Underutilisation of information communication and technology in the public sector construction project’s implementation

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Abstract
Purpose – The construction industry’s daily processes demand heavy data usage and communication between project participants to meet client requirements. Thus, the application of information technology in project implementation has been increasing in the construction sector (CS) lately. However, the same cannot be seen in public sectors responsible for implementing government projects in South Africa. This study aimed to investigate the causes and effects of the underutilisation of information communication technology (ICT) in the building section of a public sector in a municipality in South Africa.

Design/methodology/approach – A qualitative approach was adopted for the study, using a public sector in one of the municipalities as a case study. Face-to-face interviews were conducted among the building unit workers, using unstructured interview questions. The data collected were analysed using the ATLAS.ti software.

Findings – The findings indicate a lack of understanding of existing and newly available ICT software and hardware technology among staff within the building technology due to lack of digitalisation in construction projects implementation, inadequate system upgrades, lack of adequate ICT resources, lack of financial resources for internet and software application subscriptions and lack of ICT training leading. The issues mentioned above have led to the outsourcing of projects professionals, slow pace of electronic emails, untrained professionals, usage of different and unlicensed software, resulting in the underutilisation of ICT within the whole building section. This change also adversely affects all officials, especially the junior officials who have graduated using the most recent ICT technology during their studies.

Research limitations/implications – The building department of only one public sector was used for the study; therefore, the findings may not be generalisable. The case study public sector’s name is withheld for confidentiality purposes.
Practical implications – Adequate change management and continuous development, combined with the allocation of proper resources, would be necessary for all staff members. Enormous investments had to be made in the ICT equipment by providing a sufficient budget in the building section of the public sectors. The building section within public sectors should provide change management to all aged skills staff by attending seminars to learn new ICT technology applied within its work environment.

Originality/value – The study established the causes of the underutilisation of ICT in the CS, especially in the public work departments and municipalities, and how this contributes to service delivery.

Keywords Information communication and technology, Construction industry, Construction projects, ICT skills, Public sector, Municipality

Paper type Research paper

1. Introduction

Information communication technology (ICT) is gradually becoming a significant element in modern times. The information must be generated, transmitted, interpreted, later conserved and eventually recycled through ICT (Akinbile and Oni, 2016). Construction processes need a substantial alteration of data and information between the project participants daily. Acar et al. (2005) also mentioned that contractors could use ICT to manage the site and improve integration, collaboration, knowledge management and procurement processes. When drawing a comparison, Acar et al. (2005) argue that there is a minimal investment in ICT within the building and construction sector (CS) compared to the services related to finance and manufacturing. The ability to effectively utilise ICTs is critical. These enable end-users to constantly familiarise themselves, adapt to change and develop the necessary skills for lifelong learning (Mostert and Nthetha, 2007). The global community continues to increase its investment in ICT. This has dramatically improved productivity within the CS and has increased the quality and speed of work, financial controls, communications and access to common data (Onyegiri et al., 2011).

According to Onyegiri et al. (2011), the influence of ICT on modern society is very intense, and the speed at which it is growing has paved the way for globalisation. It has introduced a global system of interconnected computers using the networks known as the “INTERNET”. It is used for sharing or exchanging data and communication amongst individuals, companies and institutions. Furthermore, Onyegiri et al. (2011) state that the construction industry (CI) is confronted with an ever continuing challenge of changing and improving their current work practices that are engineered to be more competitive and accommodating to the client. They will also become more productive in the construction processes through ICT adoption. ICT can immensely improve the design, planning, quality and cost of new and existing infrastructure by permitting digital management (Aurecon Group, 2015). The Aurecon Group (2015) further explains that this has profound implications and productivity benefits for government processes and the community. Therefore, ICT should be perceived as a necessary tool for development (Ngume, 2016). It can improve service delivery and efficiency in information gathering and processing. Ngume’s (2016) study shows that even though public sectors in South Africa have tried to implement an ICT strategy, only a tiny proportion understood and used ICT. The underutilisation of ICT in the CI has been noted and demonstrated by authors such as Hlahla (2013), Wart et al. (2017) and Asogwa (2011) in South Africa. The CI has been reluctant to embrace the benefits of ICT, as the sector is one of the industries that had not been able to pioneer or embrace the technology (Heiser et al., 2008 and Hosseini, 2012). Therefore, this study aimed to establish the causes of underutilisation of ICT in the construction department of the public sector responsible for government projects implementation in South Africa.
2. Literature review

2.1 Use and adoption of information communication technology in the construction industry

ICT use in the CI and the available real-time construction project applications have been researched and analysed extensively. Adriaanse et al. (2010) state that the investigations have been done because there is a need to identify and analyse the mechanisms influencing ICT use in detail. Doing so could eliminate potential barriers to the successful use of ICT. Hosseini et al. (2012) have also noted that the CI does not embrace technology because its positive effects are not. Hosseini et al. (2012) further explained that technology had progressed fast in other industries. The CI has been lagging for a long time in adopting new technology or ICT (Hosseini et al., 2012). During the past decade, Alaghbandrad et al. (2011) have noted that ICT developments have influenced the CI. New technologies have been invented for construction organisations to store and process their information easily and fast. These technologies can store a large amount of data. One of the tools that have been made available is building information modelling (BIM). When talking about BIM, it is a set of digital tools used to manage a construction project’s effectiveness (Latifi et al., 2013). It is said that BIM can improve the planning process, design and enhance the construction of projects. Albeit, the application of ICT in the CI is a serious challenge, especially in developing countries, including South Africa (Maskuriy et al., 2019). According to Latifi et al. (2013), the Malaysian Government encourages all the construction players to apply BIM to their projects because BIM can solve the problem of the construction projects. Latifi et al. (2013) further elaborate that ICT in construction projects helps manage the project’s productivity and effectiveness.

One of the other tools that have been made available is communication technology. It provides a fast communication tool for all the firms that are into construction (Alaghbandrad et al., 2011). Developing a new ICT tool saves time and cost and can be used as a communication channel (Alaghbandrad et al., 2011). The CI can use electronic archives, and by doing so, it can improve accuracy, provide easy access to information and decrease paper works. However, several positive feedback from ICT uses internal and external barriers to integrating ICT into the CI (Alaghbandrad et al., 2011). Bazini et al. (2011) explain that the external barriers can be named a high cost of ICT and ICT security concerns. The internal ones include lack of ICT awareness and knowledge and lack of relevance ICTs to the organisation or business. Alaghbandrad et al. (2011) state that identifying these barriers helps decision-makers transform problems into opportunities. Table 1 illustrates the CI’s main driving forces to adopt ICT-related methods collected from existing literature.

2.2 Impact of information communication technology in the construction sector

The CI is one of the significant contributors to the South African GDP. This industry supports development by providing basic infrastructure (Latifi et al., 2013). Furthermore, investors followed by the government are the main actors within the CI (Latifi et al., 2013). Alaghbandrad et al. (2011) studied the benefits of ICT in the Malaysian country in the CI. They concluded that the main benefits are client satisfaction, cost reduction, improving management, competitiveness advantages, improving business success criteria (i.e. efficiency, effectiveness and performance), increasing response rate, increasing work flexibility, increasing market share, improving information quality, improving organisational growth, improving work relations and reducing working time. Hosseini et al. (2012) further explain that ICT has been found to strengthen coordination processes and collaboration between firms participating in a construction project. It has also been confirmed by Hosseini et al. (2012) that it also improves information exchange and communications. One of the essential benefits, which have been derived from using ICT, is reduced mistakes in documents and ease of doing complex tasks,
saving time and increasing productivity (Mutesi and Kyakula, 2011). Software and applications have been a massive development in ICT history and have changed building design and procurement (Onyegiri et al., 2011). Onyegiri et al. (2011) explain that these different applications have been built specifically for different purposes, and some are compatible with others. For example, there is a software application developed just for architects. It is called AutoCAD. It is there for drawings and can be transferred to modelling software such as 3D studio max, which is helpful to the architects. Osunsanmi (2020) indicates the benefits of ICT usage in construction as enhancing project performance, enabling innovative construction sites and supporting virtualisation.

2.3 Information communication technology applications and platforms
New inventions in electronic information and communication technology have become indispensable working tools within the CI due to the size and speed of storing and sending information. The hardware and software technology in the CI is evolving (Onyegiri et al., 2011). It has been suggested that many people find computers as necessary as telephones and fax machines because they make day-to-day business effective and efficient. Again adoption of computer technology at workplaces has positive effects on productivity (Meno, 2020). However, according to OECD (2017), this phenomenon comes with the risk of job losses and low skill development. Computers are also known as one of the communicative domains. Kumar (2008) explains that ICT tools have many multi-functional peripherals which could be used for various functions, i.e. data projection, messaging, copying, recording, storing, etc. Different applications and software have been designed for different purposes with special reference in the CS. Some of these are compatible with others. For instance, when the architect wants to draw, they can use AutoCAD, which can be transferred to modelling software, such as 3D Studio MAX. Onyegiri et al. (2011) explain that multi-functional electronic data processes and management are available in the same package; for example, one of these is ArchiCAD. Usually, these are called BIM software, which incorporates so many of these tasks into a single application.

2.3.1 Computer-aided drafting. The significant output of any architectural and engineering team is drawings. These drawings are primarily generated on computers. Like any other computer-aided drafting (CAD) software, construction-oriented CAD is based on the same principles but may differ to some extent in its designing and application methods.
CAD systems provide drawing entities with powerful construction, editing and database techniques to produce drawings and models of what buildings will look like when finished (Onyegiri et al., 2011). Several designers can also share the drawing over a computer on the network. This is done mainly by specialists in particular design areas such as landscape, structural and mechanical designers. The features of CAD are allowing the choice of computer-aided engineering (CAE) and CAD tools to meet product and process needs; providing a high-definition user involvement; warranting an accurate, two-way interchange of CAE and CAD composite part definitions; presenting design for manufacturing maintenance; and offering extended team-centre combination (Onyegiri et al., 2011).

2.3.2 Geographical information systems. Geographic information system (GIS Software) is intended to store, retrieve, manage, display and analyse all types of geographic and spatial data (Singh et al., 2012). It allows one to produce maps and other graphic displays of geographic information for analysis and presentation. This software lets you create maps and other graphic displays of geographic information for analysis and presentation (Singh et al., 2012).

2.3.3 Spreadsheets and word processors. Spreadsheets and word processors have changed information processing in construction societies (Onyegiri et al., 2011). They are used to resolve difficulties. They also circumvent long delays faced in dealing with the outdated manual way of performing office administration (Onyegiri et al., 2011). Spreadsheets such as Microsoft Excel, Word and PowerPoint are important office tools as they stand for worksheets’ daily running.

2.3.4 Building information modelling. Many activities need to be done during the construction and post-construction phases. Latifi et al. (2013) explain that these activities include designing, scheduling and estimating. These activities generally involve the use of BIM technologies. BIM tools such as Revit Architectural, Revit Structure, Revit MEP, Navisworks and Cost-X are developed to assist professionals in CI through all phases in the construction process (Latifi et al., 2013). Land administration systems lay the foundation for supporting the processes of determining, recording and disseminating information about the lease, value and use of land. These systems use cadastral data models to manage the spatial dimension of rights, restrictions and responsibilities associated with a piece of land or property; rights are proprietorship and contract. Osunsanmi et al. (2018) suggest that BIM has many advantages; however, some organisations have identified reluctant usage by their employees. In contrast, restrictions usually control practice and events on property and responsibilities relate more to a social, ethical obligation to eco-friendly sustainability (Atazadeh et al., 2016). With BIM, there is currently no capacity for recording and representing information about ownership and the boundaries of properties, which is core land administration information (Atazadeh et al., 2016). BIM is referred to with two distinct contexts: product and process. BIM is an approach to create, manage, derive and share building information among the different actors involved in the building development process to facilitate collaboration and communication (Eastman et al., 2011). Shen (2011) alludes that BIM links various construction software program applications to provide real-time updates regarding planning, including possible design flaws and recommended best corrections, progress monitoring, reporting and recording. Figure 1 shows a graphical overview of BIM process flow with activities.

2.4 Benefits and impact of information communication technology in the construction industry
Heiser et al. (2008) write that laptops slowly make an incongruous appearance alongside the building site’s hard hats, mud and mayhem. So, is this just a case of keeping up with the
times, or are there other issues driving the industry, from “bricks to bytes”. Brown and Thompson (2011) has explained that the adoption and the use of ICT have improved the quality of the services. Heiser et al. (2008) mention that one of the answers that have been a part of the benefits is the project management tool. With a different selection of people needing to use project management tools such as planners to plumbers, many on the market base are just too enterprise-based and not easy to use. Some industries have begun using online project collaboration tools (Heiser et al., 2008). It is used to keep projects on schedule and budgeting; these tools allow project drawings and other documents to be made available online whenever needed, to whoever needs them, wherever they happen to be (Heiser et al., 2008, p. 42). This is one of the benefits of using ICT in the industry. It makes it easy for project leaders to keep track of the project formulation. Kerr (2015) explains that, across the globe, the revolution of the internet facilitates communication, and it makes it easy to access information with network-connected devices. Due to the evolution of the internet and network-connected devices, Heiser et al. (2008) write that communication with subcontractors is vastly improved, becoming more instantaneous, reliable and trackable. Integration with design software means builders can easily update and publish drawings and make them available to their subcontractors, resulting in a largely paperless process. The none-use of CAD by some contractors is responded to by using design web format files, which enables the sharing and viewing of 2D and 3D files without native programs (Heiser et al., 2008).

3. Research methodology
3.1 Research approach
In this study, qualitative research was used to probe and explore the underutilisation of ICT in the building section of a public sector in a municipality of South Africa. Leedy and Ormrod (2015) write that qualitative research is appropriate for answering any question. According to Creswell (2014), qualitative research is exploratory, and it is used to probe a topic when the theory base and the variables are unknown. Leedy and Ormrod (2015) further explain that this kind of approach seeks to describe, explain, explore, interpret and build theory. Mason (2017) contends that “qualitative research faces new opportunities in a social
world that is increasingly thought to be complex and multi-dimensional, and where the particularly qualitative strengths of understanding context, diversity, nuance, and the process might potentially be very highly valued. As the study intends to understand the underutilisation of ICT in the case study public sector, a qualitative approach was best suited. Thus, qualitative interviews were conducted, and the information collected was then analysed and interpreted to get the final answer. This enabled the researcher to understand and prove the causes of the underutilisation of ICT in the building section of the concerned public sector organisation.

3.2 Case study
Creswell (2014) explains that a case study is found when the researcher seeks to develop an in-depth analysis of a case or a program, event, activity and process. This is done to one or more individuals depending on the case. Creswell (2014) further explains that issues are bound by time and activity, and various data collection is done over a sustained period. Leedy and Ormrod (2015) also explain that when the researcher seeks to understand one person or situation, it may be in a small number of great depth. Because of that, this research adopted a case study. Duff (2018) writes that case study research has received the minimum attention despite the long history and the fact that it has been used extensively so far. Hancock and Algozzine (2016) state that a case study defines what is known based on careful analysis from multiple sources of information about the case. A case study may take a few hours, a few days and even a few months until one can get the information that defines the case (Hancock and Algozzine, 2016). Hancock and Algozzine (2016) alluded that its insights can influence policies, procedures and future research and are usually done to address a phenomenon. For example, in the case of this study, it is to understand in depth the underutilisation of ICT.

Secondly, Hancock and Algozzine (2016) further explain that this phenomenon can be researched or studied in its natural context, as it is bound by space and time. For example, in this study, the researcher seeks to understand the underutilisation of ICT, specifically in the building section of the case study public sector. Thirdly, in the phenomenon being studied, there are key participants, style or interview designs, and other literal techniques to create mental images that bring many variables that have been essential to life (Hancock and Algozzine, 2016). The organisational structure for the building section of the case study public sector is indicated in Figure 2.

3.3 Population and sampling
Sampling is a technique of selecting a suitable representative for a population or unit to determine the whole population or unit (Leedy and Ormrod, 2015). Furthermore, it is used to conclude a specific population or unit of study. Leedy and Ormrod (2013) contend that identifying the sampling depends on the research question. The building section is divided

![Figure 2. Organisational structure for the building section of the case study public sector](image)
into four sections that oversee all the building projects under the case study public sector (Figure 2). These are named as follows: building inspection, professional services, construction unit and maintenance unit. In these sections, 2 interviewees from each section were purposefully selected as participants totalling 8 participants out of the 15 employees working in the building section. The interviewees are Chief Quantity Surveyor, Chief Architect, Engineer, Building Inspectors and Quantity Surveyor. The sampled personnel are the ones that deal with construction projects from different districts, and they have been with the case study public sector for over 5 years. The participants are prominent users of the ICTs for their works during the project implementation process and occupy higher positions. There have been controversies concerning an appropriate sample size for a qualitative study using a single case. Some authors suggest a sample size of 5–25 is sufficient for a qualitative case study (Sandelowski, 1995; Leedy and Ormrod, 2015), whereas others suggest a 15–40 (Creswell, 2009; Hagaman and Wutich, 2017). However, Mayring (2007) states that what is essential is when saturation is reached during a qualitative interview. In this study, saturation was reached at the 7th interviewee; thus, the eight participants used is acceptable.

3.4 Data collection
Leedy and Ormrod (2015) explain that a qualitative researcher might note initial hunches and intuitions to pursue through further observations or interview questions to collect data. Williams (2011) states that even though the questionnaire survey is always relevant, they still have some kind of limitation. Therefore in this study, individual interviews were used to collect data. Creswell (2014) states that an individual interview seeks to understand the personal experience. Williman (2015) states three types of interviews: structured, unstructured and semi-structured interviews. According to Leedy and Ormrod (2015), the structured interview requires the researcher to ask standard questions and nothing more. The semi-structured interview requires the researcher to follow the standard questions with one or more individually designed questions to get clarification to probe another person’s reasoning. The researcher used unstructured interview questions to interview the participants at their offices. The interview took about 30–45 minutes per participant. Further, Williman (2015) writes that an unstructured interview is a flexible and helps to gain more insight and collect relevant data.

3.5 Data analysis and interpretation
Leedy and Ormrod (2015) write that qualitative data analysis is iterative. Thus, a good researcher would opt to go back and forth a little among the previously presented strategies. Qualitative data can be analysed by searching for themes and categories and primarily using inductive reasoning. Thematic analysis was also conducted on the transcripts from the researcher’s interview. Clarke and Braun (2013) explain that thematic analysis is crucial to identifying and analysing qualitative data patterns. Abdulaziz (2016) further explains that key thoughts and ideas must be grouped into keywords and themes. The following six steps must be followed in thematic analysis, according to Clarke and Braun (2013: 02):

- **Step 1**: familiarisation with the data – the first important step is for the researcher to familiarise themselves with the data. The researcher read the transcript thoroughly and immersed herself within the data. This was done to make it easy for the researcher to stipulate her observation.
- **Step 2**: coding is the next step when conducting qualitative analysis. The researcher gathered and coded every data item using ATLAS.ti software.
• **Step 3:** the researcher searches for all the themes – this was done by pointing out every meaningful pattern in the data relevant to the research question. This phase ended by ordering all the coded data relevant to each theme.

• **Step 4:** the researcher then reviewed every theme – the review was done by checking whether the themes “work” concerning the coded extracts and the full data sets. The researcher would then state whether the themes tell a convincing story.

• **Step 5:** This is where the researcher defines and names the themes accordingly. The researcher identified and named each theme.

• **Step 6:** Writing up – this is the step where the researcher extracts the data and tells the reader a clear and convincing story about the data concerning the existing literature.

The demographic profile of the participants is indicated in Table 2.

### 4. Findings and discussions

#### 4.1 Causes of underutilisation of information communication technology

Participants were asked to share their experiences regarding the causes of the low utilisation of ICT in their department. The responses were then analysed using Atlas.ti to identify the main themes. The findings from the participants’ responses, indicating the various themes, are shown in Figure 3.

The main themes that emerged from the participants responses are lack of digitalisation in construction projects implementation, inadequate system upgrades and relevancy of...
applications, lack of adequate ICT resources at the department, lack of financial resources for internet and software application subscriptions and lack of training leading to ICT skills insufficiency.

4.1.1 Theme 1: lack of digitalisation in construction projects implementation. P4 highlights the manual processes still used in civil and construction engineering at their department. These entail the usage of the drawing board, as it is the norm in the entire profession. Hosseini et al. (2012) concur that the CI has been lagging for a long time in adopting new technology or ICT as a whole. P2 also stresses an enormous potential for significant improvement if there can be a paperwork reduction. Yet, the problem of resistance to change remains a standing issue in the study. As P4 and P2 narrate:

P3: “[...] I use a drawing board, even though, if we had a similar tool on a computer, it would save time and make things easier. However, we don’t have any application, so we execute the work the best to our knowledge [...].”

P2: “[...] but we all understand that everything rises and falls on the management. We cannot still be living as if we are in the old days. This old system wastes time and wastes money. This has the potential of demotivating the workers especially those young graduates and professionals who are more likely exposed to more modern ICT applications for building and construction projects”.

The resistance to change is one of the reasons workers tend to slowly up-take new technology solutions in their assigned roles and functions. The fear of job loss and failure in using the newly introduced system in an organisation is mentioned by Castiglione (2012). Yet, in fulfilling the objectives of an introduced system, an organisation’s management is expected to ensure a transformational leadership approach that takes the employees along the values linking such a system and those of the organisation (Tomek and Kalinichuk, 2015). In doing so, employees are made to buy into the new culture of using a digitalised system in executing their roles after understanding the benefits, both as individuals and as an organisation. P7 alluded to the main gap in ICT utilisation in the government sector that construction employees execute a minimal project; thus, they do not use maximum computer software to aid their works. As P7 states:

P7 “[...] we do very little projects and as such, we are not utilising the computers to its full potential. Because you might have WinQs but it is used once or twice in a year. At times when you are not using it so frequently, you forget the tools that you should be using”.

4.1.2 Theme 2: lack of adequate information communication technology resources at the department. P3 alluded that, as the building office, there is no specific application that is deemed or perceived as mandatory or standard procedure for project implementation, such as planning, designing and costing of construction projects due to insufficient ICT resources. Thus, everyone applies the procedure they seem fit where possible they use their software to facilitate the work. As P3 states:

P3 “[...] except for when I was working as an architect, we used AutoCAD as the main application for drawing”.

Kerr (2015) meanwhile explains that, across the globe, the revolution of the internet facilitates communication, and it makes it easy to access information with network-connected devices. The participants alluded that using AutoCAD, GIS, messenger and emails in the building sector of the case study public sector will enhance work performance. P1, on-time efficiency, states that the ICT applications save time dealing with large amounts of information. Yet, they are hindered as they are not required to adopt it due to a lack of
resources. The aspect of time efficiency relates to the unified theory of acceptance and use of technology (UTAUT) theory that asserts the construct of performance expectations. The performance issue has a timer element, and this is fulfilled with the expectancy of fulfilling tasks within time. Wang and Wang (2010) assert that UTAUT’s construct on performance expectancy reiterates that end-users expect the system to enhance their performance level, including time as a performance element. On the issue of ease of use, users hope that the system is easy to navigate and relates to the elements of effort expectancy in the UTAUT theory. P3 explains that the digital filling system is more secure than the manual one and that there are security features and functions that secure such organisational data. As P3 stated:

P3: “[. . .] one will have to use a password in order to open the computer”

Latifi et al. (2013) attest that ICT tools used in construction ought to be able to demonstrate how a construction project would affect traffic flows, access and exit roads, public transport and the storage of materials on-site, as well as the scheduling of different types of machinery and personnel. P2 stresses that, currently, the organisation stores its information using both paper and electronically, but the paper is mainly used in record keeping. Alaghbandrad et al. (2011) findings support this view that the CI can use electronic archives by doing so as it can improve accuracy, easy access to information and decrease paper works:

P2: “[. . .] however, and I don’t think it is efficient especially the paper may get lost easily and there is no order or ventilation in the record room and the paper gets moisture. There is no proper archiving and labelling of the filling system. The current mode is not efficient”

Hosseini et al. (2012) also assert that the CI had not pioneered or embraced ICT technologies in responding to the socio-technological demands associated with building and construction requirements. Yet, owing to the emergence of the 4th Industry revolution, Hosseini et al. (2012), builders are now beginning to collaborate more closely with their information technology (IT)-savvy colleagues, such as the architects and engineers responsible for the ideas behind their work. P4 stresses that the preference for the manual transition rather than electronic data modelling and processing in building and construction projects results from ICT equipment inadequacy in their department. As P5 notes:

P4: “[. . .] and electronically and I think as the Region we are not there yet in order to use only electronically. Most of the time we end up using both because we are not constantly updating them electronically”

P5, in corroborating with P4, stated that the organisation uses both electronic and paper and is slowly transitioning into using electronic tools in project delivery. P3 mentioned that, because they have no network as a section, it would be easier if all staff members had adequate access to the networks. The P3 states as follows:

P3: “[. . .] right now, there is no form of communication whatsoever and we can’t use our personal phones. We normally ask people with the internet to use their computers of which I do not think it is professional”

4.1.3 Theme 3: lack of system upgrades and relevant software applications. P2 laments the lack of adequate system upgrades that have affected the quality of organisational productivity and performance. As P2 notes:

P2: “The technology in AR is very behind [. . .] the capturing system here is very behind. For instance, if you submit a leave request form there should be a system or a server that is used to
capture your details and your leave days. You can send it to your manager without interacting or waiting for the availability of your manager. We are very behind as the Region”.

Heiser et al. (2008) suggest that ICT tools in construction projects allow project drawings and other documents to be made available online whenever needed and to whoever needs them, regardless of geographic distance. Nonetheless, P1, a Mechanical engineer involved in projects and engineering drawings, exposes the lack of relevant applications on their assigned laptops. As P1 narrates:

P1: “[...] We should be having Ms. Project, but it is not installed on my computer. I have my own student version because our Region does not have licenses”.

The mentioned limited installations in the interviews can be linked to Hosseini et al. (2012). They mentioned that the CI has been lagging for a long time in adapting to new technology or ICT as a whole. During the past decade, Alaghbandrad et al. (2011) have noted that ICT developments have influenced the CI. At the same time, Castiglione (2012) attests that during the 1980s and early 1990s, investment in ICT and the growth of ICT development were minimal and non-existent. However, recently a vast improvement in ICT growth in the CI has been observed in contemporary research findings. P3 mentions that it would be helpful if the maintenance unit in the building section of the case study public sector had a software application such as AutoCAD. As P3 states:

P3: “[...] we really need an application as the maintenance unit for example with the current project that we have, we had to manually draw it and imagine how it would look like. Whereas if you were using an application you would have the exact measurements and how it would look”.

Onyegiri et al. (2011) relate with these findings that multi-functional electronic data processes and management are available in the same package. For example, one of these is ArchiCAD and also elaborates that usually; these are called BIM software, which incorporates so many of these tasks into a single application. The above arguments were also identified by Onyegiri et al. (2011) as part of the challenge of a lack of access to fulfill the planning and design requirements in construction. Concerning the setting of the network infrastructure, as highlighted by Participant 3, there is also a lack of adequate attention to network workstation requirements that create an enabling ICT environment for workforce performance. As P3 narrates:

P3: “[...] We also don’t have plugs or data points. We have moved from one building to another but still, there is not much of a difference”.

Onyegiri et al. (2011) has also concurred that the hardware and software technology in the CI is evolving. That accessibility makes construction projects’ data available to the entire project team employing an interactive, interoperable and intuitive interface. Beneficiaries of such data entail architects, engineers, contractors, fabricators, owners, facility maintenance and users.

4.1.4 Theme 4: lack of training leading to information communication technology skills insufficiency. P1 states that more training is needed, especially for Excel, windows or computer systems. P1 further explains that mostly our older generation needs the training. Generally, if one is an Architect, they must be able to use WinQs, and if you have a background in the industry, one should be able to use MS Project. In support of P1’s views, P2 stresses that one would need a bit of skill if there is a perceived lacking in certain skills and requests training. Again, P3 asserts the need to broaden knowledge of ICT application skills and proficiencies through relevant training. The views of P2 and P3 are stated as follow:
P2: “[…] I think there is a need to go in-depth when it comes to using MS office especially Outlook, Excel, and Word. There is also a need for training in AutoCAD but for me, the skills are enough”.

P3: “[…] it is not enough to be able to use AutoCAD […] would like to be trained on Revit. Revit gives you a live drawing such as 3D. You are able to see clearly what you need to do. Also, be able to create plans and be able to train our interns on the new and available tools”[…].

Latifi et al. (2013) support these views by explaining that BIM is evolving. BIM tools such as Revit Architectural, Revit Structure, Revit MEP, Navisworks and Cost-X are developed to assist professionals in CI through all phases in the construction process. P4 explained that he has never been trained or introduced to an application that enhances the manner he executes his professional quantity surveying tasks. As P4 narrates:

P4: “[…] I have never been trained or introduced in such an application I have been doing them manually all my life […] but I perceive that it would make things very easy”.

Alaghbandrad et al. (2011) also found that training outside the construction company is not as efficient as inside classes. Therefore, some construction professionals have had to learn more in universities to know what they do in the CI. At the same time, P2 asserts that ICT applications might not be fully utilised:

P2: “[…] we are not fully using these applications […] or half utilising them or not utilising them at all. The systems that we have in AR are AutoCAD, WinQs, and Ms Project”.

P5 alluded that training is being done in their department. P6 corroborates the latter by stating the following:

P6: “[…] as we are introduced to new software or application, we keep on being trained”.

Hlahla (2013) has also noted that the CI faces the challenge of poor skills due to the unwillingness of contractors to invest in the training of their labourers. The inherent fear can explain this inclination that training workers may not be beneficial to a company as the trained workers will be lost to other contractors in the labour market. According to Hlahla (2013), contractors also believe that their time on training translates into lost productivity and, hence, the reluctance to train labourers. According to the organisation for economic cooperation and development (OECD) (2004), the lack of ICT skills and business skills are widespread impediments to effective uptake once adoption decisions are made.

4.1.5 Theme 5: lack of financial resources for information communication technology subscriptions.
P5 raises the financial resource challenge when he mentions that internet access is, at times, not available because of failed monthly internet subscriptions. P6 and P4 corroborate the financial issue with subscriptions for applications by stating that they do not have computers for their fieldwork due to budget constraints. Their views are as follows:

P5: “[…] the main disadvantage with applications such as AR is that when you want to use the application you cannot access them because the department did not pay. Sometimes we get used to using these applications to make our lives easy”.

P6: “[…] budget becomes an issue because you will not be able to access the application if we do not pay for them and it is expensive […] at times the subscription has expired”.

P4: “They don’t have computers or networks when they traveling on-site, they need to come back to the Regional Office if they need any assistance to see what tool or the easy way they can use for the project”.
Onyegiri et al. (2011) support the importance of access to the network, as elaborated on by P4 when he explains that a network can simply be described as the act of connection between computers or devices and the internet, in particular, which provides exceptional opportunities for communication and sharing of information. The implication is that project implementation at the case study public may experience accuracy and other inefficiencies problems as computer-aided designs and taking off are usually more accurate than manually executed designs.

4.2 Effects of the underutilisation of information communication technology on project delivery

Participants were then asked to express their views on the effect of inadequate utilisation of ICT on construction projects and general work activities. The data was analysed using content analysis to arrive at various themes, as indicated in Table 3.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risks in outsourcing ICT competencies</td>
<td>P7, P4</td>
</tr>
<tr>
<td>Information Security Risk</td>
<td>P3, P2, P1, P6</td>
</tr>
<tr>
<td>Work inefficiency</td>
<td>P3, P2, P4, P5, P6, P7, P8</td>
</tr>
<tr>
<td>Risk of untrained professionals</td>
<td>P1, P3</td>
</tr>
<tr>
<td>Usage of different and unlicensed application versions</td>
<td>P2, P1</td>
</tr>
</tbody>
</table>
training to staff members as a risk to the organisation’s ICT utilisation and performance optimisation:

P2: “it is very easy to lose information due to a lack of understanding of the application”.

P3: “[...] It would be a risk for someone that is not trained because untrained users might delete the much-needed information because of lack of knowledge”.

P6 attests to the challenges that a lack of adequate or reliable network and communication bottlenecks are erratic barriers to ICT utilisation in the department and stressed the need to have a robust system with sound data storage and archival properties:

P6: “[...] Information can easily get lost if we do not have a back-up server. There is no back-up serve for our information. Information can easily get lost and the emails are always slow”.

The implication of these findings is that data storage is a problem in the organisation; thus, important data may be lost in the future, hampering the work progress as the same work might have to be redone, leading to work duplication and work hours. These may also compound the inefficacy work method in the system.

4.2.3 Theme 3: effect on work efficiency. P3 explained that when using the ICT application, it makes things easy, and also, to read the plans is not much of a hustle. It shows you how the design should look, especially when starting a building project. However, the slow pace of existing internet services makes it difficult for them to work efficiently. At times sending an email to a colleague takes too long to go through. This view was also collaborated by P2. As P2 states:

P2: “Emails can be very slow because of network issues”.

On the other hand, P4 blamed the IT department for not upgrading their computers regularly, thereby affecting their operating capacity. This phenomenon has made their computers non-responsive, in some cases making them wait for several minutes to allow the system back during working, thus affecting work efficiency. The notion of slow reaction time to computer-related problems on workstations by assigned ITC professionals was also stated by Participant 3. As P4 and P3 state:

P4: “[...] I would not say that there is a gap, but IT department does not update our computers at all”.

P3: “It takes time for the IT office to adhere to issues that we have with the computers and also our applications are limited”.

P2 stresses the underutilisation of ICT as people are not trained to work on either the software or hardware part of ICT. P5 mentions network challenges. The participants further suggest having a Wi-Fi router for staff members to access the internet and relevant Web-based applications in fulfilling their project tasks. P6 also mentions network issues and prolonged network downtime as gaps in the performance of the ICT infrastructure in the organisation. As P6 notes:

P6: “Network issues, Internet connectivity it’s sometimes slow and sometimes we do not have at all. We do not have phones to communicate with the stakeholders. We have a Wi-Fi router that we use for accessing the things that we cannot access when using the AR network and sometimes that Wi-Fi router stops working”.

P8 sees it from a different angle regarding the low usage of ICT in their department. He notes that since more people use manual system systems, work efficiency is usually negatively affected as they spend more time designing projects. Again P7 stated that work
is due to insufficient electronic points at their office and suggested that even if they have computers, they will become useless. The views P7 and P8 are stated as follows:

P8: “Some people have been trained in using a computer. Still, they are not able to use a computer. Most of the people are still using manual than computers”.

P7: “We rather sit and chat because of the lack of network and computer plugs. This is a discouragement for the maintenance unit”.

It has been observed by Onyegiri et al. (2011) that, in construction, electronic mails are useful as they are a fast and convenient means of sending and receiving mails and files. Kumar (2008) also explains that ICT tools have many multi-functional peripherals which could be utilised for various functions, i.e. data projection, messaging, copying, recording, storing, etc. According to Latifi et al. (2013), the 4D BIM models demonstrate how a construction project would affect traffic flows, access and exit roads, public transport, the storage of materials on-site and the scheduling of different types of machinery and personnel. Therefore, not having access to modern technology in the case study organisation significantly affects workflow and efficiency; thus, government may be paying workers who are not executing the scheduled task or output at their offices.

4.2.4 Theme 4: risks of untrained professionals and project scope accurate readings. The participants assert that everything revolves around ICTs, and as such, operating without the usage of ICTs is a barrier to productivity in the building and construction projects sector. For instance, P1 raises the issue of computer literacy challenges within the building department, which may affect staff capacity in using ICT to perform their tasks. P3 further adds on the frustration of the end-user to the system (such as AutoCAD without training), which affects the accuracy of their designs. The views of some participants are stated as follows:

P1: “Currently in this office specifically, we have quite a huge contingent of old people that are struggling or are not really familiar with ICT specifically computers”.

“[…] need a bit of training, sometimes the budget becomes an issue and also the training if they so happened, they are always outside this municipality”.

P3: “[…] now you need to do a lot of thumb sucking […] we don’t have the training of the application adequately provisioned […] a great disadvantage that we don’t have any application as the maintenance section”.

According to Alaghbandrad et al. (2011), it has been revealed that some leading construction firms in ICT consider ICT skills as a requirement for job applicants in the CI, and that this has encouraged the architects, engineers, etc. to learn ICT skills before their employment. Therefore, the lack of staff training emanating from the study’s finding is a worrying trend as the employee may lack capacity in ICT for future job prospects.

4.2.5 Theme 5: usage of different and unlicensed application versions. It was revealed that due to lack of system and software upgrades, workers usually installed the software they were familiar with and some of which are unapproved and unlicensed. P2 adds the challenge of using different application versions to manipulate the same file during the information exchange between employees and management. P1 stresses the challenges they have to go through in requesting for authorised and licensed software to be installed for
them. Often, the authorities discard their requests; thus, they have to rely on the unlicensed ones to execute their work. The views of P2 and P1 are stated as follows:

P2: “[…] If people have different versions of the application, the one on the receiving end might not be able to open the file due to different file formats […] some people may not be able to use it at all”.

P1: “[…] Just for us to have licenses for the application we even have to fight in order for us to access them. Even the budget becomes a problem”.

Tomek and Kalinichuk (2015) stress that communication with sub-contractors with ICT technologies must be vastly improved, instantaneous, reliable and trackable. At the same time, integration with design software means that builders can easily update and publish drawings and make them available to their subcontractors, resulting in a largely paperless process (Heiser et al., 2008). The findings thus indicate how serious the authorities should address these challenges to ensure job efficiency and effectiveness in the case study public office.

5. Conclusions and recommendations
Research findings highlight the importance of modern software applications for engineering and architectural designs. However, this study has noted that some users find it challenging to adapt to technology because of a lack of training, especially old employees, leading to employees’ inability to adopt modern technology building software. The age of the users in the case study municipality workers has also added to the lack of embracing technology. The lack of ICT skills training has increased the use of manual means to do designs, leading to a situation where project documents are hand-delivered instead of electronic delivery. Inadequate system upgrades and relevancy of applications, lack of adequate ICT resources at the department, lack of financial resources for internet and software application subscriptions have exacerbated the culture of ICT utilisation at the building department for project implementation and management. The consequence of the low patronage of ICT is the usage of unlicensed software by workers to execute their work, outsourcing project designs and the risk of losing project information due to lack of information control and poor work efficiency. This may suggest that the government pays for inefficient workers monthly, thus incurring costs not matched by work output. Therefore, it is recommended that adequate change management and continuous development, combined with the allocation of proper resources, would be necessary for all staff members. Enormous investments had to be made in the ICT equipment by providing a sufficient budget in the building section of the public sectors. It is recommended that the building section within the municipality implement change management to all aged skills staff by allowing them to attend seminars to learn new ICT technology required within its work environment. Furthermore, there should be developmental support to switch to the latest technology, thus keeping them updated. Therefore, the budgetary needs for ICT should include a vast array of needs such as updating information events, new technology installation and/or upgrades, licensing of software and training. The building department should prepare a comprehensive budget when planning to ensure that it meets all the resource and development needs of ICT. Future may include more municipalities to ascertain if the same ICT usage challenges exist.
References


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**Further reading**


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