

## **Study on ICT Skills for Cloud Computing Implementation among Quantity Surveyors in Pre-Construction Stage**

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**Abstract:** Cloud computing is a new paradigm of information technology (IT) that allows users to access software, hardware, and data stored on a cloud server. However, ICT adoption leads to a high-cost investment, a lack of knowledge, expertise, adequate training, etc. in adapting it to the construction industry. These problems affect the implementation of cloud computing in the construction industry. Thus, this study was conducted to identify the key ICT skills needed and then, to determine the challenges and the relationship between key ICT skills needed and challenges among QS at pre-construction. The research used a quantitative (questionnaire) method and the respondents of this research are the Quantity Surveyor at Johor. 200 questionnaires were distributed and 103 questionnaires were returned. Then, the data were analysed by using the SPSS to provide the frequency analysis, descriptive statistics, and correlation analysis. Key ICT skills are highly endorsed by the respondents and the results stated that cloud services require key ICT skills to be implemented effectively. Then, major challenges to implementing cloud computing at the pre-construction stage are the lack of knowledge and skill among employees, cost issues, and security issues. In addition, ICT-related and cloud computing challenges seemed to significantly affect the respondents' needed key ICT skills in using the cloud computing technology. In conclusion, this research contributes to enhancing the understanding of the relationship between the ICT skills needed and the challenges to implementing cloud computing among the Quantity Surveyor at the pre-construction stage.

**Keywords:** Cloud computing, ICT skills, Pre-Construction stage, Quantity Surveyor

## 1 Introduction

Projects typically have three phases; the preconstruction phase, the construction phase, and the post-construction phase (Lau *et al.*, 2018). As stated in a study by Bakar and Embi (2016), the pre-construction phase is one of the most important phases in construction that influences the success of a project. According to Lau *et al.* (2018), this phase involves gathering the necessary information in advance to set the direction of the project and start construction. Even though the construction industry is already embracing the new technology revolution, many case studies found that lack of knowledge and training are the key barriers to the adoption and use of IT/ICT applications (Ern *et al.*, 2017). Information and communications technology (ICT) skills refer to communication ability through various technologies (Doyle, 2021), and in terms, ICT refers to a wide range of technologies that manipulate and communicate information and the common uses of the internet like electronic mail (e-mail) and electronic commerce (e-commerce) which in prepare the electronic invoicing, payments, materials receipts, etc. Since the ICT becoming more advanced, it helps quantity Surveyors to boost up their work processes and through technology like facilitate the process of preparing tender documents, carrying out measurement work, and preparing BQ and other documents related to the project (Seah, 2021). However, Seah (2021) also said that the rate of adoption of technology in Malaysia's construction industry is relatively low despite the many benefits it can bring to Quantity Surveyors.

According to Benlian *et al.* (2018), in the IT industry, cloud computing is the newest ambiguous term. Cloud computing is a technology that has evolved in information technology to provide access to computing resources and has become a dominant business model for delivering IT infrastructure, components, and applications. Thus, by deploying cloud computing, individuals and organizations will be able to access scalable and managed resources on demand, such as servers, storage, and applications (Sunyaev, 2020) and the best part about it is that cloud computing makes the individuals and organizations possible to access IT resources instantly, anytime, anywhere, and from any device (Okai *et al.*, 2014; Malik, Rashid, and Wani, 2018). Furthermore, as a QS job involved with big data and most quantity surveying firms face at least one challenge in the adoption of ICT in their daily operations (Anifowose, Alabi & Mangvwat, 2018). Thus, to address the above-mentioned issues, this study seeks to identify the key ICT skills needed for implementing cloud computing among QS at the pre-construction stage.

Pre-construction phases of a project also known as planning and design phases are very important stages in the construction process to control the success of the project (Lau *et al.*, 2018). According to Garyaev & Rybakova (2018), one of the issues that can obstruct the proper implementation of building projects is the separation and insufficient interaction between the participants in the design and construction process. In response to that, many researchers have already acknowledged the importance of effective planning practices and the integration of designers and contractors in the early stages of the construction project life cycle (Bakar & Embi, 2016). However, as reported in TheStar during pandemic Covid-19, “*The government has decided that 80% of government staff and 40% of the private sector will work from home as one of the strategies to flatten the Covid-19 curve*” (Bedi and Timbuong, 2021). Providing all stakeholders involved in the design and construction process with access to information and communication tools is frequently a difficulty during implementation. Therefore, the meeting between the stakeholders at this phase still has the limitation of people which it seems still need another platform to make sure all the stakeholders get the same input during the time the discussion should be held. Thus, IT professionals require more assistance in encouraging and improving their knowledge about the IT, and organizations who do not invest in their employees' talents now will pay the price later.

Ern, Kasim, Masrom, and Chen (2017) stated that technology has advanced rapidly in other industries, but construction has largely lagged behind other industries in terms of technology adoption. Information and communication technology (ICT) or also known as information technology (IT), has

had an unquantifiable impact on business systems and processes. As a result of the complexity of work, administrative requirements, the expense of doing business, and the ongoing demand for upgrading and better know-how, the benefits of ICT come at a cost. Furthermore, according to Anifowose, Alabi & Mangvwat (2018), the adoption of ICT in daily operations poses at least one challenge for most quantity surveying firms. Then the high cost of purchasing technologies, according to industry stakeholders, is the biggest impediment to ICT implementation. In addition, several case studies in the construction industry have discovered that a lack of knowledge, expertise and adequate training are among the barriers to adopting and deploying IT/ICT applications. Furthermore, Day (2020) stated that in the IT industry, cloud expertise is in high demand, and cloud certifications are linked to the highest earnings. This is because the new technology necessitates new skill sets and training, and the country requires competent and skilled IT employees. As a result, the cost is one factor that limits an organization's ability to grow and use more ICT (Ern *et al.*, 2017).

Cloud computing, according to Namasudra (2018), is a new paradigm of information technology (IT) that allows users to access software, hardware, and data stored on a cloud server. Bello *et al.* (2020), stated that cloud computing technology provides economical and scalable computing facilities using a pay-as-you-go pricing model. In addition, cloud computing is an essential perspective tool for assisting the construction industry, since it allows for remote collaboration via the most popular and already available means of data transport, such as personal computers, the Internet, laptops, tablets, and smartphones (Garyaev, & Rybakova, 2018). However, there is a lack of research has been done on the specialized applications of cloud computing in the construction industry, as well as future developments. Furthermore, in the construction industry, data demanding because heterogeneous data that continuously generated as the project advances (Bello *et al.*, 2021) while cloud computing has a lot of potential in the construction business, it isn't widely used (Oesterreich & Teuteberg, 2016). The construction business, on the other hand, is one of the least digitized. This is because the construction sector is capital-intensive, it may be hesitant to experiment with new technologies, resulting in a delayed rate of technological adoption. Therefore, a better understanding of the ICT skill needs with the challenges to be faced have to be explored and utilized to increase the production, efficiency, and quality of local industries, and also to strengthen the ICT skills and knowledge in people. Therefore, the objectives of this study are including (1) To identify the key ICT skills needed for cloud computing implementation among QS at the pre-construction stage, (2) To determine the challenges on ICT skills needed for cloud computing implementation among QS at the pre-construction stage and (3) To analyse the relationships between the key and challenges on ICT skills needed for cloud computing technology implementation among QS at the pre-construction stage.

The research scope focuses on investigating the key ICT skills needed and challenges for cloud computing implementation among QS at the pre-construction stage. As reviewed by Ling *et al.* (2020), the growth of the economy causes the growing demand for workers with skills in software development and IT technologies, such as mechatronics experts with software skills, which will result in a higher need for people with expertise in software technologies. The research is concentrated on the Quantity Surveyor at the pre-construction stage. At this stage, the quantity surveyor's role is to conduct a feasibility study like do the preliminary estimate, prepare the Tender document (bill of quantity (BOQ), condition of a contract, articles of agreement, and so on (Nuwan, 2019). Then, the area will focus on Johor due to the biggest and most controversial development like the Forest City project which is well established at both national and international levels (Clark, 2018). Based on Bahagian Perancang Ekonomi Negeri (BPEN) Johor (2020), stated that Johor is the 3rd largest contributor to Malaysia's construction sector. Compared to other states, Johor has a high level of achievement and according to the GDP value of the state, Johor is 4th out of 15 states including the Wilayah Persekutuan.

From this study, the construction industry can improve the knowledge and skill in terms of ICT for the new upcoming generation of using cloud computing at the pre-construction stage. This study also can give recommendations to the Quantity surveyor team on how to implement cloud computing technology in any construction project during the pre-construction stage and it also will boost the ICT skill in implementation in construction projects. Furthermore, it may develop solutions to the challenges of applying ICT skills for cloud computing implementation and gain benefits from using that technology in managing construction projects. Last but not least, the research will help produce a generation with

smart IT and the latest technologies to help in increase and develop the economy of the construction industry in Malaysia. From this study, the construction management also can improve and enhance the knowledge and skill in terms of ICT for cloud computing among the workers in the management sections where soft skills are highly demanded in any industry. In addition, the use of cloud computing can be further expanded in the field of construction management since the use of cloud computing is increasingly widespread all over the world.

## 2. Literature Review

### 2.1 QS in Construction Industry

A Quantity Surveyor (QS) is a person who is in charge of project financial control, cost management, and contractual administration. However, during the pre-construction phase, the QS reviews the plans of the designers and engineers, separates the expenses involved, and then develops a general assessed budget plan for each activity in the project as shown in Table 1.

**Table 1: Roles and Responsibilities of QS (Reddy, 2017)**

QS of Client	QS of Contractor
Prepare an early cost estimate prior to construction	Cost planning for various contractor activities
Advice on appropriate procurement strategies	Preparing precise detailed information for contractor activities
Prepare Bills of Quantity (BQ)	Pricing Bills of Quantity (BQ)
Evaluate Tenders and Tender negotiation	Finalizing measurement details with Client QS
Cost Planning	Maintaining project progress database

### 2.2 ICT Skills Needed for Cloud Computing.

#### (a) Definitions

The nature of the topic under discussion is about the details of Information and Communication Technology (ICT) and Cloud Computing (CC). Information and Communication Technology (ICT) is the method of using digital technology, communication tools, and networks to acquire and evaluate information, communicate with others, and perform practical tasks, was found to be a necessary skill in the research by Falck, Heimisch, Wiederhold (2021). ICT also like information technology (IT), refers to the use of technology for routine, everyday actions such as sending an email, making a video call, searching the internet, using a tablet or mobile phone, and so on. Alabi and Anifowose (2018) defined in the research paper that Information and Communication Technology (ICT) is any method of storing, retrieving, manipulating, transmitting, or receiving electronic information as an important aspect of technology that has a combination of manufacturing and service industries. It is a sector that includes information technology distribution, telecommunication products, information technology manufacturing, maintenance, and communication system installation.

In the term of cloud computing, it can be defined as a new paradigm of Information Technology (IT) that transforms how hardware and software data from the cloud server are managed and utilized (Bello *et al.*, 2020). However, according to Griffith (2016); Yamaura (2018) in cloud computing, data is collected, disseminated, and analyzed by using services like application, storage, and processing over the Internet instead of the user computer's the hard drive. In cloud computing, instead of setting up their physical infrastructure, users commonly contract with a mediator provider. Additionally, cloud computing is also defined by the National Institute of Standards and Technology (NIST) as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Amron, Ibrahim and Chuprat, 2017). Then,

in the aspect of research by Srivastava and Khan (2018); Samarraie and Saeed (2018), a cloud in cloud computing is a collection of networks, similar to clouds in real life, which are collections of water molecules

(b) *Type of ICT Skills Needed for Cloud Computing*

As known, due to its enormous and profound socioeconomic benefits, Information and Communication Technology (ICT) plays an important role in nations' well-being and prosperity (Lew *et al.*, 2019) and it is no wonder that ICT skills are increasingly in demand on the job market since the online world has become a major part of everything we do. This can be proved by Samarraie and Saeed (2018) who stated that cloud computing is the method for delivering resources of computing infrastructure in the form of Internet-delivered services through the use of information technology (IT). Then, in the story about cloud computing, it's already known that cloud computing is one of the technology systems under the Information and Communication Technology (ICT). Furthermore, it is frequently necessary to use several different applications to complete tasks in the ICT skills assessment, for example, managing requests to reserve a meeting room with a web-based reservation system, sending out e-mails to decline requests that cannot be accommodated, etc. Thus, Table 2 shows the type of skills needed for Cloud Computing.

**Table 2: Type of Skills Needed for Cloud Computing (CompTIA, 2021)**

Skills	Explanation
Cloud Security	<ul style="list-style-type: none"> <li>• A major barrier to cloud adoption.</li> <li>• A cloud security solution includes new capabilities like data loss prevention (DLP) and identity access and management (IAM), and IT professionals can also help create best practices around processes like procurement and integration.</li> </ul>
Virtualization	<ul style="list-style-type: none"> <li>• The fact that virtualization skills are still in high demand reflects the amount of modernization that many businesses must still through to transition from a static on-premises mindset to a dynamic as-a-service strategy.</li> </ul>
Business Continuity / Disaster Recovery (BC/DC)	<ul style="list-style-type: none"> <li>• As of now in the Covid-19 epidemic IT professionals can establish a comprehensive BC/DR plan that helps their organization handle interruptions by understanding the many alternatives available in cloud storage and cloud software.</li> </ul>
Optimization	<ul style="list-style-type: none"> <li>• This is something that few businesses have done before, especially if they haven't looked into virtualization, and it requires IT professionals to understand the behavior of apps as well as the many characteristics of cloud infrastructure alternatives and cloud providers.</li> </ul>
Private Cloud Construction	<ul style="list-style-type: none"> <li>• As organizations become more aware of the distinctions between models, they may decide to construct a real private cloud, which will necessitate the deployment of software to dynamically distribute resources and self-monitor based on certain characteristics.</li> </ul>
Orchestration	<ul style="list-style-type: none"> <li>• A multi-cloud environment is a natural by-product of optimization, in which many distinct providers and models are used to get the greatest performance. This is comparable to traditional data center administration but on a much bigger scale.</li> </ul>
Data analysis	<ul style="list-style-type: none"> <li>• There is a plethora of data generated by cloud operations that must be</li> </ul>

examined for efficient orchestration and cloud components enable businesses to undertake more powerful data analysis than they have in the past.

In conclusion from the elaboration above, many of these skills apply to IT professionals across multiple disciplines. Then, according to Ling *et al.* (2020), the increased demand for workers with skills in software development and IT technologies, such as mechatronics specialists with software skills, would result in a greater requirement for people with competence in software technologies.

### 2.3 Challenges on ICT Skills Needed in Cloud Computing

#### (a) ICT Skills Challenges

Information and Communication Technology (ICT) skills are one of the skills that high demanded globally nowadays, not only in the construction industry but also in the other industry, and this statement is proven by Ling *et al.* (2020), which mentioned that the increased demand for software developers and IT specialists, including mechatronics specialists, would result in a higher demand for people with software skills. Therefore, Table 3 shows the challenges found in different research.

**Table 3: Challenges of ICT Skills**

Challenges of ICT	Vasista & Abone (2018)	KKR (2020)	Lew <i>et al.</i> (2019)	Lekan <i>et al.</i> (2018)	Ern <i>et al.</i> (2017)	Taylor & Packhom (2016)	Turk (2020)	Paudyal (2016)
Financial	/		/	/	/		/	
Knowledge & Skill		/	/	/		/	/	/
Legal & policy	/		/		/		/	
Technological	/	/			/	/	/	/
Organizational & management	/	/	/	/				
People			/		/	/	/	

Therefore, the most significant challenges found that take part in every research are knowledge and skill, and also the technological challenges. Knowledge and skill challenges are leading to the challenge like inadequate education, knowledge, lack of skill and training, and also lack of sufficiently exposed to ICT and its benefits, etc. Next, the challenges like difficulty in coping with new technologies innovation, technological incentives, automation, R&D activity, the level of technological awareness a market possesses, lack of support from ICT providers, internet access, and inefficient use of software are challenges under the technological factor. Then, follow with the financial challenge factor such as high investment and maintenance costs, the budget limit for ICT investment, high cost of specialist software and training, etc. Lekan *et al.* (2018) also stated that the issue of limited budget in ICT investment ranked the highest on the table research, which means that budget constraint is a major factor. In response to the above statement explanation, there are top three challenges that may affect the adoption of ICT skills that have to face in empower and expand the Information and Communication Technology (ICT) skills.

#### (b) Cloud Computing Implementation Challenges

Cloud computing is a new Information Technology (IT) paradigm that enables users to access software, hardware, and data from a cloud server. Although the construction sector is ideally positioned to use these technologies for competitive and operational benefit, technology diffusion in the industry also uses this technology (Bello *et al.*, 2021). Cloud computing is also known as a powerful tool with significant scalability and flexibility, allowing students, faculty, administrators, and other campus users

to access file storage, databases, and other university applications from anywhere, at any time. As a result, Cloud Computing (CC) has become an option for many enterprises, particularly in light of the current economic crisis, which forces every decision made by opting not to harm the organisation (Amron, Ibrahim, and Chuprat, 2017). Thus, the Table 4 shows the challenges that have been stated based on several research journal.

**Table 4: Challenges of Cloud Computing Implementation**

Challenges of Cloud Computing	Okai <i>et al.</i> (2014)	Amron, Ibrahim & Chuprat (2017)	Dustdar (2016)	Namasudra (2018)	Samarraie & Saeed (2018)	Bello <i>et al.</i> (2021)	Bayramusta & Nasir (2016)
Security and privacy	/	/	/	/	/	/	/
Legal and policy	/	/		/			/
Accessibility		/		/	/	/	/
Data Storage			/	/		/	/
Cost			/			/	
Knowledge and skills					/		
Availability				/		/	/
Trust				/	/	/	/

Based on the table above shows the major challenges of cloud computing is security and privacy factor. As stated by Namasudra (2018), this issue can be attributed to the lack of a standardized Application Programming Interface (API). A report by the cloud security alliance asserts that the main challenges of cloud computing in terms of security and privacy are insecure interfaces, shared technology issues, malicious insiders, account hijacking, data loss or leakage, and unknown risk profiles. Okai *et al.* (2014) also stated that all clients whose data are stored on the cloud vendors' infrastructure will be impacted if a hacker gains access to those data outside the firewalls of the users. Then, follow by accessibility where the cloud computing implementation needs to use the internet to access and connected to the cloud computing system. Thirdly, is legal and policy challenges. The least of the challenge that can be seen is the knowledge and skill with storage challenge.

#### 2.4 Relationship Between ICT Skills and Cloud Computing

The definition of ICT skills is "the ability to use digital data, computer tools, and networks to acquire, evaluate, and communicate information" (Falck *et al.*, 2021) and as described by Bayramusta and Nasir (2016), "Cloud Computing is an approach for providing a range of IT services remotely through the Internet or a networked infrastructure". This shows that ICT is one of the methods that are being applied in forming the cloud computing technology which can provide a variety of services like assembling, spreading, and analysing the data. Thus, in applying the cloud computing technology, there are needed the ICT skill to key in the data in the storage, handle the data and make sure the safety and security of data, etc.

**Table 5: Relationship Between ICT Skills and Cloud Computing**

Relationship Between ICT Skills and Cloud Computing	Connectivity	Services	Quality	Cost	Knowledge & Skills	Security & Privacy	Organizational	Technological

Okai <i>et al.</i> (2014)	/				/	/
Namasudra (2018)		/	/	/	/	
Amron, Ibrahim & Chuprat (2017)				/	/	/
Bayramusta and Nasir (2016)	/				/	
Ern <i>et al.</i> (2016)						/
Malik, Rashid & Wani (2018)	/	/		/		
Bello <i>et al.</i> (2021)		/			/	
Garrison <i>et al.</i> (2015)						/
Madden (2021)				/		
Loukis, Arvanitis, & Kyriakou (2017)						/
Falck <i>et al.</i> (2021)	/			/		

Based on Table 5, shows that the most concerning things that may affect the relationship between ICT Skills and Cloud Computing are Security and Privacy factors. as stated in the challenges of cloud computing regarding security and privacy, the research by Namasudra (2018) stated that as the IT sector develops, security and privacy concerns are becoming more and more relevant and important in the cloud computing system technology.

Furthermore, cloud computing is a new Information Technology (IT) paradigm that enables users to access software, hardware, and data from a cloud server. Okai *et al.* (2014) study state that cloud computing has the Internet as its backbone to deliver a flexible and scalable computing infrastructure for many applications. It is also supported by Bayramusta and Nasir (2016), who that stated Cloud computing enables a range of IT services to be delivered remotely via the Internet or through a networked environment. Thus, without a connection to the internet, the user cannot access the server and as part of the cloud computing promise, users will also be able to deliver IT services faster as well as be accessible when and wherever needed, at reduced costs, and only pay for what they consume (Namasudra, 2018).

In addition, Cloud computing also has gained considerable traction on the commercial front, and currently, cloud computing plays an important role in the planning of projects that must be scalable without compromising efficiency or reliability and now in 2021, the research by Madden (2021), found that cloud computing skill is the number 3 skill that stated as the top of IT skills demanded in 2021. However, according to Loukis, Arvanitis, & Kyriakou (2017), employees' ICT skills, price competition, and quality competition have no bearing on CC adoption propensity. On the other hand, having an ICT investment reduction strategy, hiring specialized personnel, and having previous experience with ICT outsourcing contribute to a firm's propensity to adopt CC. This is supported by Ern *et al.* (2016) that pointed out that lack of software integration and lack of standardized platforms for information exchange that control by the organization are other problems that limit the benefits of ICT for construction projects.

In conclusion, ICT gives many contributions to making the cloud computing technology as a product/system that helps many users or people carry out their work, especially work related to large data storage and they are interconnected with each other to face the economic progress of our country. Thus, cloud computing now becoming more popular by the day; it is no longer simply a pipe dream or something that is only discussed at seminars and conferences. It is the reality of rapid, automated, and low-cost IT resource management that has combined to make information technology an appealing paradigm for increased efficiency and production.

### 3. Research Methodology

#### 3.1 Research Design



This study will utilize by using the quantitative method. The quantitative method whereby data collection will be conducted through a survey. Furthermore, as we are now already in the Covid-19 endemic phase, the self-developed questionnaire will not just be held by using the Google Form which is an online platform that knows it can be easily distributed without having to get any close contact or physically contact with others like using the online networking applications such as WhatsApp and Email. However, the endemic phase allows me to distribute and collect data directly and the validity of the data collected is higher than just using the online platform.

Additionally, the secondary data also will be used which will be analyzed by using the source of the data from the journal article, book, webpage, and report that is related to the ICT Skill for Cloud Computing Implementation among Quantity Surveyors in Pre-Construction Stage. Therefore, Table 6 shows the research design method that will be used to achieve the objective required in completing the research refer to Figure 1 in Appendix A for the research process of this study.

**Table 6: Research Design Method**

No.	Research Objective	Method
1	To identify the key ICT skills needed for cloud computing implementation among QS at the pre-construction stage.	
2	To determine the challenges on ICT skills needed for cloud computing implementation among QS at the pre-construction stage.	<ul style="list-style-type: none"> <li>• Literature Review</li> <li>• Quantitative</li> </ul>
3	To analyse the relationships between the key and challenges on ICT skills needed for cloud computing technology implementation among QS at pre-construction stage.	

### 3.2 Data Collection

For this study will be acquired utilizing quantitative methods by distributing questionnaires to target respondents. The question that will be asked in the questionnaires will be focused on the research's objectives to guarantee that answers the achieve the needed of the study. Any study literature review is based on secondary data. It is a crucial method because of the impossibility to conduct new surveys that accurately capture historical changes or advances. Thus, government papers, books, Internet articles, and journal articles by previous researchers are used as secondary data gathering sources (Ajayi, 2017) in finding all the information that can be used to relate in this study.

### 3.3 Data Analysis

Data analysis is the process of collecting, modeling, and analyzing data to extract insights that support decision-making. Statistical software was used to organize and analyze gathered data, i.e., SPSS Statistics Software. Several descriptive statistics, including frequencies and means, were calculated from the quantitative data to reveal data about respondents' demographic profiles and the most important ICT skills required and challenges with implementing cloud computing among QS at the pre-construction stage. Last but not least, the data analysis will come out with the relationship between objective one and objective two either positive or negative correlation. The data were analyzed by referring to the Pearson's correlation terms using the SPSS Statistic Software.

## 4. Result and Discussion

The result of a data collection analysis from a questionnaire distributed among Quantity Surveyors at Johor. The data in Section A of the questionnaire will be evaluated by using frequency analysis, and the results will be presented in the form of a table. Section B will likewise be subjected to frequency

analysis, with the results displayed in the form of a chart and table. Sections C and D, on the other hand, were evaluated using descriptive analysis to derive mean values, whilst Objective 3 was analysed using crosstabs analysis which also refers to data collection from section C and D. All were being analysed by using the Statistical Packages for Social Science (SPSS) software.

#### 4.1 Respondent Percentage

According to Krejcie and Morgan's (1970) sampling size table, it came out with the number of sample size to be acquired in this study was set at 191. Thus, 200 questionnaire sets were given to responders. However, a total of 103 sets of questionnaires were returned with answers among the 200, and all of the returned questionnaires were used for data analysis. Thus, the Table 7 shows the quantity and the percentage where there are 51.5% questionnaire that being collected and 48.5% of questionnaire that not being returned.

**Table 7: Respondent Percentage**

No.	Item	Quantity	Percentage
1	Questionnaire distribute	200	100%
2	Questionnaire collected	103	51.5%
3	Questionnaire failed to be collected	97	48.5%

#### 4.2 Reliability Analysis

A reliability test was conducted to measure the internal consistency of all variables in this study. As observed in Table 8, the Cronbach's alpha values were found to be 0.941 (ICT Skills Needed), 0.831 (ICT Skills Challenges), 0.859 (Cloud Computing Challenges), and come out with the total Cronbach's Alpha was 0.938. All Cronbach's alpha values were higher than 0.9, thus exceeded the conventional minimum of 0.70 for reliability (Nunnally, 1978). Therefore, all variables in this study were deemed to be reliable.

**Table 8: Reliability Analysis**

No	Variables	No of items	Cronbach's Alpha
1	ICT Skills Needed	14	.941
2	ICT Skills Challenges	6	.831
3	Cloud Computing Challenges	9	.859
<b>Total</b>		<b>29</b>	<b>.938</b>

#### 4.3 Respondent Demographic

The respondents of this study were generally those who are currently working in the quantity surveying industry. A total of 103 respondents returned their survey response. As can be seen from the demographic profiles in Table 9.

**Table 9: Respondents' demographic profiles**

	Frequency	Percentage (%)
<i>Gender</i>		

Male	59	57.3
Female	44	42.7
<i>Ethnicity</i>		
Malay	74	71.8
Chinese	21	20.4
Indian	8	7.8
<i>Age (year)</i>		
20 years old or below	2	1.9
21 to 30 years old	43	41.7
31-40 years old	47	45.6
41-50 years old	11	10.7
<i>Highest Academic Qualification</i>		
Diploma	8	7.8
Degree	88	85.4
Master	6	5.8
PhD	1	1.0
<i>Sector of your company</i>		
Government	10	9.7
Private	93	90.3
<i>Type of your organization</i>		
Consultant	68	66.0
Contractor	27	26.2
Developer	8	7.8
<i>Position at your company</i>		
Junior Quantity Surveyor	46	44.7
Senior Quantity Surveyor	31	30.1
Assistant Quantity Surveyor	19	18.4
Manager	3	2.9
Executive	4	3.9
<i>Years of working at current working place</i>		
Less than 1 year	18	17.5
1 to 5 years	32	31.1
6 to 10 years	35	34.0
More than 10 years	18	17.5

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#### 4.4 Knowledge on Cloud Computing

The survey also included several questions to identify the respondents’ prior knowledge about Cloud Computing as shown in Table 10.

**Table 10: Knowledge about CC system**

No	Question	Yes	No	Not Sure
1	Do you know about CC system?	91 (88.3%)	8 (7.8%)	4 (3.9%)
2	Did the company apply the use of CC in company management system?	81 (79%)	22 (21%)	-
3	If Q2 yes, is the use of CC helpful?	81 (79%)	-	-
4	Does the company emphasize on the importance of ICT skill for handling CC?	98 (95.1%)	5 (4.9%)	-

Next, the survey also elicited inputs from about respondents’ view on the potential use of cloud computing in their working organization as shown in Table 11.

**Table 11: Knowledge about the Potential of Cloud Computing for Working**

No	Questions	Responses	
		Yes	No
1	Do you think it is important to have good ICT skills to use Cloud Computing in assisting your work?	98 (95.1%)	5 (4.9%)
2	Do you think that your company should apply Cloud Computing for data management?	103 (100%)	0 (0%)
3	Would you like to use Cloud Computing in the future?	103 (100%)	0 (0%)

#### 4.5 Key of ICT Skills

By referring Table 12 in Appendix B, it come out with specifically the top skills needed (by mean values) are:

- 4.5.1 Cloud security skill with overall mean = 4.345;
- 4.5.2 Data analysis skill with overall mean = 4.27; and
- 4.5.3 Orchestration skill with overall mean = 4.22

In addition, the respondents were also asked to specify others key ICT skills needed for cloud computing implementation based on their experience and knowledge. The additional skills are given as: 1) Invest in learning a database query language and database platform. Learning language like MySQL, and 2) programming languages and AI.

#### 4.6 Challenges to ICT Skills in Implementation of Cloud Computing

##### (a) ICT Skills Challengers

By referring to Table 13 in Appendix C, it shows the value of the respondent’s votes. Then, the overall mean of 3.974 suggests that respondents generally had a quite high level of agreement about ICT skills challenges for Cloud Computing implementation. Of all the six aspects, the challenge which recorded the highest mean value (4.20; 84.5% of agreement) is “*the lack of knowledge and skill among employees in using ICT for cloud computing implementation*”. This is followed by the item on

“Expensive budget in enhancing ICT skills for cloud computing implementation” (mean = 4.11; 80.6% of agreement). Thus, this suggests that the main issues related to ICT skills from the pre-construction perspective are related to the employees’ knowledge and skills as well as the cost factor.

(b) Cloud Computing Challengers

By referring to Table 14 in Appendix D, it shows the value of the respondent’s feedback. Then, similarly, the overall mean of 3.984 suggests that respondents generally showed a quite high level of agreement about the specific challenges related to cloud computing. The item which recorded the highest mean value (4.18; 85.4% of agreement) is “Some cloud computing applications need to be purchased”. This is followed by the item on “Lack of security controls in storing company’s information in cloud computing application” (mean = 4.17; 84.5% of agreement). Thus, cost and security issues appeared to be the most crucial challenges related to Cloud Computing. Overall, the descriptive analyses for both types of challenges highlighted that some of the major challenges for implementing Cloud Computing in the pre-construction stage are:

- 4.6.1 The lack of knowledge and skill among employees;
- 4.6.2 Cost issues
- 4.6.3 Data security issues

4.7 Relationship between Key and Challenges

Finally, the third research question is “What are the relationships between the key and challenges on ICT skills needed for cloud computing technology implementation among QS at pre-construction stage?”. The Pearson correlation analysis was used to study whether there are significant relationships between each variable in this study, namely ICT Skills Needed, ICT Skills Challenges, and Cloud Computing Challenges. Table 14 and Table 15 shows the correlation analyses. Therefore, it can be concluded that the ICT-related and Cloud Computing challenges seemed to significantly affect the respondents’ needed key ICT skills in using the Cloud Computing technology for the pre-construction quantity surveying work.

**Table 14: Correlation analyses between all variables**

Components	ICT Skills Needed	ICT Skills Challenges	Cloud Computing Challenges
ICT Skills Needed	1		
ICT Skills Challenges	.258**	1	
Cloud Computing Challenges	.491**	.249*	1

\*\*Correlation is significant at the 0.01 level (2-tailed).

\*Correlation is significant at the 0.05 level (2-tailed).

**Table 15: Correlation analysis between ICT Skills Needed and Overall Challenges**

Components	ICT Skills Needed	Overall Challenges
ICT Skills Needed	1	
Overall Challenges	.453*	1

\*Correlation is significant at the 0.05 level (2-tailed).

#### 4.8 Summary of Findings

As shown in table 16, the summary comes out with the result where the collection data for objective 1, a high level of agreement among the respondents about the need for key ICT skills. The results suggest that the key ICT skills are important requirements for the effective implementation of Cloud Computing in the pre-construction industry. Next, for objective 2, the descriptive analyses for both types of challenges were ICT skills challenges and Cloud Computing challenges, some of the major challenges for implementing Cloud Computing in the pre-construction stage are; the lack of knowledge and skill among employees, cost issues, and data security issues. Last but not least, objective no 3 results were ICT-related and Cloud Computing challenges seemed to significantly affect the respondents' needed key ICT skills in using the Cloud Computing technology for the pre-construction quantity surveying work.

**Table 16: Summary of Findings**

Objective	Summary
1	<p>Specifically, the top skills needed (by mean values) are:</p> <ul style="list-style-type: none"> <li>a) Cloud security skill with overall mean = 4.345;</li> <li>b) Data analysis skill with overall mean = 4.27; and</li> <li>c) Orchestration skill with overall mean = 4.22</li> </ul> <p>ICT skills are one of the skills that indicate the high level of importance of all these skills among the respondents for their working purposes. As a result, the findings suggest that key ICT skills are necessary for effective Cloud Computing implementation in the pre-construction industry.</p>
2	<p>Most crucial ICT Challenges.</p> <ul style="list-style-type: none"> <li>a) Lack of knowledge and skills (mean = 4.20; 84.5% of agreement)</li> <li>b) Expensive budget in enhancing ICT skills (mean = 4.11; 80.6% of agreement)</li> <li>c) Lack of exposure about ICT skills (mean = 3.94; 79.6% of agreement)</li> </ul> <p>Most crucial CC Challenges.</p> <ul style="list-style-type: none"> <li>a) CC apps need to be purchased (mean = 4.18; 85.4% of agreement)</li> <li>b) Lack security (mean = 4.17; 84.5% of agreement)</li> <li>c) Expensive cost of extra data purchasing (mean = 4.05; 84.4% of agreement)</li> </ul> <p>Thus, in an overall view, the descriptive analyses for both types of challenges highlighted that some of the major challenges for implementing Cloud Computing in the pre-construction stage are:</p> <ul style="list-style-type: none"> <li>a) The lack of knowledge and skill among employees</li> <li>b) Cost issues</li> <li>c) Data security issues</li> </ul>
3	Relationship correlation;

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ICT skill needed & ICT skill challenges (Correlation = 0.258)  
 ICT skill needed & CC challenges (Correlation = 0.491)  
 ICT skill needed & Overall challenges (Correlation = 0.453)  
 The respondents' need for key ICT skills in using the cloud computing technology for pre-construction quantity surveying seemed to be significantly affected by ICT issues and Cloud Computing challenges.

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## 5. Conclusion

In conclusion, the research context is to analyse the ICT skill for cloud computing implementation among Quantity Surveyors in the pre-construction stage. Therefore, the issue in the problem statement that created the research question and produce the research objective will be achievable as what this research wants. Then, the objective was achieved through the previous research that had been analyzed in the literature review and then also through the primary data collection (quantitative method) that was distributed to the respondent. This research has shown that, by analysing the data from the returned questionnaires, all the objectives of this research were accomplished. This was determined by looking at the results of the research where ICT abilities are one of the skills that suggest the respondents place a high value on all of these skills for their professional reasons. As a result, the findings imply that for effective Cloud Computing adoption in the pre-construction industry, important ICT skills are required. Then, as a result of the descriptive analyses. Other than that, the correlation analysis of the relationship shows that there was a moderately significant positive relationship. Thus, it showed that ICT skills and knowledge were needed in applying the use of cloud computing, and in this way, ICT skills need to be strengthened to implement the cloud computing software among quantity surveyors to make it easier for them to carry out their duties, and as well as the construction industry, it could be better developed.

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## Appendix A

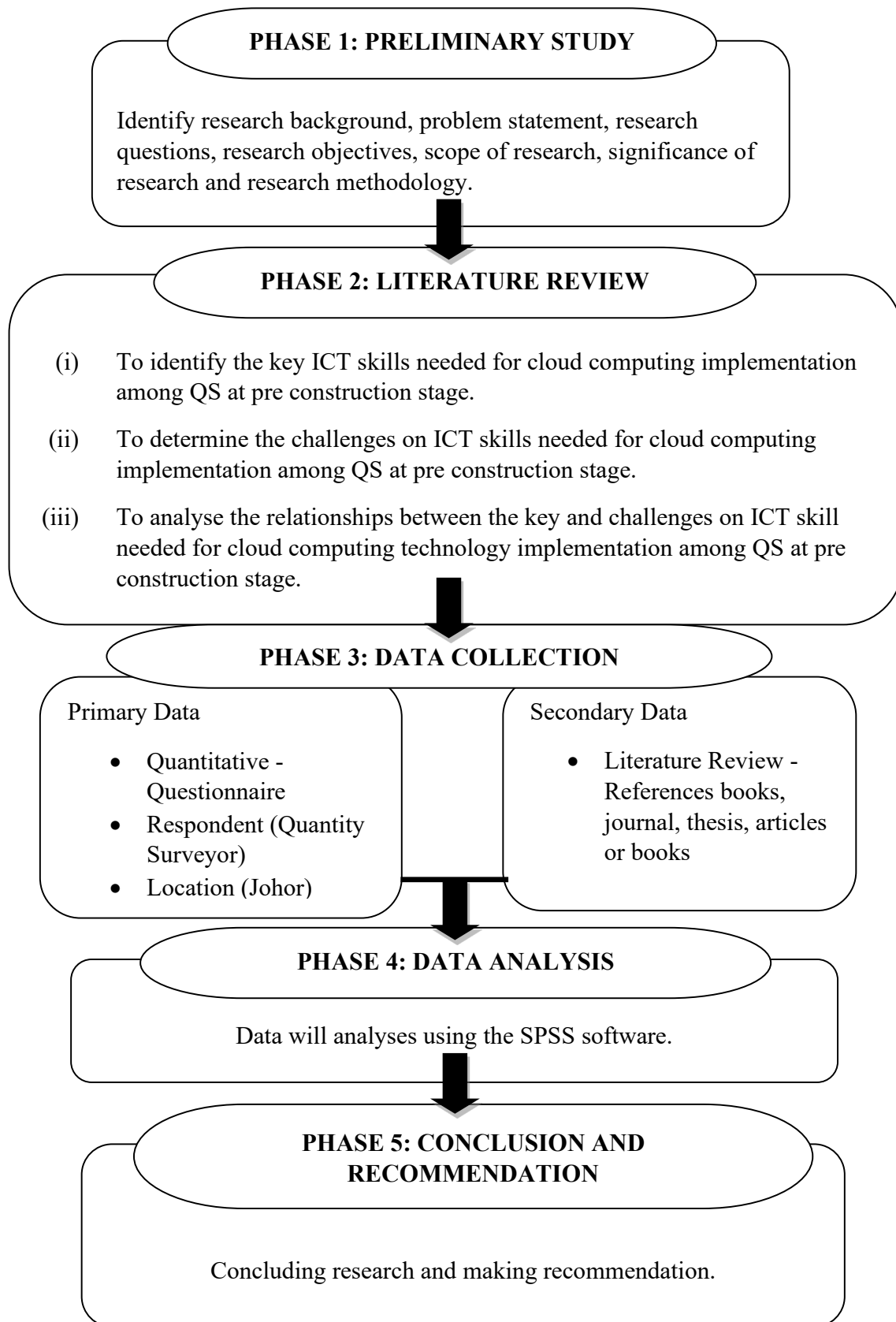


Figure 1: Research Process

**Appendix B**

**Table 12 : Descriptive statistics on ICT Skills Needed**

No	Items (overall mean = 4.235, SD = .522)	Disagree %	Neutral %	% Agree	Mean	SD	Rank
	<b>Cloud Security skill</b>	<b>1.5</b>	<b>4.85</b>	<b>93.7</b>	<b>4.345</b>	<b>.683</b>	<b>1</b>
1	Skill to ensure the safety of company's information in the cloud system.	1	1.9	97.1	4.41	.633	
2	Skill to ensure the company's information are properly controlled and not being compromised.	2	7.8	90.3	4.28	.733	
	<b>Virtualization Skill</b>	<b>1.95</b>	<b>9.75</b>	<b>88.3</b>	<b>4.205</b>	<b>.72</b>	<b>5</b>
3	Skills to improve the overall picture of the work being made more clearly visible.	2.9	14.6	82.5	4.08	.776	
4	Skills to manage the data and running software in the cloud system.	1	4.9	94.2	4.33	.663	
	<b>Business Continuity/Disaster Recovery (BC/DR) Skill</b>	<b>1</b>	<b>9.2</b>	<b>89.8</b>	<b>4.185</b>	<b>.678</b>	<b>7</b>
5	Skills to plan work done when any problem or incident occurs.	1	9.7	89.3	4.17	.678	
6	Skills to protect applications in the cloud and moving to the cloud.	1	8.7	90.3	4.20	.677	
	<b>Optimization Skill</b>	<b>1</b>	<b>9.7</b>	<b>89.4</b>	<b>4.195</b>	<b>.687</b>	<b>6</b>
7	Skills to improve the understanding about software in optimising the cloud expenditure and reducing cloud resource software.	1	5.8	93.2	4.22	.641	
8	Skills to help employees discover alternative methods to achieve similar goals in using cloud software.	1	13.6	85.5	4.17	.733	
	<b>Private Cloud Construction Skill</b>	<b>1.5</b>	<b>10.7</b>	<b>87.9</b>	<b>4.215</b>	<b>.727</b>	<b>4</b>
9	Skills to increase the security in managing cloud computing	1	10.7	88.4	4.27	.730	

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	information within a wide range of situations.						
10	Skills to manage the dynamic resource distribution and self-monitoring of data.	2	10.7	87.4	4.16	.724	
	<b>Orchestration Skill</b>	<b>2</b>	<b>8.75</b>	<b>89.3</b>	<b>4.22</b>	<b>.725</b>	<b>3</b>
11	Skills to manage overall the interconnections and interactions among the workflow of cloud computing element.	2	10.7	87.4	4.17	.733	
12	Skills to increase the efficiency in using advanced software services with proper manageability.	2	6.8	91.2	4.27	.717	
	<b>Data Analysis Skill</b>	<b>1</b>	<b>3.85</b>	<b>95.2</b>	<b>4.27</b>	<b>.629</b>	<b>2</b>
13	Skills to empower the individuals to continuously manage the flow of cloud computing information to be collected.	1	5.8	93.2	4.24	.649	
14	Skills to ensure the validity of data and make sure the project development is on track.	1	1.9	97.1	4.30	.608	

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## Appendix C

Table 13: Descriptive statistics on ICT Skills Challenges

No	Items (overall mean = 3.974, SD = .625)	% Disagree	% Neutral	% Agree	Mean	SD	Rank
1	Expensive budget in enhancing ICT skills for cloud computing implementation.	3.9	15.5	80.6	4.11	.839	2
2	Lack of knowledge and skill among employees in using ICT for cloud computing implementation.	2.9	12.6	84.5	4.20	.809	1
3	Lack of legal support in developing ICT skills for cloud computing implementation.	3.9	21.4	74.8	4.04	.874	4
4	Difficult to adapt the technological development of ICT from time to time.	3.9	23.3	72.8	3.87	.788	5
5	Lack of exposure about ICT skill provided by the employer.	3.9	16.5	79.6	3.94	.752	3
6	Negative attitude among employees in using ICT at the company.	11.6	28.2	60.2	3.68	1.012	6

## Appendix D

Table 14: Descriptive statistics on Cloud Computing Challenges

No	Items (overall mean = 3.984, SD = .562)	Disagree %	Neutral %	% Agree	Mean	SD	Rank
1	Lack of security controls in storing company's information in cloud computing application.	2.9	12.6	84.5	4.17	.833	2
2	Lack of legal support in using the cloud computing at the company.	4.8	21.4	73.8	3.95	.890	6
3	Lack of internet access in connecting to the cloud computing system.	11.6	29.1	59.3	3.66	1.005	9
4	Challenge on data management using cloud computing.	1	24.3	74.7	3.98	.767	5
5	Limitation on data storage provided by the cloud computing system.	2	25.2	72.9	3.91	.768	8
6	Expensive cost for purchasing extra data storage using cloud computing.	2.9	12.6	84.4	4.05	.772	3
7	Challenge on technological skill required in using the cloud computing.	3.8	17.5	78.6	3.91	.781	7
8	Some of cloud computing application need to be purchase.	2	12.6	85.4	4.18	.764	1
9	Lack of trust in sharing the data of works through cloud computing.	1	21.4	77.7	4.03	.760	4