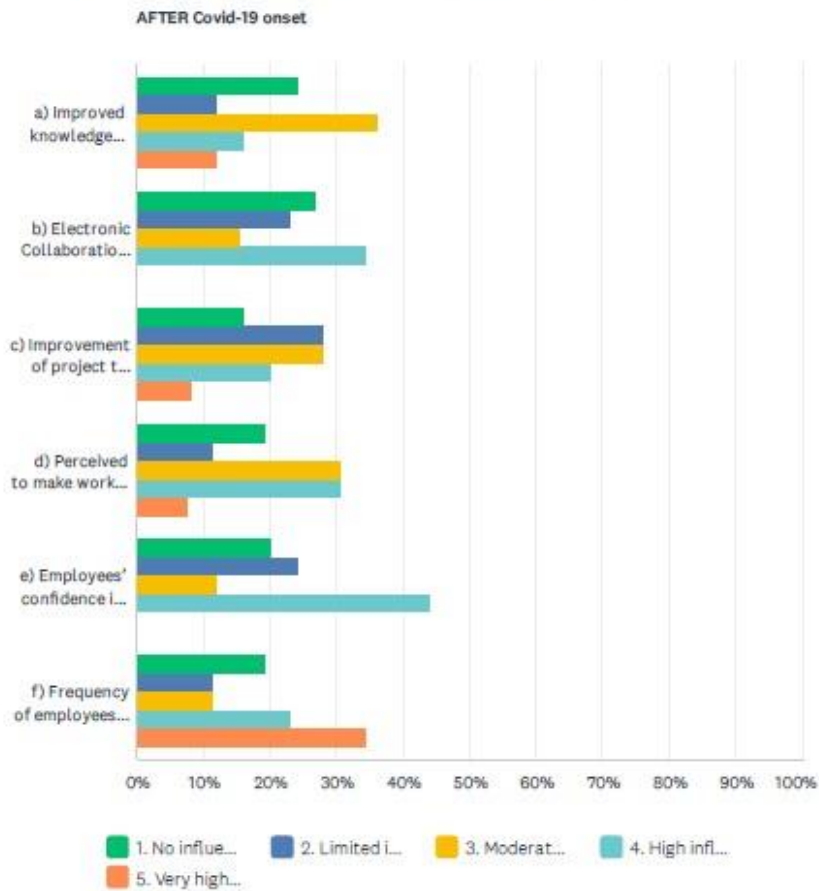
SurveyMonkey

BEFORE Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Reduction in process, transaction and administrative cost	27.27% 9	30.30% 10	18.18% 6	18.18% 6	6.06% 2	33
b) Reduction in cycle times for processes and transactions	30.30% 10	18.18% 6	30.30% 10	6.06% 2	15.15% 5	33
c) Improved response time (from either client to bidding company or bidding company to client) during the procurement process	29.41% 10	14.71% 5	32.35% 11	14.71% 5	8.82% 3	34
d) Improved accuracy of the procurement process since e-procurement minimizes errors	30.30% 10	15.15% 5	33.33% 11	15.15% 5	6.06% 2	33
e) Improved flexibility of the procurement process by making it easier either for the client to communicate changing supply requirements or for the contracting company to react to them	24.24% 8	18.18% 6	30.30% 10	15.15% 5	12.12% 4	33
f) Ease of use of e-procurement software	36.36% 12	24.24% 8	24.24% 8	9.09% 3	6.06% 2	33
g) Reduction of paper work within the contracting or client company	28.13% 9	21.88% 7	28.13% 9	9.38% 3	12.50% 4	32
h) Availability of policies promoting e-procurement	30.30% 10	18.18% 6	30.30% 10	12.12% 4	9.09% 3	33
AFTER Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Reduction in process, transaction and administrative cost	33.33% 9	25.93% 7	14.81% 4	14.81% 4	11.11% 3	27
b) Reduction in cycle times for processes and transactions	37.04% 10	18.52% 5	14.81% 4	18.52% 5	11.11% 3	27
c) Improved response time (from either client to bidding company or bidding company to client) during the procurement process	33.33% 9	18.52% 5	11.11% 3	18.52% 5	18.52% 5	27
d) Improved accuracy of the procurement process since e-procurement minimizes errors	38.46% 10	23.08% 6	11.54% 3	7.69% 2	19.23% 5	26
e) Improved flexibility of the procurement process by making it easier either for the client to communicate changing supply requirements or for the contracting company to react to them	25.93% 7	22.22% 6	14.81% 4	14.81% 4	22.22% 6	27
f) Ease of use of e-procurement software	44.44% 12	11.11% 3	11.11% 3	18.52% 5	14.81% 4	27
g) Reduction of paper work within the contracting or client company	33.33% 9	14.81% 4	18.52% 5	0.00% 0	33.33% 9	27
h) Availability of policies promoting e-procurement	33.33% 9	18.52% 5	14.81% 4	22.22% 6	11.11% 3	27

Q11 Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following drivers' influence on the adoption of e-Collaboration (EC) before versus after the onset of Covid-19

Answered: 33 Skipped: 42





BEFORE Covid-19 onset

	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Improved knowledge management (creating, organizing, using and sharing data) in an organization	25.00% 8	21.88% 7	34.38% 11	9.38% 3	9.38% 3	32
b) Electronic Collaboration Software assists with managing information overload	33.33% 11	21.21% 7	27.27% 9	15.15% 5	3.03% 1	33
c) Improvement of project team communication	24.24% 8	27.27% 9	27.27% 9	21.21% 7	0.00% 0	33
d) Perceived to make work more effective and efficient	18.75% 6	31.25% 10	28.13% 9	15.63% 5	6.25% 2	32
e) Employees' confidence in their technological abilities	21.88% 7	25.00% 8	37.50% 12	15.63% 5	0.00% 0	32
f) Frequency of employees' access to internet use	21.21% 7	21.21% 7	18.18% 6	24.24% 8	15.15% 5	33

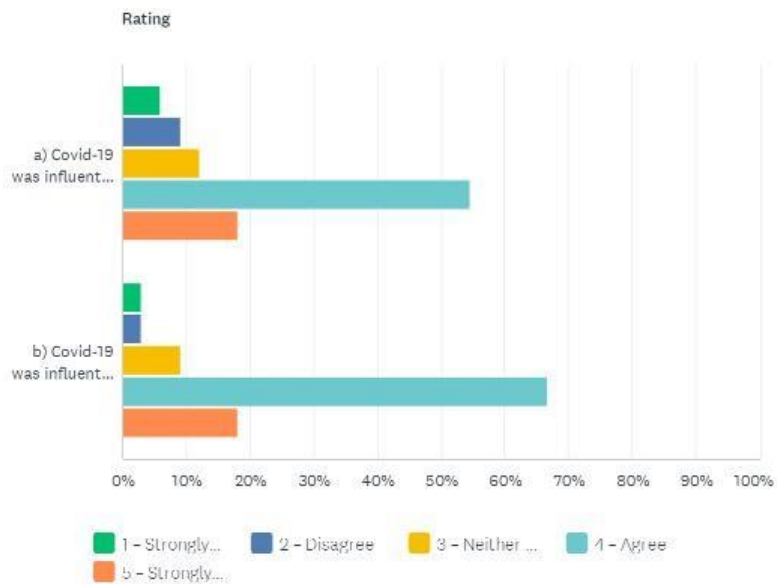
Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

SurveyMonkey

AFTER Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Improved knowledge management (creating, organizing, using and sharing data) in an organization	24.00% 6	12.00% 3	36.00% 9	16.00% 4	12.00% 3	25
b) Electronic Collaboration Software assists with managing information overload	26.92% 7	23.08% 6	15.38% 4	34.62% 9	0.00% 0	26
c) Improvement of project team communication	16.00% 4	28.00% 7	28.00% 7	20.00% 5	8.00% 2	25
d) Perceived to make work more effective and efficient	19.23% 5	11.54% 3	30.77% 8	30.77% 8	7.69% 2	26
e) Employees' confidence in their technological abilities	20.00% 5	24.00% 6	12.00% 3	44.00% 11	0.00% 0	25
f) Frequency of employees' access to internet use	19.23% 5	11.54% 3	11.54% 3	23.08% 6	34.62% 9	26

Q12 Please indicate on a scale of 1-5 (where 1 = strongly disagree and 5 = strongly agree), your perception of Covid-19 itself as a driver to e-procurement and/or e-collaboration

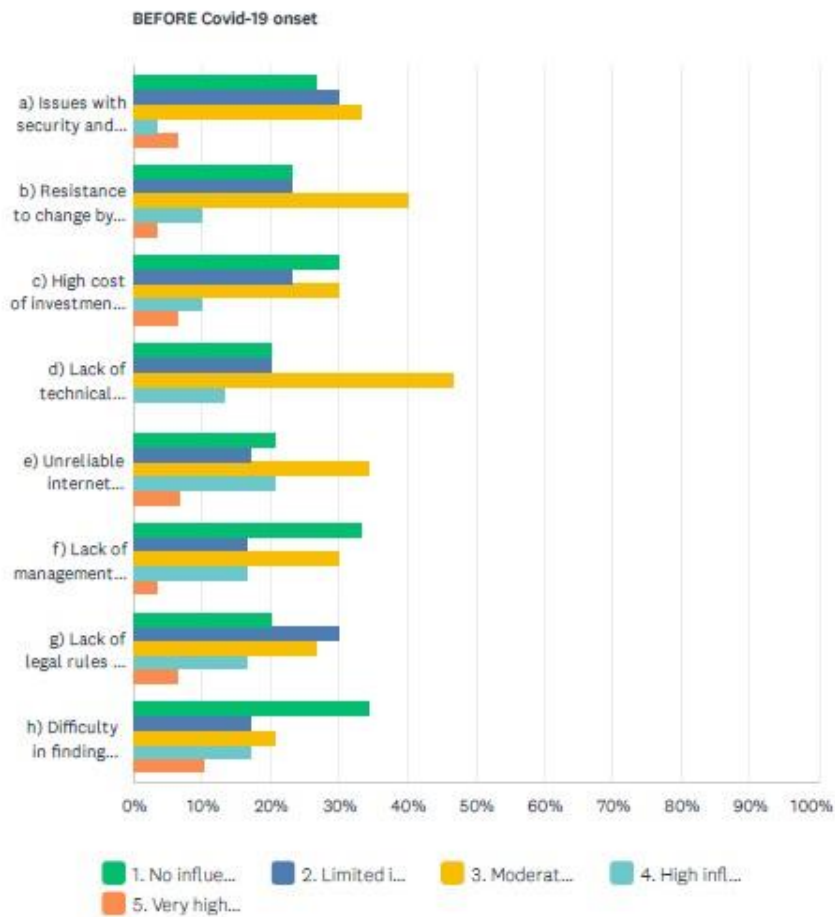
Answered: 34 Skipped: 41

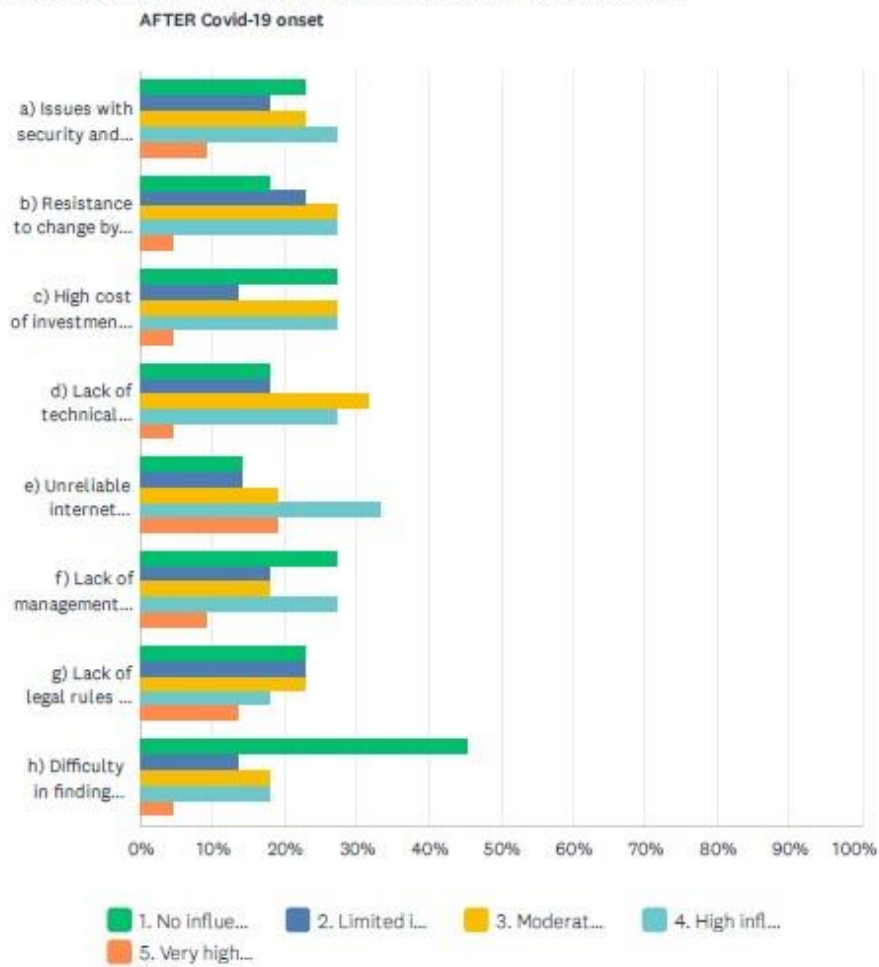


Rating	1 - STRONGLY DISAGREE	2 - DISAGREE	3 - NEITHER AGREE OR DISAGREE	4 - AGREE	5 - STRONGLY AGREE	TOTAL
a) Covid-19 was influential to e-procurement adoption	5.88% 2	8.82% 3	11.76% 4	52.95% 18	20.59% 7	34
b) Covid-19 was influential to e-collaboration adoption	2.94% 1	2.94% 1	8.82% 3	64.71% 22	20.59% 7	34

Q13 Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following barriers' influence on the adoption of e-Procurement (EP) before versus after the onset of Covid-19

Answered: 30 Skipped: 45





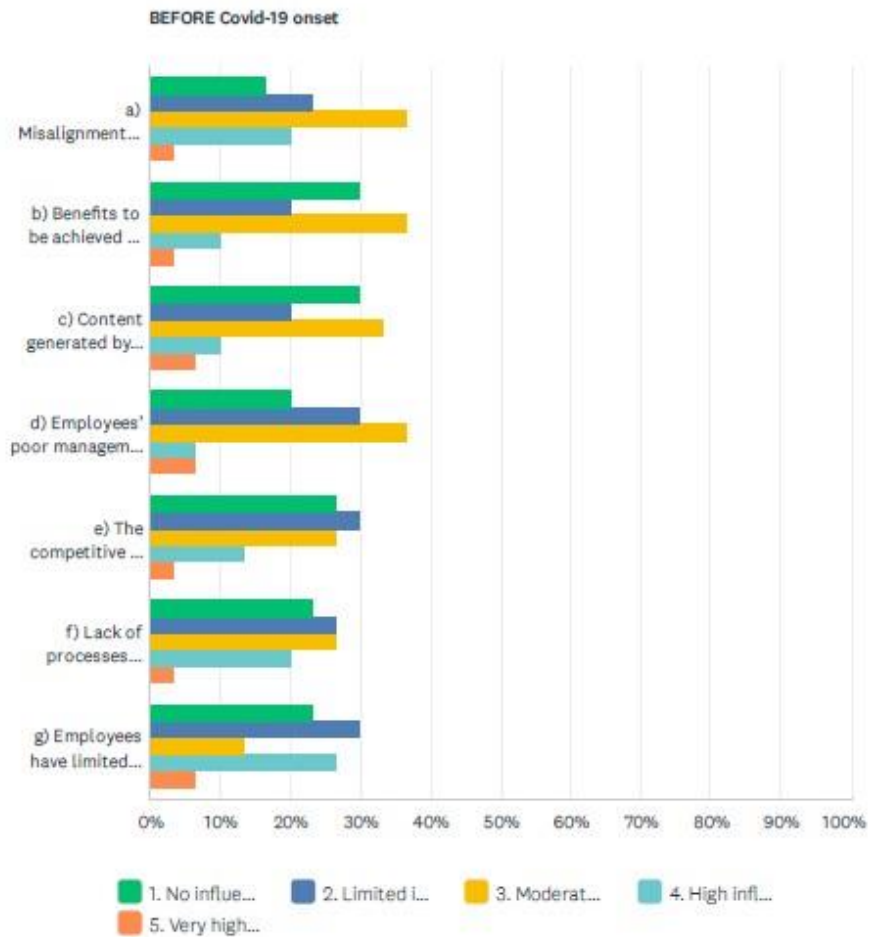
Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

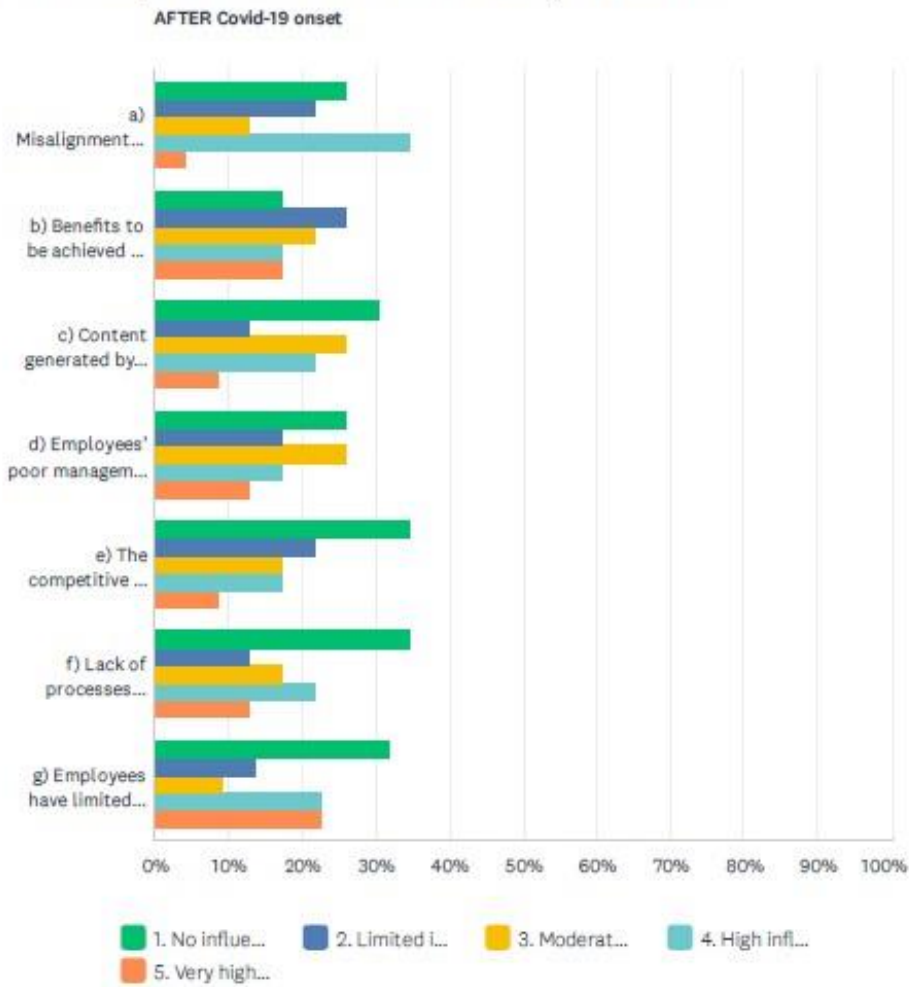
SurveyMonkey

BEFORE Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Issues with security and privacy of data transactions	26.67% 8	30.00% 9	33.33% 10	3.33% 1	6.67% 2	30
b) Resistance to change by employees within your organization	23.33% 7	23.33% 7	40.00% 12	10.00% 3	3.33% 1	30
c) High cost of investment linked to e-procurement adoption	30.00% 9	23.33% 7	30.00% 9	10.00% 3	6.67% 2	30
d) Lack of technical skills & expertise (digitizing the company's procurement process, competency in using e-procurement software) needed for e-procurement adoption among employees	20.00% 6	20.00% 6	46.67% 14	13.33% 4	0.00% 0	30
e) Unreliable internet service and power supply within your company	20.69% 6	17.24% 5	34.48% 10	20.69% 6	6.90% 2	29
f) Lack of management support from within your company (either as the client or contracting company)	33.33% 10	16.67% 5	30.00% 9	16.67% 5	3.33% 1	30
g) Lack of legal rules and regulations for e-procurement within the South African construction Industry	20.00% 6	30.00% 9	26.67% 8	16.67% 5	6.67% 2	30
h) Difficulty in finding e-procurement tools that are suitable to your company	34.48% 10	17.24% 5	20.69% 6	17.24% 5	10.34% 3	29
AFTER Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Issues with security and privacy of data transactions	22.73% 5	18.18% 4	22.73% 5	27.27% 6	9.09% 2	22
b) Resistance to change by employees within your organization	18.18% 4	22.73% 5	27.27% 6	27.27% 6	4.55% 1	22
c) High cost of investment linked to e-procurement adoption	27.27% 6	13.64% 3	27.27% 6	27.27% 6	4.55% 1	22
d) Lack of technical skills & expertise (digitizing the company's procurement process, competency in using e-procurement software) needed for e-procurement adoption among employees	18.18% 4	18.18% 4	31.82% 7	27.27% 6	4.55% 1	22
e) Unreliable internet service and power supply within your company	14.29% 3	14.29% 3	19.05% 4	33.33% 7	19.05% 4	21
f) Lack of management support from within your company (either as the client or contracting company)	27.27% 6	18.18% 4	18.18% 4	27.27% 6	9.09% 2	22
g) Lack of legal rules and regulations for e-procurement within the South African construction Industry	22.73% 5	22.73% 5	22.73% 5	18.18% 4	13.64% 3	22
h) Difficulty in finding e-procurement tools that are suitable to your company	45.45% 10	13.64% 3	18.18% 4	18.18% 4	4.55% 1	22

Q14 Please indicate on a scale of 1-5 (where 1 = no influence and 5 = very high influence), your perception of the following barriers' influence on the adoption of e-collaboration (EC) before versus after the onset of Covid-19

Answered: 30 Skipped: 45





BEFORE Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Misalignment of company hierarchy and software approach (the way the technology is taught)	16.67% 5	23.33% 7	36.67% 11	20.00% 6	3.33% 1	30
b) Benefits to be achieved as a result of E-Collaboration Software (such as employee work performance improvement, employee empowerment , easy availability of data which is not restricted by location or time) are not communicated by management in order for employees to understand and buy into e-collaboration	30.00% 9	20.00% 6	36.67% 11	10.00% 3	3.33% 1	30
c) Content generated by some employees on e-collaboration software is not useful (ineffective) to their colleagues' work because it is not the type of content they need to carry out their work.	30.00% 9	20.00% 6	33.33% 10	10.00% 3	6.67% 2	30
d) Employees' poor management of multiple tools to be used on e-collaboration software	20.00% 6	30.00% 9	36.67% 11	6.67% 2	6.67% 2	30
e) The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive as its success is based on sharing of information	26.67% 8	30.00% 9	26.67% 8	13.33% 4	3.33% 1	30
f) Lack of processes /standards that govern and guide e-collaboration use in your company	23.33% 7	26.67% 8	26.67% 8	20.00% 6	3.33% 1	30
g) Employees have limited time during their workday which restricts their ability to learn how to use e-collaboration tools	23.33% 7	30.00% 9	13.33% 4	26.67% 8	6.67% 2	30

Examining the drivers and barriers to e-procurement and e-collaboration adoption in South African construction- post Covid-19

SurveyMonkey

AFTER Covid-19 onset						
	1. NO INFLUENCE	2. LIMITED INFLUENCE	3. MODERATE INFLUENCE	4. HIGH INFLUENCE	5. VERY HIGH INFLUENCE	TOTAL
a) Misalignment of company hierarchy and software approach (the way the technology is taught)	26.09% 6	21.74% 5	13.04% 3	34.78% 8	4.35% 1	23
b) Benefits to be achieved as a result of E-Collaboration Software (such as employee work performance improvement, employee empowerment, easy availability of data which is not restricted by location or time) are not communicated by management in order for employees to understand and buy into e-collaboration	17.39% 4	26.09% 6	21.74% 5	17.39% 4	17.39% 4	23
c) Content generated by some employees on e-collaboration software is not useful (ineffective) to their colleagues' work because it is not the type of content they need to carry out their work.	30.43% 7	13.04% 3	26.09% 6	21.74% 5	8.70% 2	23
d) Employees' poor management of multiple tools to be used on e-collaboration software	26.09% 6	17.39% 4	26.09% 6	17.39% 4	13.04% 3	23
e) The competitive and non-sharing culture in your company makes it difficult for E-Collaboration Software to thrive as its success is based on sharing of information	34.78% 8	21.74% 5	17.39% 4	17.39% 4	8.70% 2	23
f) Lack of processes /standards that govern and guide e-collaboration use in your company	34.78% 8	13.04% 3	17.39% 4	21.74% 5	13.04% 3	23
g) Employees have limited time during their workday which restricts their ability to learn how to use e-collaboration tools	31.82% 7	13.64% 3	9.09% 2	22.73% 5	22.73% 5	22