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SHAH ALAM**

**Information Technology Application for Facilities
Management Industry in Malaysia**

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Technology in Facility Management with honours**

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ABSTRACT

Malaysia as a rising country that is slowly developing the implementation of Facilities Management in many public and private sectors shall realised the important of Information Technology application in the industry will bring a lot of benefit for this industry. The purpose of Information Technology in Facilities Management is to create, process, store, secure and exchange all forms of electronic data about the existing assets and upcoming purchasing asset, while computing capability advanced of the organization operational tasks.

While the big players of the industry plays their role in developing Facilities Management to be more mature and establish throughout it , the importance of Information Technology application shall not be forget as it helps in drive the process of Facilities Management to be more manageable and secured. Hence, this research is to **to promote best practice on Information Technology aspect in Facilities Management industry**. This research use abductive research design approach and mixed method design for the research methodology in search of data. The instrument consists of semi-structure interview and survey. The result will be evaluated based on the findings on the approach for the issue of Information Technology aspect in Facilities Management industry

Keywords: *Facilities Management; Information Technology(ies), Computer Aided Facilities Management (CAFM)*

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CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

According to Myeda et Al. (2011), FM is still progressing slowly in Malaysia relative to both Western countries, namely the United Kingdom (UK) and the United States of America (USA), and neighbouring Asian countries, namely China, Singapore and Japan. In the most relevant finding and perhaps also the most significant that Facilities Management (FM) act as an umbrella that covers wide range of property and related functions that serve the user, which is brought together for the benefit of the organisation and employees as a whole (Spedding and Holmes, 1994). Information Technology application is to ensure those process of work is properly manage, secure, kept and safe by providing a systematic data management that is easier to be updated and monitored.

Chin (2006), with the country's growth, science and technology especially information technology is developing very fast. Advancement of information technology has increased the use of internet, websites and networking in different areas. This technology's rapid development is also seen in different types of software systems to help facilitate management work nowadays.

In addition, former Facility Manager of the Facilities Management Terminal Gleen Cruise, Vasanthankumar (2011) emphasizes that little attention is paid to best practices, personnel, expertise and other aspects that relate to the organization's core business and there is no adequate guideline or strategic Facilities Management structure in Malaysia to serve as guidance for business needs.

This research will focus on raising awareness of the value of making full use of information technology application in Malaysia's facilities management industry. This is to ensure that the industry will in future be able to serve better service and facilities for the user while at the same time achieving the highest return on investment possible.

1.2 PROBLEM STATEMENT

Computerized Maintenance and Management System (CMMS) and Computer-Assisted Facility Maintenance (CAFM) software applications by eliminating the tedious, time consuming, and duplicative data recollection effort that is often the first step in developing these applications. (Smith & Tardif, 2009). Advancements in digital technologies have provided significant opportunities to improve Architecture, Engineering, Construction and Owner-Operated (AECO) sector's performance through superior data management, but awareness of Facility Management profession has so far had very little input into the evolution of latest Information Technology system in Facilities Management industry.

1.3 CENTRAL RESEARCH QUESTION, AIM, SECONDARY RESEARCH QUESTION, RESEARCH OBJECTIVE & RESEARCH HYPOTHESIS

1.3.1 Central Research Question

How to derive Information Technology application aspect towards the advancement of Information Technology in Facilities Management industry?

1.3.2 Research Aim

In order to produce a reliable and potential research, a researcher needs to be clear about the aim of the research. Aim that act like a knowledge that makes the researcher understand what is needed to be done to answer the research question.

The researcher aim is **to promote best practice on Information Technology aspect in Facilities Management industry**. In Malaysia, Facilities Management is still in developing phase to be compared with other countries, the Facilities Management industry more likely is already stable.

1.3.3 Secondary Research Question

Research question is crucial part in a research as it guides arguments and inquiries that will develop the researcher interest about a topic. There are few research questions that is designed to be solved in this research.

- i. What is the type of Information Technology application in Facilities Management industry?
- ii. What is the effectiveness of the Information Technology application in Facilities Management industry?
- iii. How to improve the level of application in Information Technology aspects toward implementation of Information Technology in Facilities Management industry?

1.3.4 Research Objective

- i. To identify type of Information Technology application in Facilities Management industry
- ii. To identify the effectiveness of the Information Technology application in Facilities Management industry
- iii. To suggest improvement toward implementation of Information Technology in Facilities Management industry

1.3.5 Hypothesis

The advancement application of Information Technology is positively related to the organisation level of

knowledge on the application of Information Technology
Facilities Management

1.4 SCOPE AND LIMITATION

The study will focus on Facilities Management organizations that apply applications of Information Technology. The research that requires data collection will be approached respondent form Facilities Management organisation that has been operating for five years and above. The company headquarters should be based in Klang Valley. The Information Technology application that will be approach is the tools or software used for management purpose in the organisation.

1.5 SIGNIFICANCE OF RESEARCH

The findings of this study will redound the benefit to researcher about the importance of application Information Technology in Facilities Management that later can be used as an employee in Facilities Management industry. Besides that, this research can be a reference to improve issues about the application of Information Technology in all Facilities Management organizations in Malaysia other than to increase the performance of the Facilities Management services serve to the related parties in this industry. Moreover, this research will work on increasing awareness on the importance of using full utilization of Information Technology application in Facilities Management industry in Malaysia. This is to ensure that the industry able to serve better service and facilities to the user in the future whilst able to achieve highest possible return on investment.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Managing an operation of Facilities Management service cannot be achieved without use of Information Technology. Nowadays, in all contract agreement terms and condition, it is required for any Facilities Management organization that is interested to join the project to have approach Information Technology in their operational works, especially for the government projects. New technologies that cause different reactions from individuals as a result of varied, subjective interpretations and perceptions of change in technology, although this does not always lead to resistance or rejection (Bouchlagem & Shelbourn, 2012).

Throughout FM literature, ICT briefly summarizes the evolving style and design of the software or tools studied in this parallel image. That type of software has drawbacks and advantages, but many software applications have already improved management and monitoring functionality that can help build industry professionals to keep track of the evolution of knowledge.

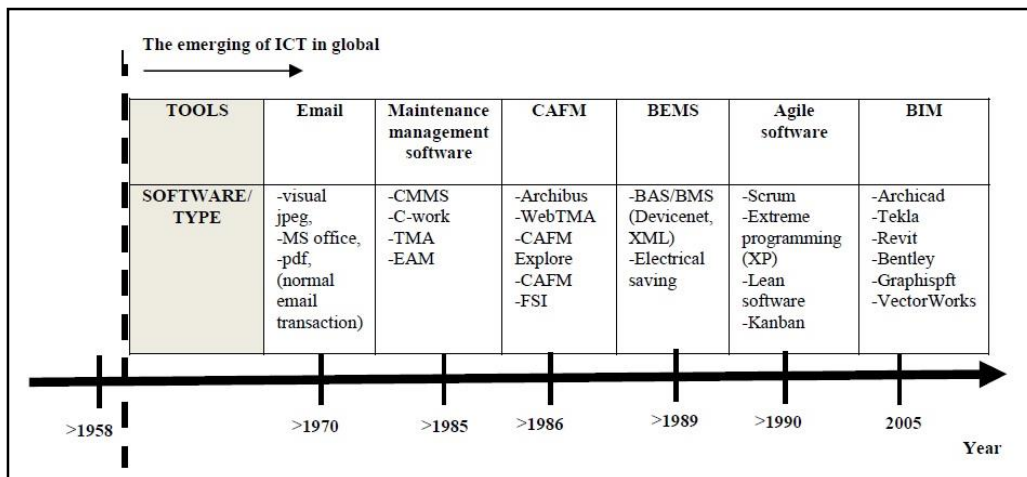


Figure 2.1 ICT Evolution in FM for over 40 years

New technologies that cause different reactions from individuals as a result of varied, subjective interpretations and perceptions of change in technology, although this does not always lead to resistance or rejection. Adoption to new technology not only will bring benefit to the organization of Facilities Management but also will show the level of advancement of Facilities Management industry in Malaysia.

2.2 FACILITIES MANAGEMENT

According to Kassem, et. Al. (2014), Facilities Management act like an umbrella that covers up overall wide-range of property and user-related functions in an organization. Supported by web article published on 2018, International Organization for Standardization (ISO) mentioned that Facilities Management unify multiple disciplines to bring out productivity and efficiency of economies of organizations, communities and societies. Moreover, it interacts between individuals with built environment.

Facilities Management as a mechanism that offers good support for key business processes as well as contribute to an organization's priorities and objectives (Hamilton and Norizan Ahmad, 2001). The goal of building facilities management, as stated by Sulzakimin and Thompson (2013), is to ensure that all building facilities are always maintained in accordance with the purpose. The value of Facilities Management is developed in order to improve the facility management organization, which ensures that the secret to building facility management is a wide and lucrative type of business if handled effectively and can prolong the lifetime of facilities management and building facilities.

Facility management, according to Sulzakimin and Thompson (2013), is a field that serves the maintenance and care of industrial, house, or organizations, offices, hospitals and others. In addition, Kelly et Al., 2005 mentioned that this area often includes land, facilities, human resources and organizations frequently associated with the administration of office blocks, educational buildings, hostels etc.

A computer system assists this role in ensuring the reliability and consistency of the efficiency of the building facilities. The Facilities Management Team shall be composed of qualified staff to be able to carry out management work professionally in accordance with the methods and procedures developed and accepted by the building facility management requirements authorities (Institute of Professional Advancement, 2007)

Table 2.2 Definition of Facilities Management

Organization	FM Definition
<p>International Facility Management Association, IFMA (2010)</p>	<p>Facility management is a profession which encompasses a variety of disciplines to ensure that the built environment works by integrating people, process locations and technology</p>
<p>Noor and Pitt (2009)</p>	<p>Create a suitable environment to complete the organization's foundations or priorities and take an integrated view of infrastructure services and use them to deliver customer satisfaction and cost-effectiveness through support for business core enhancement</p>
<p>Pitt and Tucker (2008)</p>	<p>Integration and coordination of non-core services, including those relating to premises required to monitor and maintain businesses in order to fully support the organization's core objective</p>
<p>Royal Institution of Chartered Surveyors, RICS (2009)</p>	<p>A discipline that boosts and promotes an organization's profitability by providing all the service needs available, the infrastructure required to achieve business goals</p>
<p>Kamaruzzaman and Zawawi (2010)</p>	<p>A combination between technological, management and business skills that may be</p>

	linked to organizational, tactical and strategic decision-making processes
British Institute of Facilities Management, BIFM (2010)	Facility management involves integrating processes within an organization to maintain and develop agreed services that support and enhance its efficiency for the core business

FM's position included not only maintenance management, but also communication, emergency preparedness and business continuity, environmental management and sustainability, finance and business, human factors, leadership and strategy, project management, efficiency, real estate and property management and technology (IFMA, 2013). FM can be defined as the overall management that integrates all services to support the organization's core business (MAFM, 2013). Integrating person, process, place and technology (IFMA, 2013) discipline is the key to achieving the business goal and sustainability of the workplace.

Chapter Two discuss the management of facilities which illustrate its function. Hamilton and Norizan (2001) claimed that Facility Management can be viewed as a process of providing strong support to key business operations as well as contributing to the achievement of an organizational mission and strategies to ensure that facilities, services, systems and manpower are built successful. This argument is then reinforced by Zuhairi and Hamid (2004), who claimed that management of facilities is

regarded as property management and providing service to support an organization's operations.

Institute of Professional Advancement (2007) mentioned a process of implementing work related to the management, operation and maintenance of all building facilities and ensuring that all building facilities are well maintained in accordance with the prescribed functions. Management of the facility is the essential to building management of the facility. When the company is well run it will be profitable for the business. This also provides more conveniently and systematic all the guidelines and methods for maintaining the building facilities.

2.3 INFORMATION TECHNOLOGY

According to Norazlina (2008), knowledge of computer is a mandatory part to able develop countries to move forward. The development of information technology in knowledge and technology is also rapidly developing (Chin, 2006). In 21st century, most information system have these features among which several different information systems can exist in one organization when electronic network is connected. Information system between organizations (inter-organizational) involves information flow in two or more organizations and is primarily used in different applications, as well as corporate systems or information systems containing hardware and computers, whether more or less connected to different network types, such as virtual private networks, intranets and internet software , databases, data and humans (Hasbullah and Omar, 2012).

Computers and networking technologies are included in the concept of information technology (Hansen et Al., 1999). As Shelly et Al. (2007) have stated, computers were used to solve current problems to trigger future phenomena and innovations. There are still many items which have not been discussed, however. Daily Express (2007) released a statistics claiming that 900,000 internet users in Malaysia. Other findings of The Star Publication in 2007 stated that only of 30% of 300,000 employees in all sectors in the country own personal computers and only about 20% have access to internet. Making preparations for the use of existing computer and information communication technology (ICT) technologies as a whole will change an organization's work culture and help to restrict the work (Ford and Weissbein, 1997)

Data is described as the basic description of objects, events, activities and transactions having records, classification, and is stored but not organized to convey specific purposes. The data may be numeric, alphanumeric, diagram, sound, or image, containing multiple data items that need to be organized for scaling (Hasbullah and Omar, 2012).

Moreover, the duo discussed that information is data that has been collected and that can bring value to the receiver. The data processed by an application program is described as more specific and has added value in comparison with simple database access (Saiful, Helmi and Suhana, 2016).

Table 2.3 Information Technology Function by Radha and Sumit (2000)

Functionality	Technology
Communication	Email, video conferencing
Coordination	Email, scheduling software
Group Process Report	Groupware
Storage and Retrieval	Database management Information Retrieval, Hypertext, Internet, Intranet
Browsing	GUI, Web browser
Presentation	Presentation software
Numerical Computation	Statistical analysis packages, Computational algorithms
Location, Filtering,	Intelligent agents
Symbolic Processing and Reasoning	AI, Expert Systems

2.3.1 Information Communication Technology

Information Communication Technology (ICT) allows the company to better manage its business processes through new and improved business models and to expand its outreach efforts through supply chain and outreach programs (Shelbourn, Sheriff, Bouchlaghem, El-Hamalawi, & Yeomans, 2012). Undoubtedly, ICT can provide important strategic and tactical resources for organizations that, if properly applied and used, could have significant advantages in promoting and improving their competitiveness (Buhalis, 2004)

A statement from Mohd Safawi in 2010, most office space or any project site face shortage of staff who should be responsible for coordinating the use of information and communication technology (ICT) and operating programs as well as providing complete infrastructure facilities to assist in facilitating work carried out.

In the field of ICT there are limited numbers of skilled employees to be placed at the office or project site of each organization. Therefore, the number of capable employees must be increased to encourage the smooth and effective use of Information and Communication Technology.

Knowledge includes data and knowledge structured and analyzed to express understanding, experience, cumulative learning and skills when applied to problems or activities, says Ikhwan and Saiful (2016); Amirul (2012). It is a combination of rules, ideas, and procedures that contribute to decision making. Information systems are also classified according to the type of aid provided, irrespective of the field of function.

As reported by Murry & James (2011), management itself needs to be a leader in improving and promoting staff growth, as well as being a user of intelligent information and communication technology. Implementing ICT at the workplace can be a dynamic process which needs significant consideration from all parties which cooperation.

Employees should be encouraged to incorporate information and communication technologies to complete the assigned task at any opportunity in the job management (Colrain M., 2008). Every facility that is provided, such as laptops and computer accessories, should therefore be optimized for use. If the employee has skills in this area, it is strongly recommended that the company appoint him to perform internal training so that other employees can effectively incorporate information and communication technology when carrying out their duties.

William Melody et Al., (2012) suggested that the company would aim to provide workers and non-employees with the best information and communication technology facilities so that they can easily access information anytime, anywhere.

2.3.2 Knowledge Management of Information Technology

“Knowledge is applied information that actively guides task execution, problem solving and decision making”, by Nonaka and Takeuchi (1995). The ability to handle knowledge is the organizational capacity to record, develop, exchange, obtain, knowledge / information to tackle rapidly evolving environments. Information management capability focuses on how to record, codify, and store organized knowledge. Report capability must be

in a form / structure which will eventually create the knowledge base (Durcikova and Gray, 2009).

Knowledge includes data and knowledge structured and analyzed to express understanding, experience, cumulative learning and skills when applied to problems or activities, says Ikhwan and Saiful (2016); Amirul (2012). It is a combination of rules, ideas, and procedures that contribute to decision making. Information systems are also classified according to the type of aid provided, irrespective of the field of function.

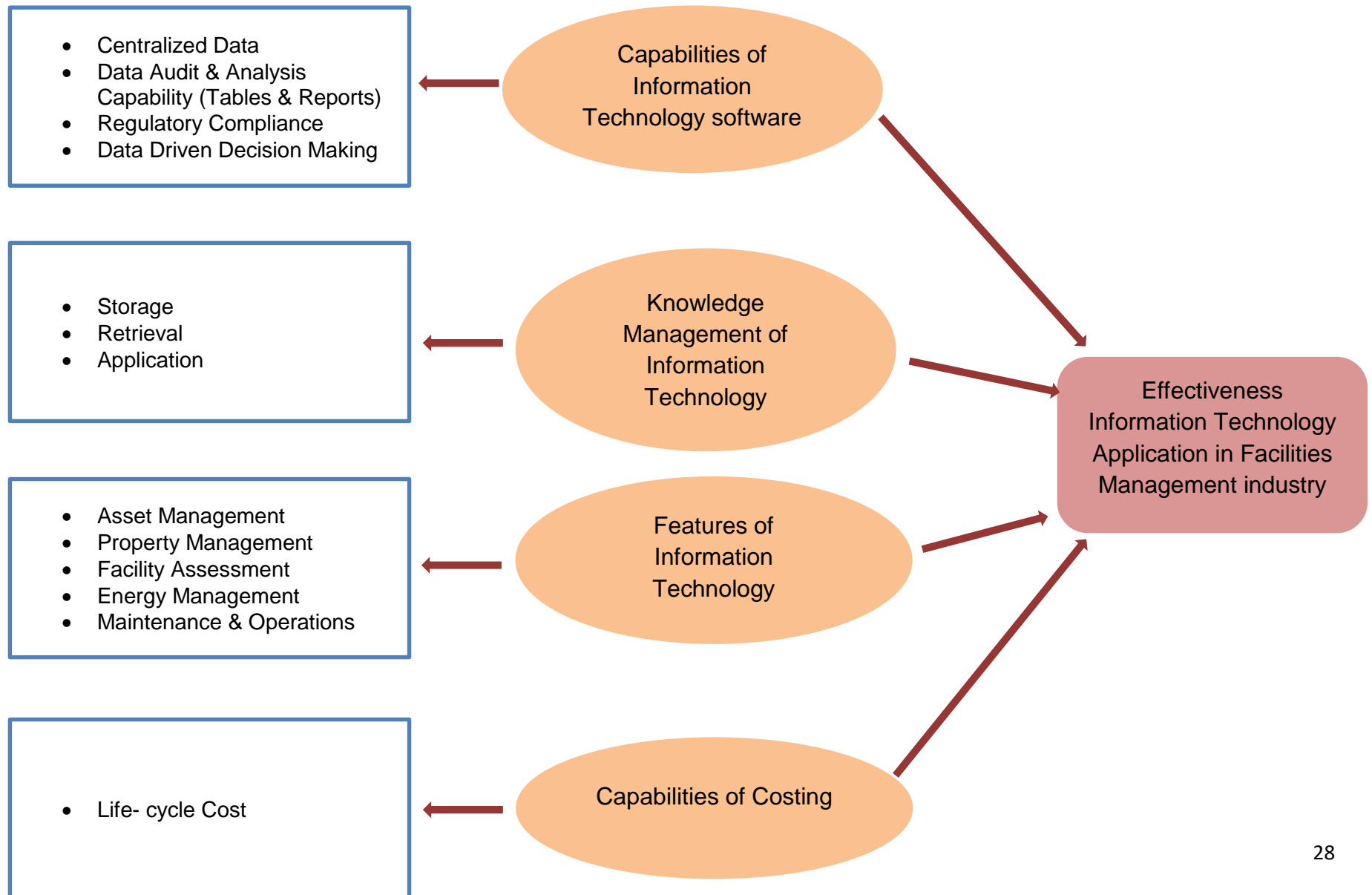
2.4 COMPUTER AIDED FACILITIES MANAGEMENT (CAFM)

In the 1970s and 1980s, CAFM began to be used for additional applications such as furniture inventory, asset management, lease management and building cost accounting. Computerized maintenance management system (CMMS) systems, such as maintenance management, telecommunications, cable management and security, began to appear as an enterprise client-server in the late 1980s and 1990s.

CAFM software allows facility managers to schedule, conduct and track all activities related to reactive and scheduled preventive maintenance, space and transfer management, asset management, operational facility services, room reservations and other customer services. Service delivery to consumers ensures that the process be well structured to ensure that service delivery times are reduced and to improve the quality of service delivery.

The facility managers see the Computer Aided Facilities Management (CAFM) as an alternative to the assembly of the details. Nonetheless, according to Jones & Collis (1996) it was noted that the Computerized Maintenance Management System (CMMS) in the context of maintenance management software was used before any implementation took place as in 1985, when maintenance managers had difficulty dealing with complex software for the first time.

2.5 FIGURE OF CONCEPTUAL FRAMEWORK



2.5.1 Capabilities of Information Technology software

i. Centralized Data

Capabilities of creating a database that is stored, maintained and located in one place (Diana, Hadi and Rima, 2016)

ii. Data Audit & Analysis Capability (Tables & Reports)

Audit is to ensure information management processes are in compliance Information Technology specific laws, policies and standard (Margaret Rose, 2019). Meanwhile Information Technology capabilities on data analysis focuses on analyzing stored data in the system in order to produce a report regarding management and operational issues.

iii. Regulatory Compliance

Federal, State and Local regulations and codes updates that governs the building or organization.

iv. Data Driven Decision Making

From the analysis of the data stored in the system, the software itself have the ability to create a decision making for an issue (Mehala and HIMAL, 2013)

2.5.2 Knowledge Management of Information Technology

According to Mahapatra and Sarkar (2000), knowledge management of Information Technology involved:

- i. Storage
- ii. Retrieval
- iii. Application

2.5.3 Features of Information Technology

Deyan Kavrakove (2015) in his journal mentioned about asset management while Mehala and Himal () mentioned the terms of Property Management, Facility Assessment, Energy Management and Maintenance and Operation.

i. **Asset Management**

A process to carry out asset function and to manage the asset own by the organization by planning the best way to generate income from the asset.

ii. **Property Management**

Acquisition and disposal of sites and building parts, advising on property investment, new building design and construction management

iii. Facility Assessment

Controlling operating budget, managing and undertake adaptation, define performance measure and standards and guideline

iv. Energy Management

Recycling and waste management, sustainability development goals

v. Maintenance & Operations

An activity that run and maintain plant, to monitor performance, controlling operating budget

2.5.4 Capabilities of Costing

According to web article published by ISS World.com, costing of a facility can be stated as life-cycle costing whereby it is affected by three factors. First it is stated as first cost whereby the organization purchase an asset. It involves capital-investment, purchasing and installation cost. Next is, future cost. Future cost involves operating and maintenance cost, energy consumption cost and capital-replacement cost. Lastly is resale. Resale happens when the asset is being disposal by the organization.

2.6 SUMMARY

This chapter explained about the reference that is used in this research. The information of literature review that is related with facilities management field, Information Technology and its application in Facility Management industry such as Computer Aided Facilities Management (CAFM). The matter discussed is more to the definition of each topics and related subject such as the feature, the benefits and the capabilities of each subject. In this chapter, researcher emphasize the definition of facility management from various perspectives.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

According to Kothari in his book, *Research Methodology – Methods and Techniques*, stated that research design or research methodology helps in smooth the research operations that can yield maximal information. The arrangement of conditions for collection and analysis of data in such way relevant to the objectives and aim of the research. Ranjit Kumar (2011) stated in his book, there are main methods in research methodology which are research design, data collection method and data analyzing method. All methods will be guide for the researcher to produce high quality of research paper.

In this chapter, researcher will explain related research methodology involve in finding the result. As stated in Chapter Two, literature review explains all facts from previous research and journals regarding the topic. When the researcher have state the facts about the topic in order to make readers understand, then researcher will explain the method used. The result will then be evaluated by using Statistical Package for the Social Sciences (SPSS) whereby this software is used to generate the data collected into statistical format (Daniel, 2012)

3.2 RESEARCH PHILOSOPHY

Research Philosophy is a belief to a development of knowledge. Knowledge development that researcher made throughout the process addressing specific problem hence developing new development of knowledge when it is being search and solve (Saunders, Lewis and Thornhill, 2019). According to Burrell and Morgan (2016), at each point of the research, researcher will make few assumptions and from it, researcher develops research questions, methods of research and ways to interpret the findings.

Saunders's Research Onion Model 2011 version shows that there are six layers of research methodology. Saunders et Al., 2012, stated that philosophies, approach, methodological choice, strategy(ies), time horizons as well as techniques and procedures are included in the Saunder's Research Onion Model. Figure below shows the model.

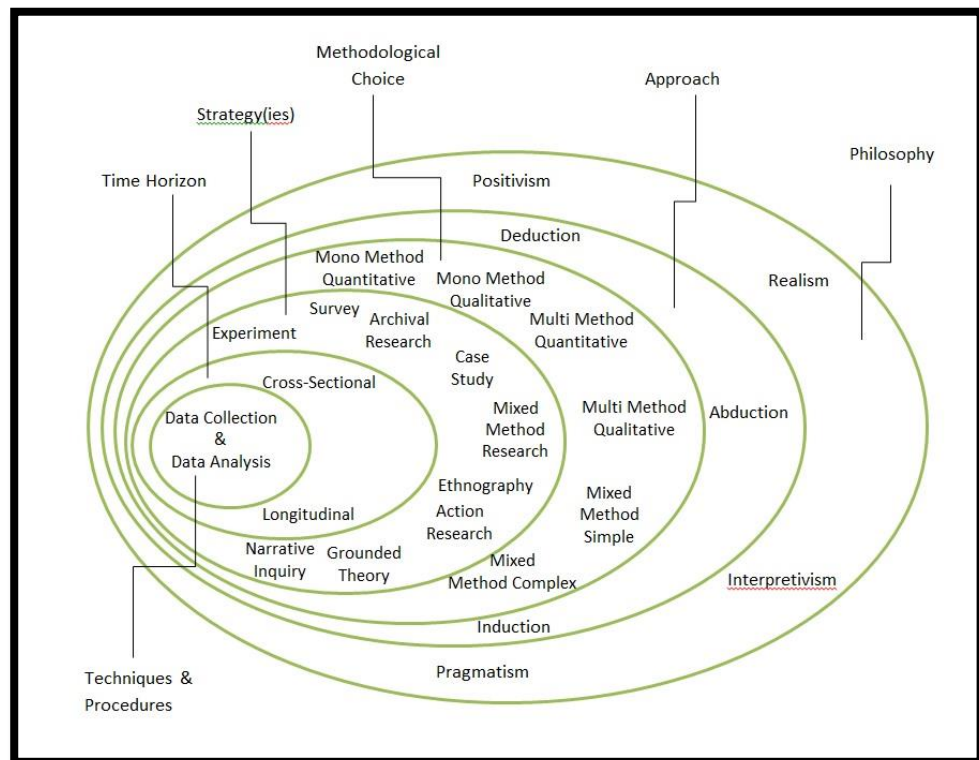


Figure 3.2: Saunder's Onion Model (Source: Institut Numerique, 2012, n.p.)

Apart from four types of research philosophies, researcher leans towards Pragmatism as research philosophy where by researcher would rather get on with research that would focus on making a difference to organisational practice. Kelemen and Rumen (2008) stated that the concepts are relevant if only they support action. This is achieved by examining theories, principles, ideas, hypotheses and research findings, not in an abstract way, but in terms of the roles they play as instruments of thought and action and in terms of their practical consequences in specific contexts (Saunders, Lewis and Thornhill, 2019). According to Elkjaer and Simpson (2011), as a pragmatist researcher, the research happens from a problem whereby researcher sense something is out of place. Reflexive process of inquiry happens, recreate trust when the problem has solved. As pragmatist interested in concrete result, the research will turns out be objectivistic or subjectivist.

3.2.1 Research Philosophy Approach

a) Deductive

This method need to be enabled the fact to be measured (quantitatively). In addition, it poses important characteristics that illustrate the relationship between concepts and variable. This approach which emphasize on quantification, generalization and testable hypothesis, underpinned it by a positivist research philosophy.

b) Inductive

This starts specifically with a preliminary hypothesis or collection of hypotheses that shape a theory that could provide a possible answer or explanation for a particular problem, and continues to use observations to rigorously evaluate the hypotheses. The

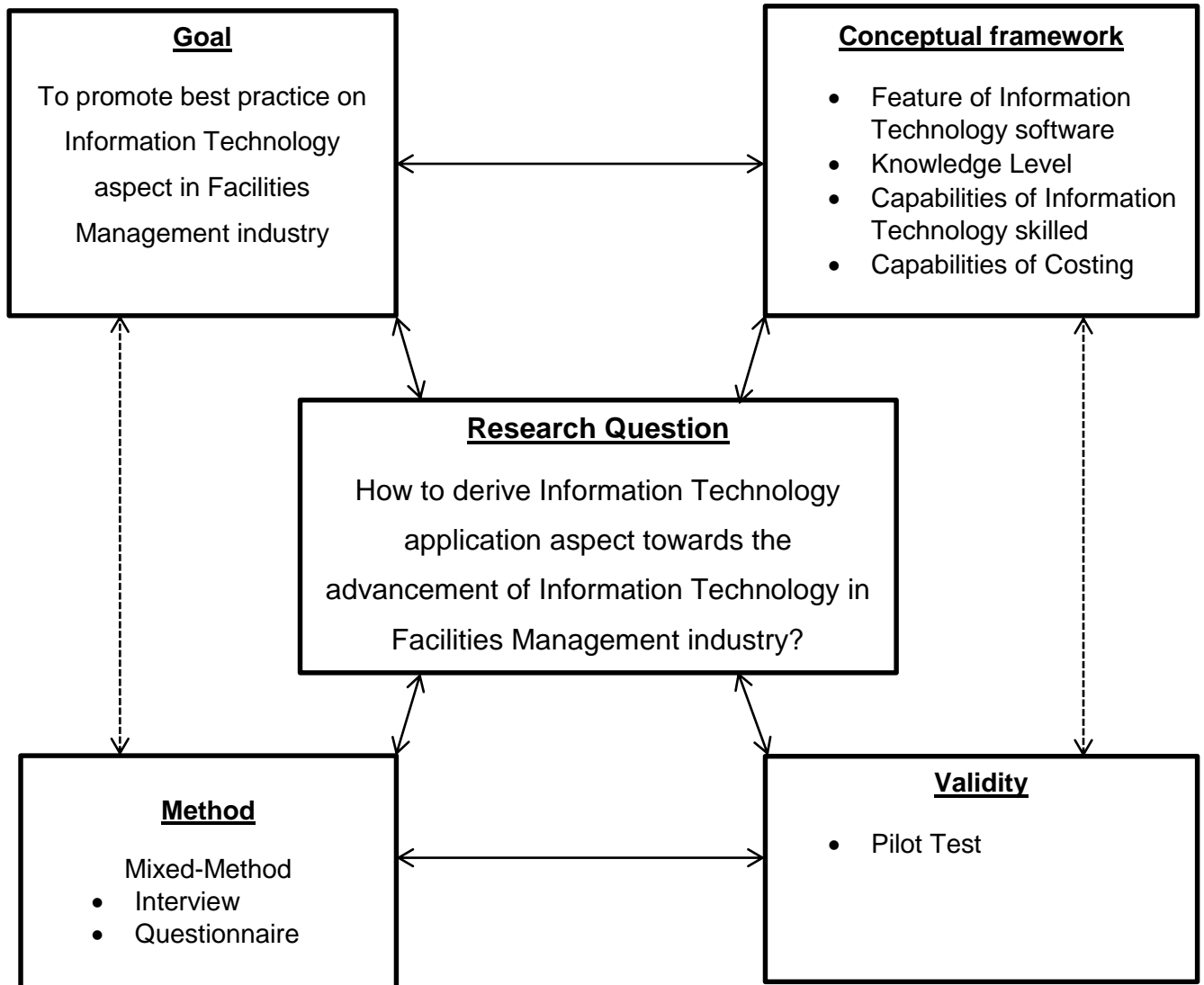
conclusion investigates by number of tests obtained and depends only on qualitative data.

c) Abductive

Suddaby (2006) pointed out that abduction is an effect that incorporates both deductive and inductive. Its unique characteristics can be underpinned pragmatism or realism philosophy. As it focuses on interpreting the observation on a fact, it turns out there are possible theories on how some issue happened.

In this research, researcher will use **abductive approach** to analyze collected data in order to identify the effectiveness of the Information Technology in Facilities Management industry that derives the best practice in this aspect. . Both qualitative and quantitative data is crucial to evaluate the best practice that can implement in Information Technology aspect in Facilities Management. For method of research, mixed-method is used by the researcher.

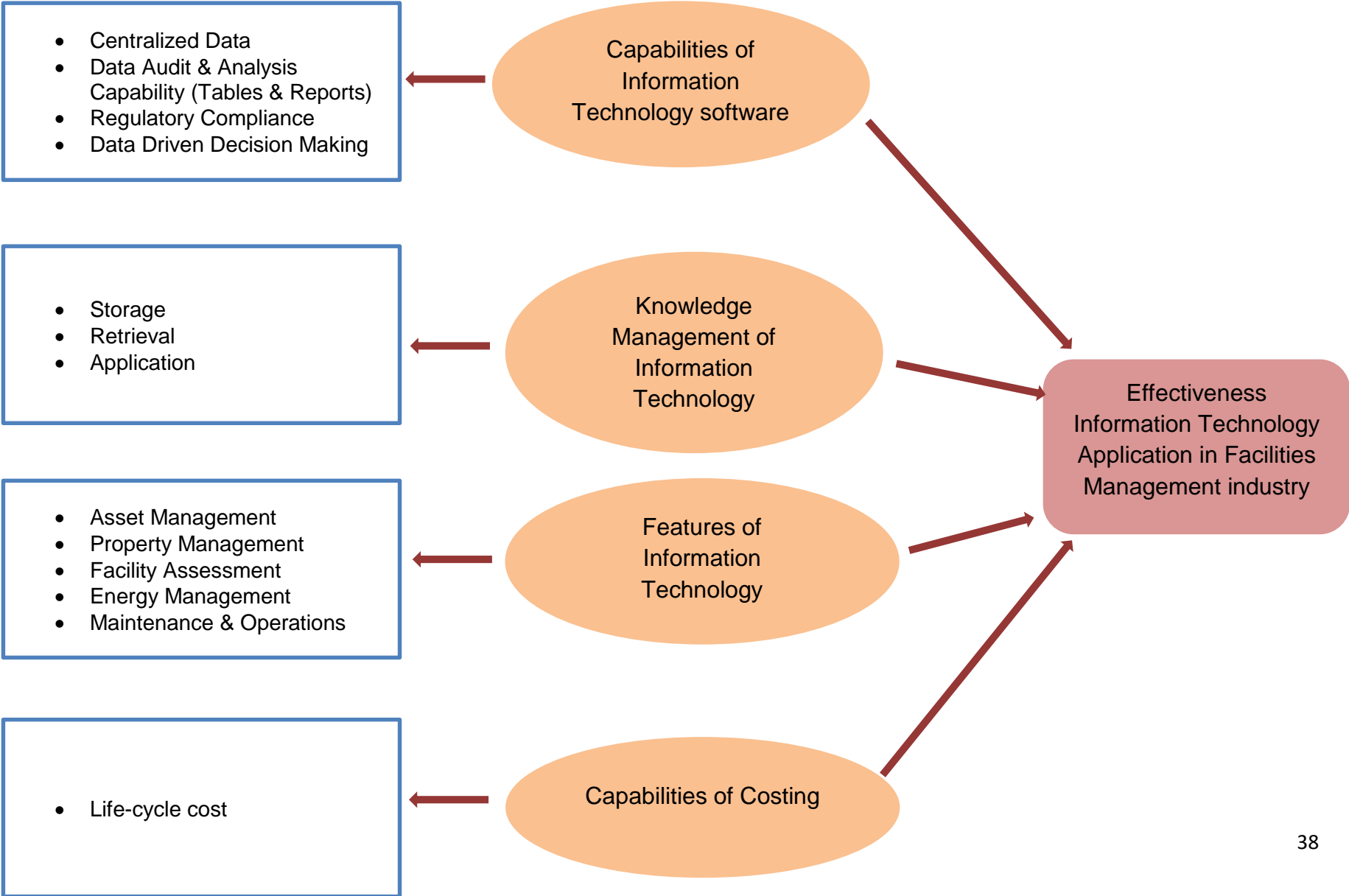
3.3 RESEARCH DESIGN



3.3.1 Aim

In order to produce a reliable and potential research, a researcher needs to be clear about the aim of the research. Aim that act like a knowledge that makes the researcher understand what is needed to be done to answer the research question. The researcher aim is to promote best practice on Information Technology aspect in Facilities Management industry. In Malaysia, Facilities Management is still in developing phase to be compared with other countries, the Facilities Management industry more likely already stable.

3.3.2 Conceptual Framework



3.3.3 Research Question

Research question is crucial part in a research as it guides arguments and inquiries that will develop the researcher interest about a topic. There are few research questions that is designed to be solved in this research.

- i. What is the type of Information Technology application in Facilities Management industry?
- ii. What is the effectiveness of the Information Technology application in Facilities Management industry?
- iii. How to improve the level of application in Information Technology aspect toward implementation of Information Technology in Facilities Management industry

3.3.4 Method of Data Collection

In this research, there are two method approaches for data collection. Each of it will interpret different outlook of the topic. There are two methods of data collection used in the research:

a) Questionnaire

Questionnaire is a primary data collection consist a series of questions to be distributed to the respondent. A questionnaire is a research instrument consisting of a series of questions and other prompts for the purpose of

gathering information from respondents. The number of respondent will be vary depends on numbers of employees in the organisation and by following Krejcie and Morgan Formula. Target respondent for questionnaire is to middle management personnel and operation line workers. The question set that will be distributed is aligned with conceptual framework of the research. Consequential of questionnaire is to evaluate respondent's interpretation towards the Information Technology application in Facilities Management of the organisation operation process. Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data. The data collected form the questionnaire distributed will be analysed by using Statistical Package for Science Social (SPSS)

b) Interview

Interview involves asking questions and getting answers or responds from the participant in the research. Syed Muhammad (2016) stated that there are variety forms of interviews that include face-to-face interview and face-to-face group interview. Interviews can be structured, semi-structured and unstructured. Researcher has choose to use semi-structured interview as it most likely meet the needs of the research objective. The interview session will be held with both personnel from top management and IT Department in the organization regarding the Information Technology (IT) aspect.. In semi-structured interview, both interviewer and respondent are engage in a formal interview. According to Syed Muhammad (2016) semi-

structured interview guide provides set of instructions for the interviewer to conduct the interview session so that data gained during the session will provide reliable and comparable qualitative data for the research. It is suggested to interview employee from Top Management Level and Information Technology (IT) or Information Communication Technology (ICT) Department as they are responsible and expose more with Information Technology of the operation.

3.3.5 Validity

3.3.5.1 Pilot Survey

Pilot survey will be distributed to random technicians and management personnel to ensure every tools used in the questionnaire are reliable and understandable by the respondent. This process is important before the actual questionnaire is distributed to the respondent. The pilot survey for questionnaire has been done within technicians and personnel in random Facilities Management organisations.

3.4 SUMMARY

There are few philosophies and research methods that are suggested by previous researcher and journalist. Each of the methods and philosophies plays their own unique characteristic that helps the researcher in producing a high quality research. In data analysis process, Statistical Package for Science Social (SPSS) is used to interpret the data collection in order to measure the output from the data collected.

CHAPTER FOUR

DATA COLLECTION

4.1 INTRODUCTION

Data collection is done in order to obtain the information necessary for the purpose of the research. In any study the data collection is the most critical element (Cresswell, 2008). Data processing methods must be things that can discuss and solve study problems. To prevent errors in choosing suitable data collection techniques, the selection of data collection techniques and methods should be focussed. A good tool or instrument for gathering data will determine the quality of the study. This chapter will explain the method of sampling, the sample size used and the rationale of specific instruments for data collection.

4.2 SAMPLE STUDY

The sample size design is based on the intent of this analysis, the sample needed, the cost and the time allocated for the research. The sample size is a category of whether it is an organization, place or phenomenon that serves as the researcher's source of knowledge. It is difficult for the researcher to do so because of factors such as large population size, diverse population and large-scale population (gain selection as needed). There are approaches in designing a sample design of a study

that act as a benchmark and simplify the process of data collection and are divided into two i.e. probability sampling and non-probability sampling.

Researchers usually use non-probability sampling approaches in both qualitative and quantitative studies. As described by Fraenkel and Wallen (2006), non-probability sampling involves selecting samples from a population defined on the basis of specified criteria. As the research methodology using qualitative method, only non-probability sampling is being discussed by the researcher.

4.2.1 Judgment Sampling

Judgment Sampling refers to a process involving a group of subjects which have certain characteristics relevant to the expertise and intent of the study. This also means that researcher classifies the respondent. Researcher selects the subject based on the research-related intent or desire. The research results and the sampling only reflect the sample group

4.2.2 Population Size and Sample size

Haji Awi (2013) claimed that the population is different with each study carried out, as the sample size and the design analysis is different. This is because of the study sample is the selected respondents to represent a population (Airasian and Gay, 2003). It is necessary to determine the population in the study, as it will decide how and number of samples that the researcher will select.

Samples are a small group of populations that the researcher select for performing the study. When deciding the sample size suitable for the population, the researcher must take approach to prevent significant errors. The sample size is determined from table Krejcie and table Morgan (1970).

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Figure 4.2.2 Krejcie, Robert V., Morgan, Daryle W., 1970. "Determining Sample Size for Research Activities", Educational and Psychological Measurement

4.2.2.1 Population Type

In this research, the population focus on employees that work in Facilities Management (FM) companies. Each company selected has been involved and establish in FM industry for more than five (5) years and have headquarters based in Klang Valley. Selected companies that involved 6 companies from different type of industry must have been using Information System (IT) application such as Computer Aided Facilities Management (CAFM). Targeted industry to be involved are healthcare industry, education industry, commercial industry and manufacturing industry.

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Figure 4.2.2.1 Population and Sample for the Research

Table 4.2.2.1 Research Sample Size

No	Item	Total
1	Companies involved in the questionnaire session	6
2	Population size (N)	226
3	Sample Size (S)	136
4	Total responded questionnaire for this research	155

Based on Table 4.2.2.1 sample size for this research is selected by following the Krejcie and Morgan Table. The questionnaire session involved six Facilities Management company with the population size of 226. As the questionnaire session is done through online platform Google Form, the link of the questionnaire is sent to each person in charge of the organization before it is blast to the selected group of respondent internally.

4.3 DATA COLLECTION INSTRUMENT

Instrument is one of the tools or methods used to gather the data. Among the data collection instruments for the study cases used in this research are questionnaire and interview with respondent as per required for the data collection process. Data collection techniques are very important steps in the analysis process since the main objective of the study is to analyse the obtained data as per stated by Burhanuddin (2003).

4.3.1 Questionnaire

Questionnaire is used in this research in order to get respondent opinions towards the application of Information Technology in Facilities Management in Malaysia. The questions list are followed and constructed according to the conceptual framework and literature review by the researcher. All the responds recorded through the questionnaire survey are strictly confidential and will be used only for the research purposes. The questionnaire is distributed by using Google Form link to six Facilities Management company that is selected by the researcher.

Table 4.3.1 (a) Questionnaire's Section

Section	Title
A	Respondent's Demographic
B	Type of Information Technology application in Facilities Management in Malaysia
C	The Effectiveness of Information Technology application in Facilities Management in Malaysia
D	Improvement towards Information Technology application in Facilities Management in Malaysia

As stated in Table 4.3.1, Section A focuses on respondent's demographic that surveys respondent's academic qualification, position in the company, years of working experience and type of the industry they are being involved. There are also two important questions being asked in this section that determine whether they can continue to answer the survey. The questions are regarding their accessibility to the Information Technology application - Computer Aided Facilities Management (CAFM) and the name of the system or application that is used by their organization.

In Section B, questions related to operational work in Facilities Management is query to the respondent. This is to acknowledge the researcher the features that are included in the application of Information Technology for Facilities Management in the organization related.

Section C is to query the respondent regarding the Effectiveness of Information Technology application in Facilities Management. Questions that included in the survey are the accessibility of the system through smart phone and computer, the ability of the system to update newest data, the ability of the system to access actual data from the older version, the level of intuitive interface of the system and the level of needs on high speed internet to access the system.

Section D is to acquire opinion from respondent regarding improvement that can be implement in application of Information Technology for Facilities Management.

Table 4.3.1 (b) List of Question in the Questionnaire

Section	List of Questions
<p>A</p> <p>Respondent's Demographic</p>	<ol style="list-style-type: none"> 1. Academic qualification 2. Designation 3. Years of working 4. Type of industry the respondent employed 5. Implementation of Information Technology in Facilities Management in the organization 6. The name of Computer Aided Facilities Management (CAFM) used by the organization
<p>B</p> <p>Type of Information Technology application in Facilities Management in Malaysia (Features)</p>	<p>Implementation of features in Information Technology application:</p> <ol style="list-style-type: none"> 1. Asset Management <ul style="list-style-type: none"> • Asset Registration • Asset Statutory & License • Asset Status & Placement • Asset Maintenance • Asset Disposal (Beyond Economic Repair) • Inventory & Store Management 2. Space Management <ul style="list-style-type: none"> • Drawing Plan

	<ul style="list-style-type: none"> • Location Code • Space Usage Status • Occupancy Number Status <p>3. Helpdesk/Administration</p> <ul style="list-style-type: none"> • Work Order Management • Customer Complaint • Operation Data Information Update • Information Update on building & organization <p>4. Operational Process Report</p> <ul style="list-style-type: none"> • Customer Complaint Daily Report • Work Order Report • Inventory Report • Planned Preventive Maintenance Report • Asset Management Report
<p style="text-align: center;">C</p> <p>The Effectiveness of Information Technology application in Facilities Management in Malaysia</p>	<ol style="list-style-type: none"> 1. Version of Computer Aided Facilities Management (CAFM) 2. Accessible level of the Computer Aided Facilities Management (CAFM) system through computer 3. Accessible level of the Computer Aided Facilities Management (CAFM) system through smartphone 4. Intuitive interface of Computer Aided Facilities Management (CAFM) system

	<ol style="list-style-type: none"> 5. The needs of Computer Aided Facilities Management (CAFM) system towards high speed internet 6. Capability of the system to provide latest information and report 7. Accessibility of old data when the system is updated into new version 8. Problems face by user when using the system such as missing and outdated data. 9. Needs of user training to ensure employee gets proper knowledge and skill about the system.
<p style="text-align: center;">D</p> <p style="text-align: center;">Improvement towards Information Technology application in Facilities Management in Malaysia</p>	<ol style="list-style-type: none"> 1. Needs of Computer Aided Facilities Management (CAFM) system application in smartphone 2. Combination of other management feature in the Computer Aided Facilities Management (CAFM) system 3. Offline accessibility of Computer Aided Facilities Management (CAFM) system 4. Importance of user training 5. Student accessibility to use Computer Aided Facilities Management (CAFM) system for learning purpose

Table 4.3.1 (c) Likert Scale

Statement	Scale
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Table 4.3.1 (d) Questionnaire Link on Google Form Platform

Questionnaire Title in Google Form	Google Form Online Link
<i>Teknologi Maklumat di dalam Industri Pengurusan Fasiliti di Malaysia</i>	Short Link
	https://forms.gle/82Br6FGWwUzoEd7X7
	Full Link
	https://docs.google.com/forms/d/e/1FAIpQLScmUwC3aQff5VTPzdIyQGYF6jas3MWI9WPQYML6OL6hfEfa3Q/viewform?usp=sf_link

4.3.2 Interview

Person interviews are a powerful way of gaining insight into people's attitudes, understandings and perspectives of an issue and may lead to a comprehensive set of data Frances, Michael, Patricia (2009). The interviewees come from top and middle management in the organization which will contribute in giving their perspective for the issues. The identities of the interviewees will remain confidential and anonymous.

Each question in the interview is to obtain and support the required data for the researcher to the research's objectives. The research objectives are:

- i. To identify type of Information Technology application in Facilities Management industry
- ii. To identify the effectiveness of the Information Technology application in Facilities Management industry
- iii. To suggest improvement toward implementation of Information Technology in Facilities Management industry

Table 4.3.2 List of Question for Interview Session

No.	Question	Objective to be achieved
1	<p>In a survey session involving 155 respondent, they had responded to the question regarding features in Information Technology application that is used in the organization operation.</p> <p>From the survey result, there is some information that is lack in the application. Some of it is:</p> <ul style="list-style-type: none"> a) Occupancy of Room/Area b) Status of Room/Area c) Human Resources features <p>In your view, will the combination of management and operational features in one application can make the working process manageable and smooth?</p>	Objective 1
2	<p>Moving forward IR 4.0 that requires establish and high speed internet connection, how does your organization overcome issue related to poor internet connection that affect Information Technology application effectiveness during the operation process?</p>	Objective 2
3	<p>69 over 155 respondents responded that, when using the application, they had face</p>	Objective 2

	issues such as irrelevant and outdated data. In your opinion, why does this happens and what is the solution?	
4	136 respondents agreed that the Information Technology application should be available offline without the internet. Was it possible to incorporate them in your opinion?	Objective 3
5	User training not only provides insight and knowledge about the Information Technology application but can also increase the employee's technical skills. What are the obstacles to the workers being provided with adequate training?	Objective 3
6	Only 1 out of 6 organizations involved in the survey session has a smartphone version for their application in Information Technology. Application for smartphone versions is essential in Industrial Revolution 4.0, which emphasizes the use of digitalization information exchange. Does your organization have any plans regarding this issue?	Objective 3

4.4 SUMMARY

This chapter has fully explained the instruments used for the data collection process. The data collection process for this research involved the use of samples as well as the use of instrument consisting of questionnaire and interview session with the respondent. Sampling design chosen is non-probability sampling for the research. In addition, the data collection instrument used by the researchers are mixed-method data collection.

CHAPTER FIVE

DATA ANALYSIS

5.1 INTRODUCTION

Data analysis is an easy to understand way of turning data into information and solving research-related problems (Sora N., 2015). Syamer (2017) claimed that data analysis is also an operation that gathers and processes data in order to address the study's question and goals. The methods used in this research are statistical descriptives and inferential statistics. Inferential statistics are techniques that enable the researcher to use measurements to generalize the population from which the samples were taken, and descriptive statistics are techniques that help the researcher to define, view and summarize the data in a meaningful manner. Descriptive data will enable the researcher to present the data in more simple interpretation of the data.

In this chapter, research focuses on analysing the questionnaire section by section. Quantitative analysis will be focused on the questionnaire session result and qualitative analysis will extracted information gained from the interview session from selected personnel. The analysing process is done by using Statistical Package for Social Sciences (SPSS) software. Acquired by IBM in 2009, this software use for interactive or batched, statistical analysis which help the researcher able to extract data in much simpler ways.

5.2 QUESTIONNAIRE

According to Rani Menta (2012) A questionnaire is a collection of question asked to individuals in order to collect statistically valuable information on a specific subject. When properly designed and implemented, questionnaires are a critical instrument from which assumptions may be made about particular groups or individuals or entire populations. They are a great way to obtain a wide variety of knowledge from a large number of individuals, often referred to as respondents.

5.2.1 Respondent Demographic

According to Gavrilova N.S., Gavrilov LA. (2011), demographic is a statistical study of the population, especially human and it can analyse any type of dynamic population of life that change over time and space. Demographic section describes background of the respondents whom answered the questionnaire.

Table 5.2.1 Background of Respondent

No	Item	Category	Sample Size (n= 155)
1	Academic qualification	SPM	3
		Certificate (<i>Sijil</i>)	10
		Diploma	113
		Degree	28
		Master	1
		PhD	0
2	Designation	Facility Manager	2
		Engineer	20
		Technician	128
		Others	5
3	Years of working	Less than 5 Years	103
		5 to 10 years	46
		11 to 15 years	5
		More than 15 Years	1
4	Type of industry the respondent employed	Manufacturing	0
		Commercial	45
		Healthcare	69
		Education	41
5	Implementation of Information Technology in Facilities Management in the organization	Yes	155
		No	0
6	Name of Computer Aided Facilities Management	CAMSIS	34
		CWORK	26
		GEMS	25

(CAFM) used by the organization	ARCHIBUS	16
	CMMS	19
	NIAGARA	35

Sample Size = Number of respondent for the questionnaire

Table 5.2.1 shows the total number of respondent (155 respondent) answered to the questionnaire distributed for the study. The demographics asked in this research are:

- i. Academic qualification
- ii. Designation
- iii. Years of working
- iv. Type of industry the respondent employed
- v. Implementation status of Information Technology in Facilities Management in the organization
- vi. Name of Computer Aided Facilities Management (CAFM) used by the organization.

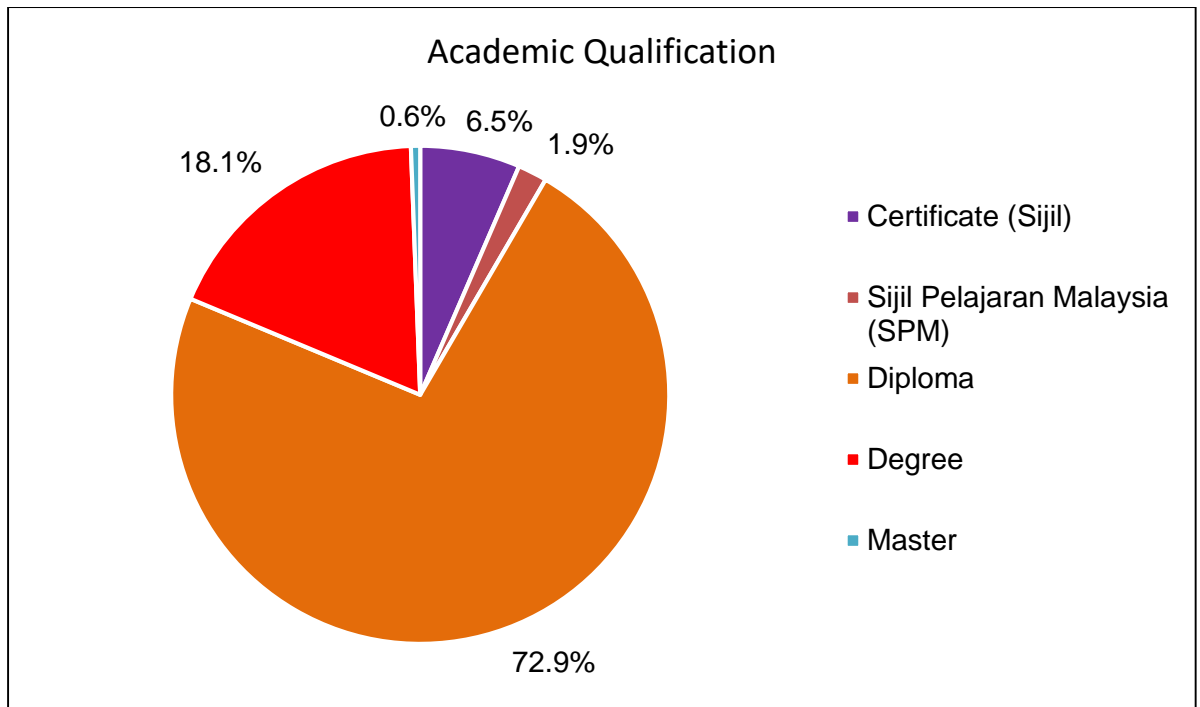


Figure 5.2.1 (a) Percentage of Academic Qualification of Respondent

From above percentage pie chart in Figure 5.2.1 (a) shown that respondent with Diploma academic qualification scored the highest percentage of 72.9% and follows by 18.1% of respondents that have Degree. Meanwhile, SPM academic qualification respondent scored 1.9% and respondent with certificate academic qualification scored 6.5%. The lowest percentage scored by respondent that have Master in academic qualification which the scored is only 0.6%.

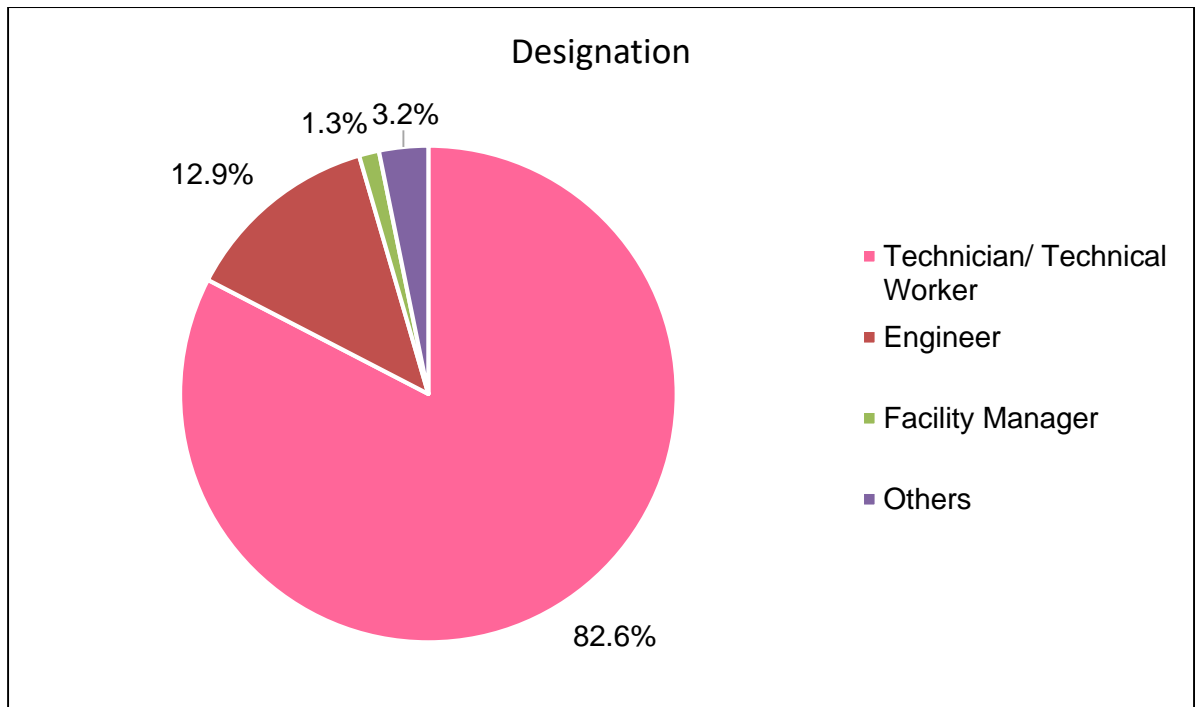


Figure 5.2.1 (b) Respondent's Designation in the Organization

Above pie chart in Figure 5.2.1 (b) shows that there are four categories for designations in Facilities Management companies that had been selected by the researcher. The highest percentage designation of the respondents for the questionnaire survey is technician or technical worker, which scored for 82.6%. Next, with the percentage of 12.9, the questionnaire is responded by engineers. 3.2% respondents are from other designation in selected company. The lowest percentage respondents are Facility Manager with the score of only 1.3%.

For the other designation, the respondents are trainees, Information Technology (IT) Analyst Executive, IT engineer and IT admin. The reason why technician or technical workers scored the highest percentage is because in every organisation, they hire more employee for technical team rather than management team because technical team requires more manpower to attend the related work process.

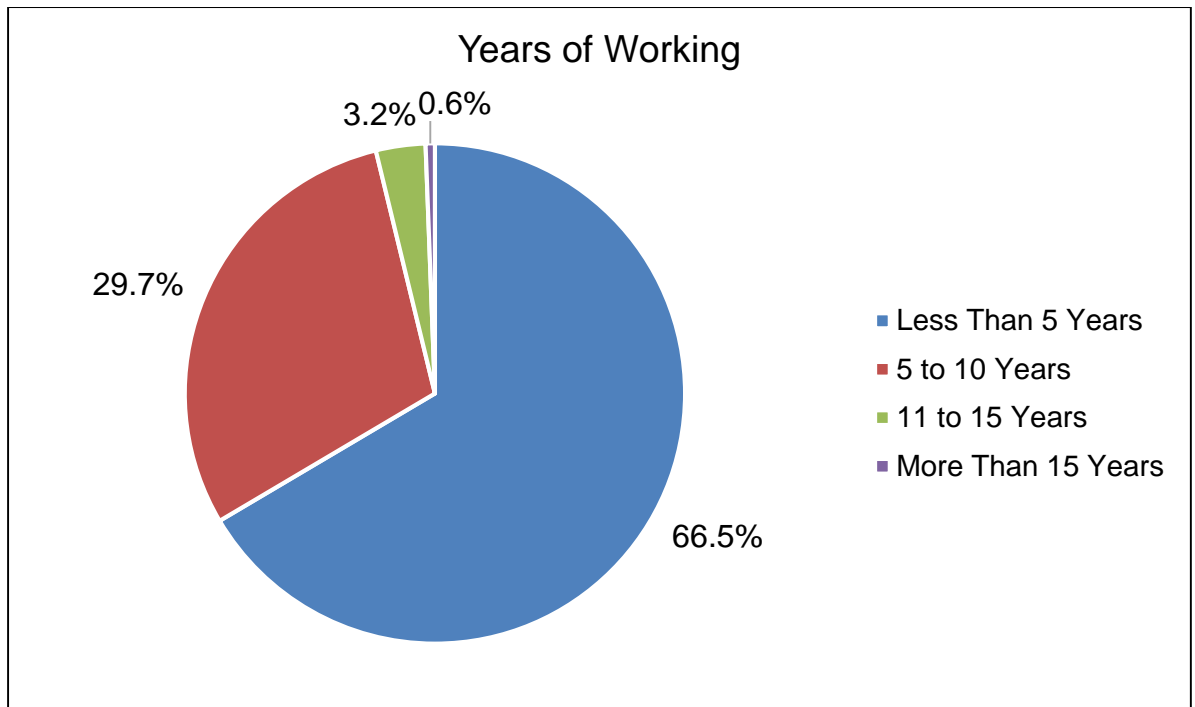


Figure 5.2.1 (c) Respondent's Years of Working

Majority of respondents are employees with working experience of less than 5 years with the percentage of 66.5%. The second highest percentage value is 29.7%. It is range for respondents with 5 to 10 years working experience. Next, respondents with 11 to 15 years working experience score 3.2% and the lowest percentage score by respondents with more than 15 years working experience.

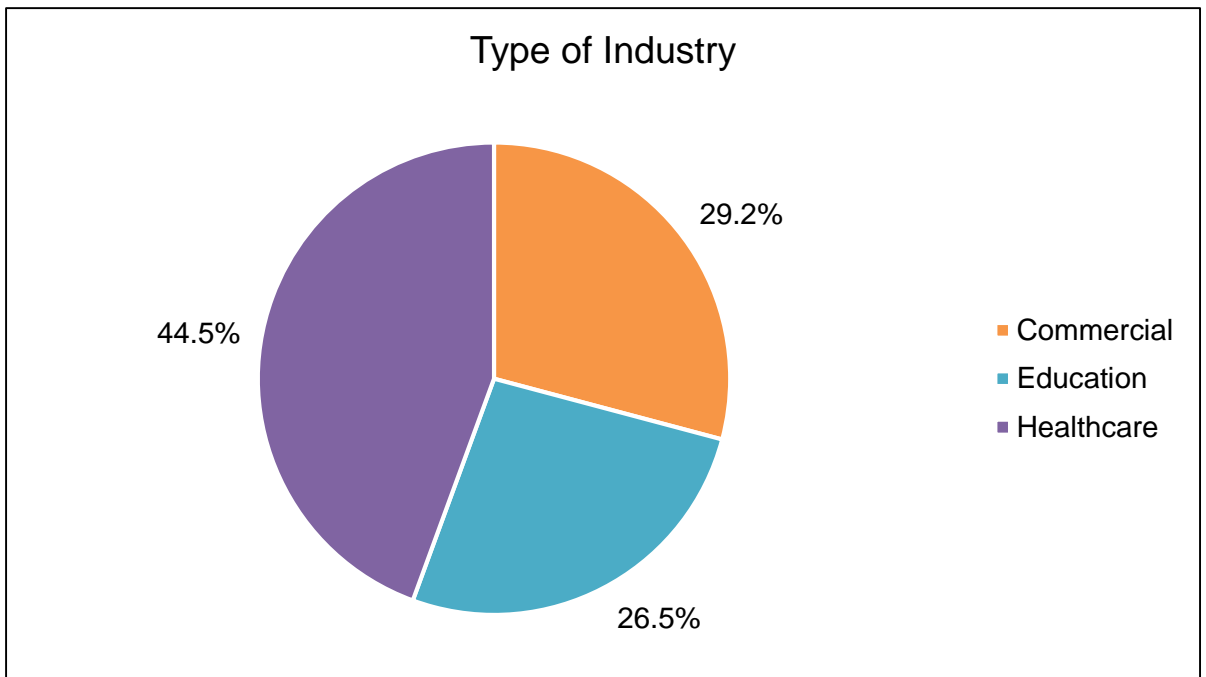


Figure 5.2.1 (d) Type of Industry the Respondent Employed

Figure 5.2.1 (d) shows the percentage of type of industry employed by the respondent. The question is asked by the researcher in the questionnaire is to know what type of industry and building does the service is being serve by the respondent. As shown in the figure above, the highest percentage scored by healthcare industry. This industry scored highest percentage because of there are two companies that serve the Facilities Management service at hospital and both of it have highest population size numbers among the population groups selected by the researcher. Second highest is commercial industry with the percentage of 29.2% and the lowest percentage is education industry with the score only 26.5%.

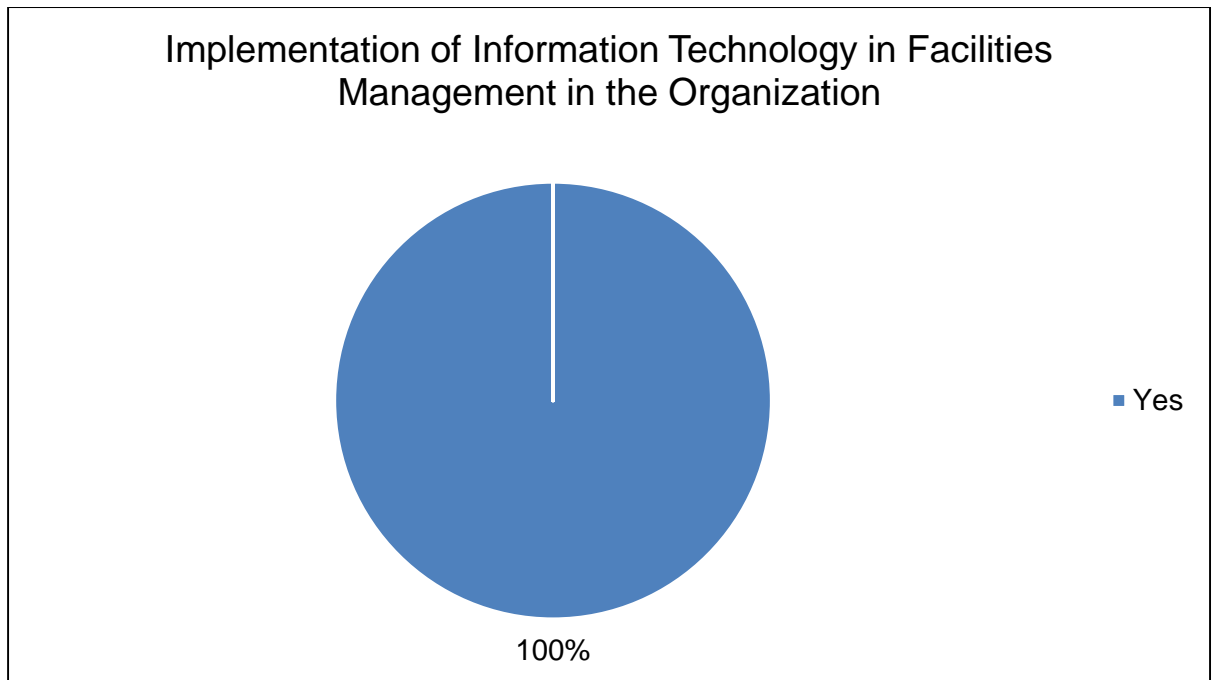


Figure 5.2.1 (e) Implementation of Information Technology in Facilities Management in the Organization

This question is asked to act as an affirmation that the population group selected by the researcher are using Information Technology application as one of feature in their organizational working procedure. From above figure 5.2.1 (e), it shown that the percentage is 100% which mean that all the respondent's organization has been implement Information Technology application in their organization.

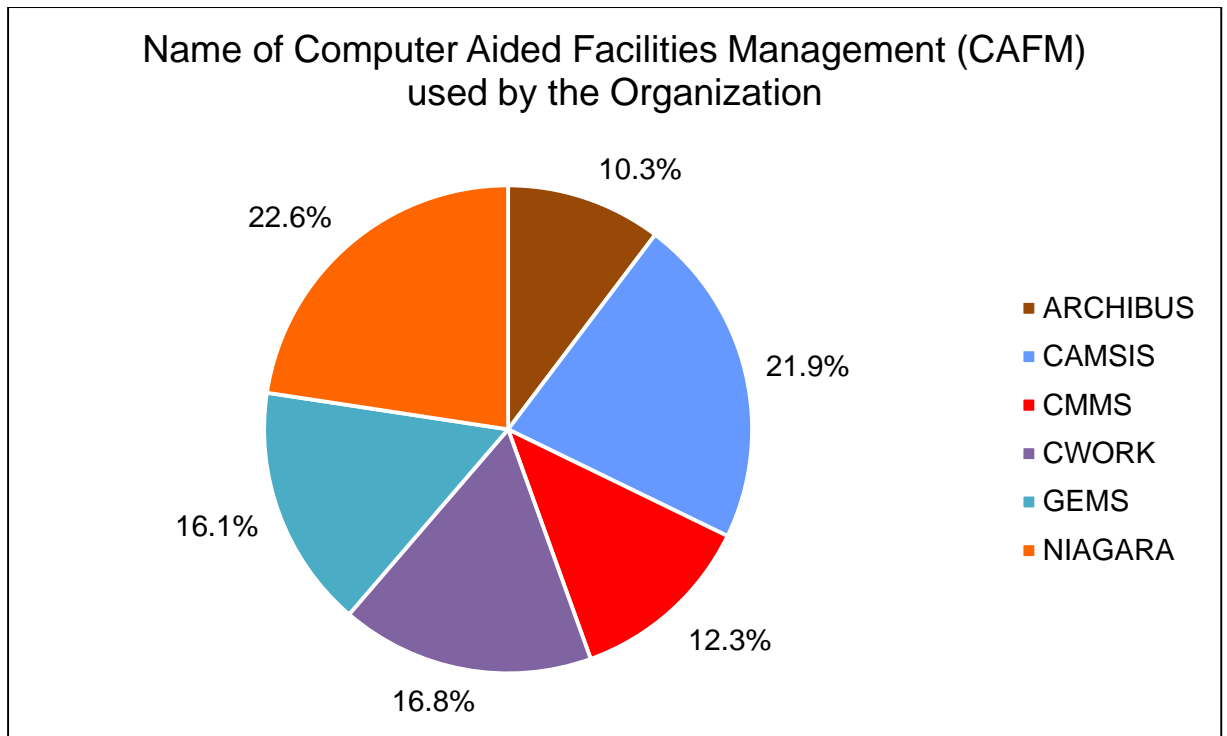


Figure 5.2.1 (f) Name of Computer Aided Facilities Management (CAFM) used by the Organization

The findings for name of Computer Aided Facilities Management (CAFM) used by the organization is shown as in Figure 5.2.1 (f). In the figure shows that NIAGARA have the highest percentage with 22.6%, follows by CAMSIS with the percentage of 21.9%. Next is CWORK with 16.8% and GEMS with 16.1% scores. The lowest percentage is CMMS system with the percentage of 12.3%. It can be concluded that the result is affected by the number of sample size from different population group. Population group with the highest number of sample size will score highest percentage since more respondent from the respected company.

5.2.2 DATA ANALYSIS FOR OBJECTIVE 1

Section B in the questionnaire is **to identify the type of Information Technology application in Facilities Management industry**. The purpose of the researcher asking this question is to find out what is the scope and features of Facility Management included in the system used by each respondent company that is involved in this research. This is to see how complete the system built for the use of Facility Management in their respective organizations.

Table 5.2.2 Score Mean for Type of Information Technology application in Facilities Management Industry

Item	Features	Category Code	Category Details	Frequency	%
B1	Asset Management	B1-A	Asset Registration	146	22.4
		B1-B	Asset Statutory & License	76	11.7
		B1-C	Asset Status & Placement	111	17.1
		B1-D	Asset Maintenance	154	23.7
		B1-E	Asset Disposal (Beyond Economic Repair)	54	8.3
		B1-F	Inventory & Store Management	110	16.9
B2	Space Management	B2-A	Drawing Plan	80	28.9
		B2-B	Location Code	155	56.0
		B2-C	Space Usage Status	40	14.4
		B2-D	Occupancy Number Status	2	0.7
B3	Helpdesk/ Administration	B3-A	Work Order Management	154	25.0
		B3-B	Customer Complaint	155	25.1

		B3-C	Operation Data Information Update	154	25.0
		B3-D	Information Update on Building & Organization	154	25.0
B4	Operational Process Report	B4-A	Customer Complaint Report	128	20.6
		B4-B	Work Order Report	155	25.0
		B4-C	Inventory Report	75	12.1
		B4-D	Planned Preventive Maintenance Report	154	24.8
		B4-E	Asset Management Report	109	17.6

Table above shows that the scope and features in the system that is used by the related organization. This section is to see whether the system used by the organization according to the aspects of Facilities Management as recommended by the Facilities Management organization such as the British Institute of Facilities Management (BIFM) and the International Facility Management Association (IFMA)

The results obtained as pictured in the table above are based on what the respondents can access while using the system. This result is also influenced by the positions held by the respondents in their respective organizations. This is common because there is system designed with accessibility restriction based on to the designation of the employee of the organisation. For example, if the respondent is a technician, he can only access the system up to the level of operation only. While if the respondent is an engineer in the organization, he can access more features such the operations and reports section feature.

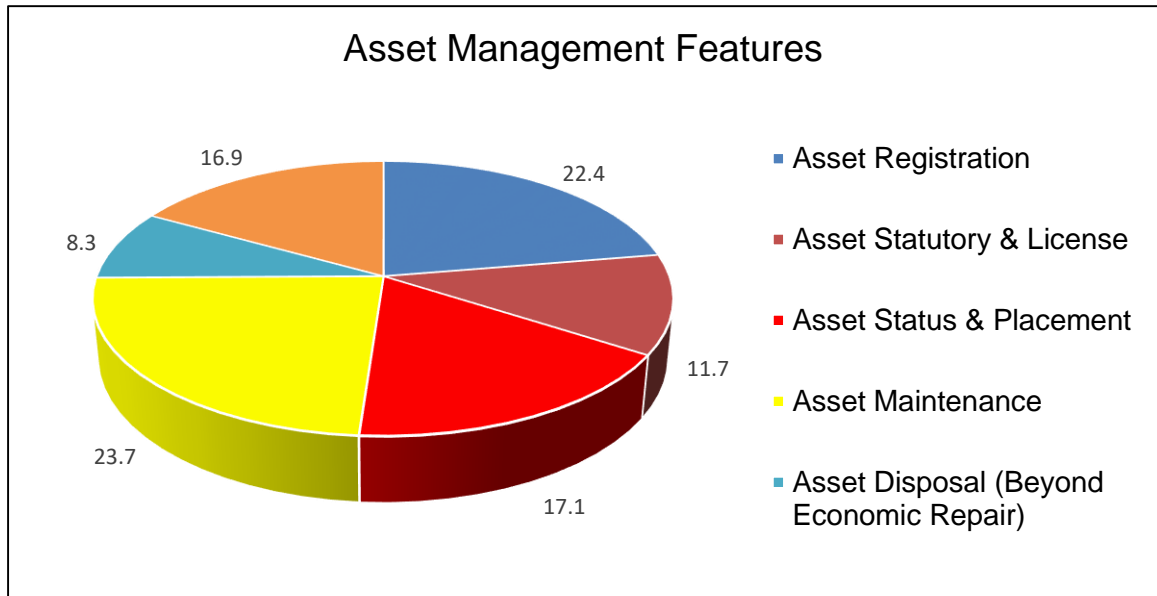


Figure 5.2.2 (a) Percentage of Asset Management Feature in Information Technology Application

As shown in Figure 5.2.2 (a) for Asset Management scope, the highest percentage scored is Asset Maintenance feature with 23.7% and follows by Asset Registration feature with 22.4%. The findings also shows that, respondent selected feature Asset Status and Placement feature with 17.1%, 16.9% for Inventory and Store Management feature and lastly 11.7% for Asset Statutory and License feature.

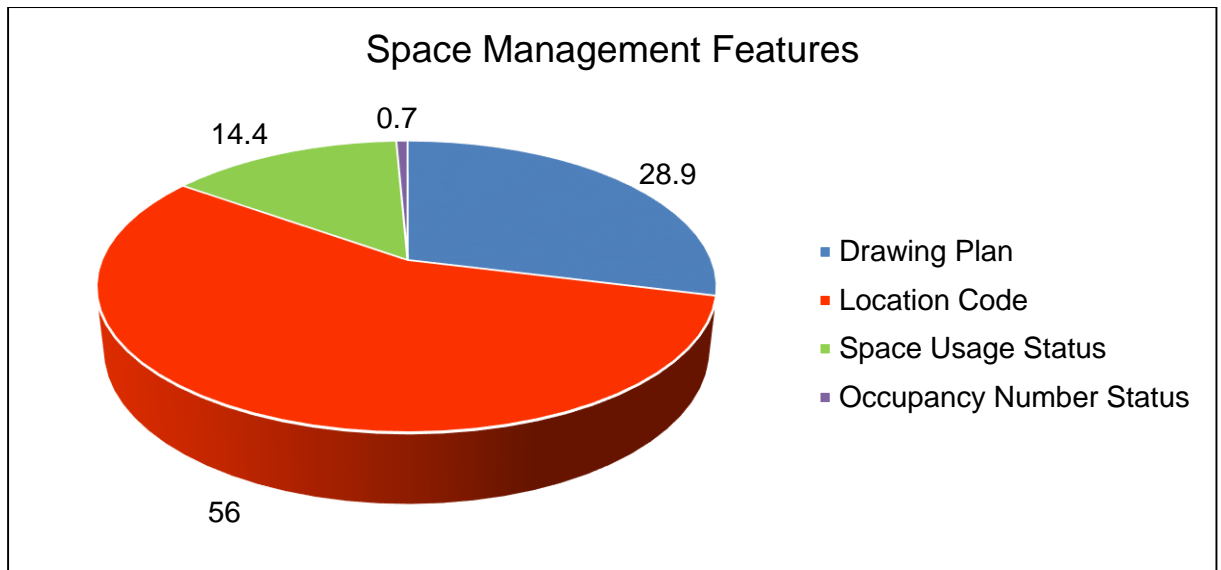


Figure 5.2.2 (b) Percentage of Space Management Feature in Information Technology Application

Space Management scope features result in the questionnaire is shown in Figure 5.2.2 (b) above. The lowest percentage is 0.7% score by Occupancy Number Status feature. Meanwhile, 14.4% is score by Space Usage Status and 28.9% score by Drawing Plan feature. The highest percentage score for this section is Location Code with 56%. It can be conclude that 155 respondents can access this feature in each Information Technology application system and it is included in the system.

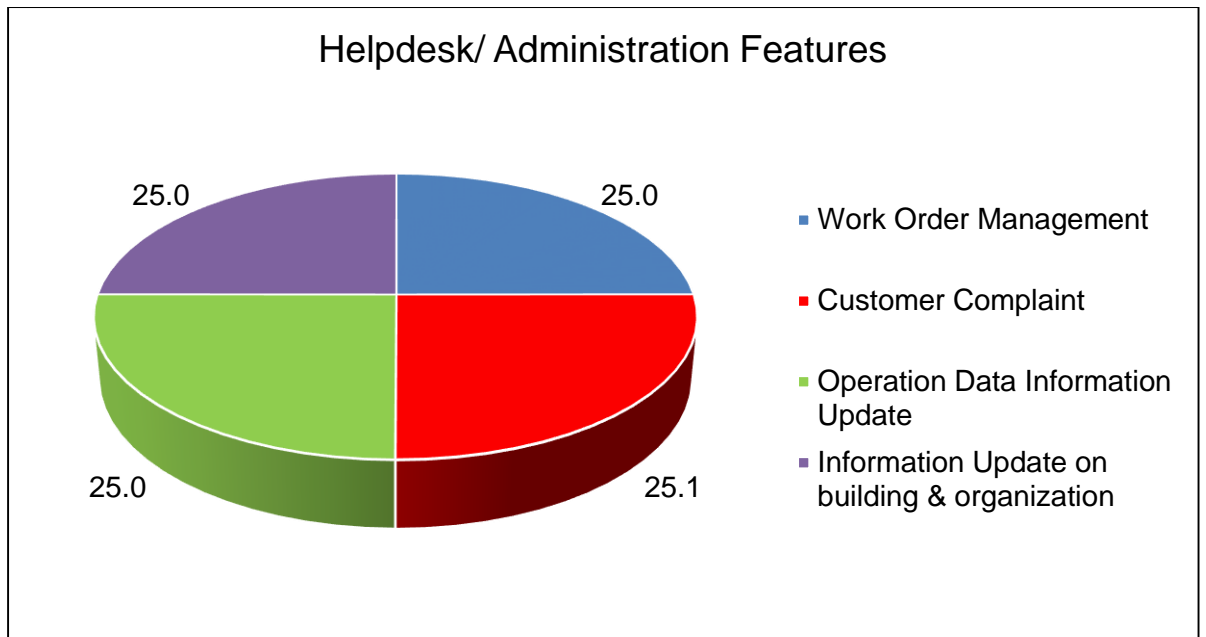


Figure 5.2.2 (c) Percentage of Helpdesk/ Administration Feature in Information Technology Application

Figure 5.2.2 (c) above show the result of Helpdesk/ Administration Feature percentage in the questionnaire. The findings show there are three features scored the same percentage of 25%. The features are Work Order Management, Operation Data Information Update and Information Update on Building and Organization. The highest percentage score by Customer Complaint feature with percentage of 25.1%. All things considered by researcher from the result, these features score relatedly similar percentage because of all the employees have the accessibility to the features.

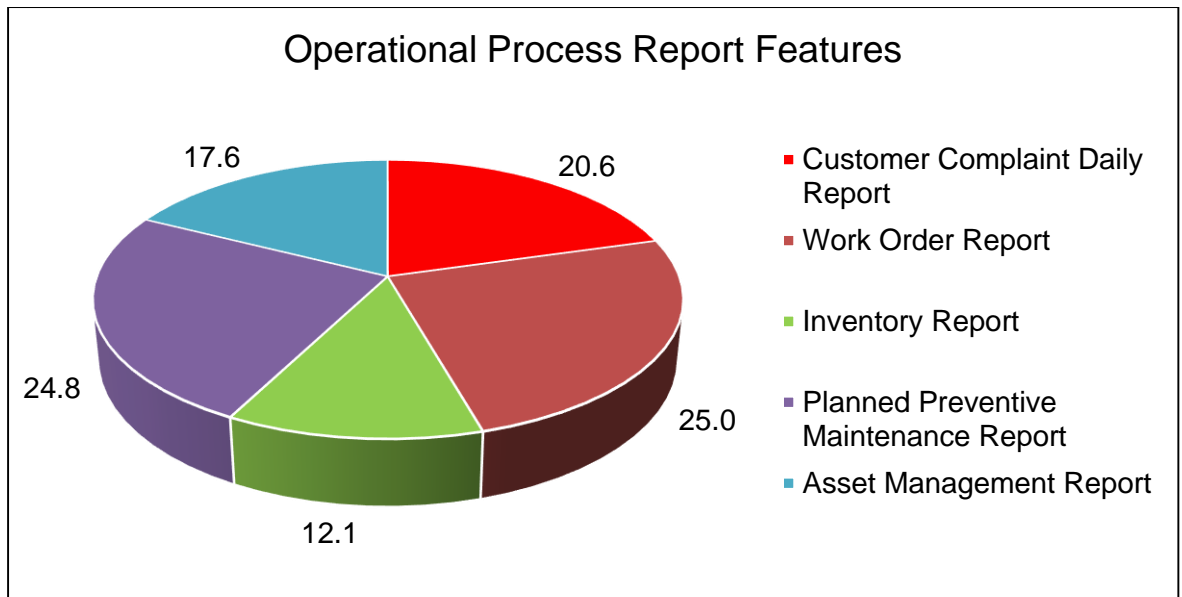


Figure 5.2.2 (d) Percentage of Operational Process Report Feature in Information Technology Application

For Operational Process Report feature the findings are as shown in the Figure 5.2.2 (d) and it shows that Work Order Report feature have the highest percentage of 25%. Follows by 24.8% of Planned Preventive Maintenance Report and 20.6% of Customer Complaint Daily Report. 17.6% is score by Asset Management Report and the lowest percentage is scored by Inventory Report feature with percentage of 12.1%.

5.2.3 DATA ANALYSIS FOR OBJECTIVE 2

This section aims to identify the effectiveness of the Information Technology application in Facilities Management industry. The data obtained were quantitative and the data were analysed using SPSS software. The instrument used to obtain the data was to disseminate survey forms to selected respondents. The findings obtained from this first objective are also used as a support tool to get more specific answers for the second objective.

Table 5.2.3 (a) Percentage Score for Computer Aided Facilities Management (CAFM) version for smartphone application

Item	Nominal Scale	Frequency Sample size (N) = 155
Does the Computer Aided Facilities Management (CAFM) have version for smartphone application?	Yes	31
	No	124

For Objective Two, respondents first were asked about the version of Computer Aided Facilities Management (CAFM) whether the system has a smartphone application version or not and it shows that only 31 respondents responded to Yes and 124 responded to No. 20% score by Yes shows that only one organisation have move forward into another level of Information Technology application in their organisation. Meanwhile the other 80% responded No for the question shows the researcher that many other organisation is still not yet implement the

smartphone application for some reasons that will be discussed in the interview section data analysis.

Table 5.2.3 (b) Percentage Score for Effectiveness of the Information Technology Application in Facilities Management Industry

No	Item	Likert Scale Score Percentage (%)			
		Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4
1	Accessible level of the Computer Aided Facilities Management (CAFM) system through computer	0.0	0.0	24.5	75.5
2	Accessible level of the Computer Aided Facilities Management (CAFM) system through smartphone	14.8	5.2	39.4	40.6
3	Intuitive interface of Computer Aided Facilities Management (CAFM) system	0.0	0.0	50.3	49.7
4	The needs of Computer Aided Facilities Management (CAFM) system towards high speed internet	0.6	0.0	40.0	59.4
5	Capability of the system to provide latest information and report	0.0	0.0	56.1	43.9
6	Accessibility of old data when the system is updated into new version	0.0	0.6	72.9	26.5
7	Problems face by user when using the system such as missing and outdated data.	15.5	42.6	36.8	5.2

8	Needs of user training to ensure employee gets proper knowledge and skill about the system.	0.0	0.0	11.6	88.4
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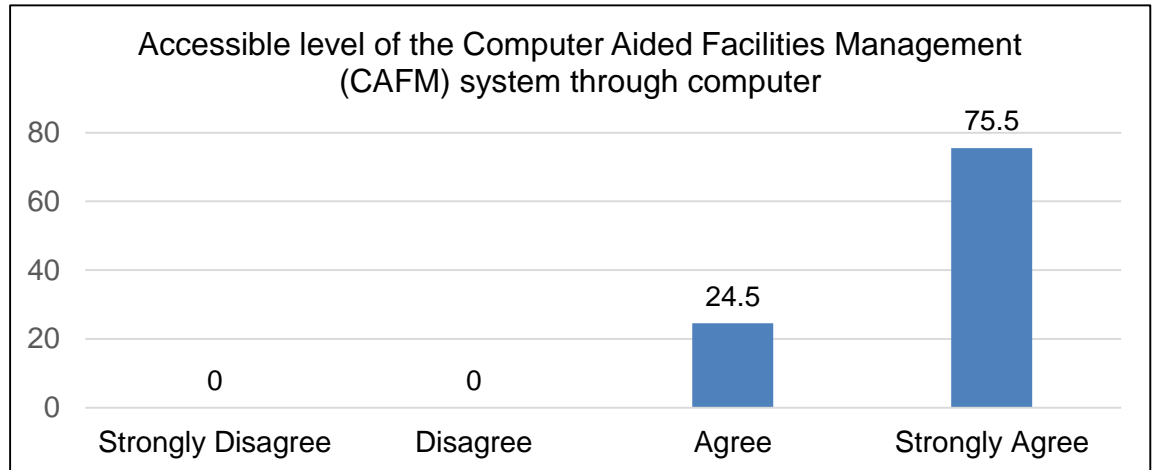


Figure 5.2.3 (a) Percentage of Accessible level of the Computer Aided Facilities Management (CAFM) system through computer

For the Accessible level of the Computer Aided Facilities Management (CAFM) system through computer, the mean score is 3.75. The highest likert scale percentage of 75.5% indicates that respondents strongly agree that they can use the existing system easily and convenience through computers. While 24.5% of respondents agreed that this system is easy to access using a computer.

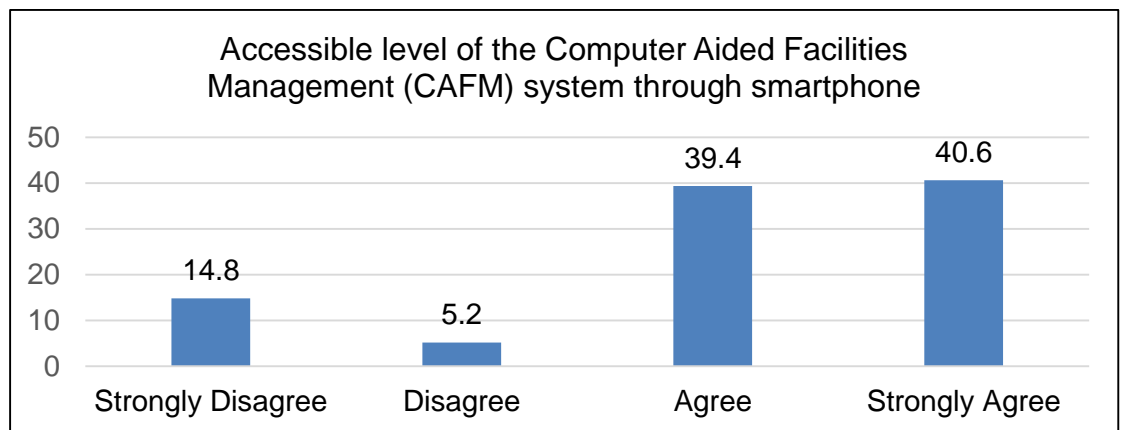


Figure 5.2.3 (b) Percentage of Accessible level of the Computer Aided Facilities Management (CAFM) system through smartphone

Next, for the Accessible level of the Computer Aided Facilities Management (CAFM) system through smartphone, the respondents were asked to find out if this system is easily accessible through a smartphone. The mean score for this question is 3.06. A total of 40.6% strongly agree that this system is easily accessible and used via a smartphone. While the lowest likert scale percentage recorded 14.8% strongly disagree that the system used by the organization is easy to access and use via smartphone.

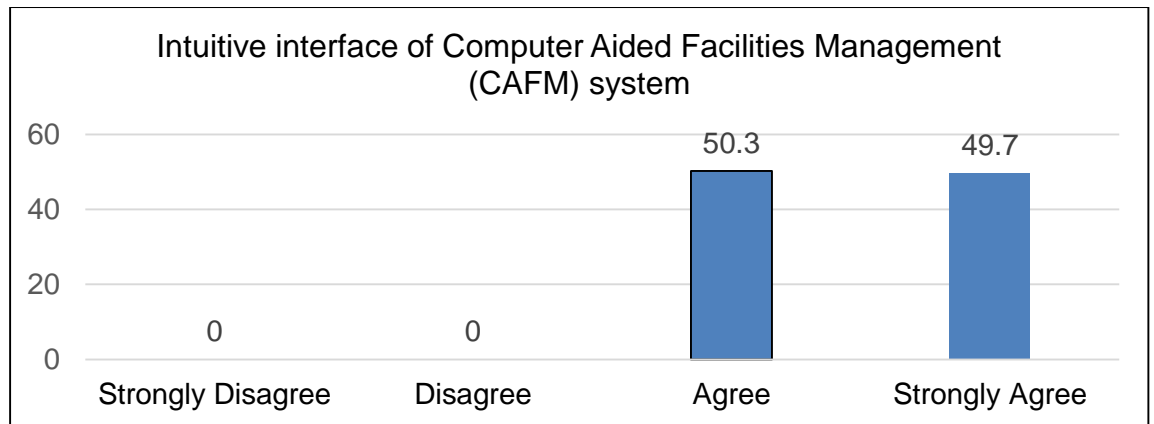


Figure 5.2.3 (c) Percentage of Intuitive interface of Computer Aided Facilities Management (CAFM) system

For this section, respondents were asked if the system used by the organization has an intuitive (user-friendly) interface. As many as 50.3% gave an agreeable response and 49.7% respondents strongly agreed that the system used is a user-friendly system. The mean score obtained for this section is 3.50.

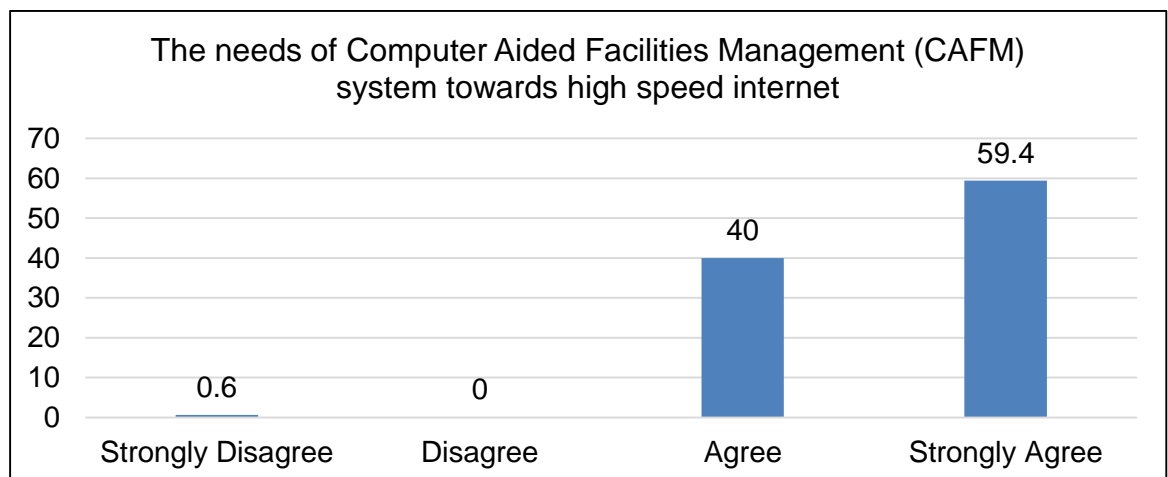


Figure 5.2.3 (d) Percentage of The needs of Computer Aided Facilities Management (CAFM) system towards high speed internet

Next is the respondent asked if the system used requires high internet speed to ensure that the system can operate smoothly and

completely providing the data information needed. The lowest percentage is 0.6% who say they strongly disagree that this system requires high internet speed to use this system. Meanwhile, 59.4% strongly agree that the system used by their organization requires high internet speed to operate properly. The mean score obtained for this section is 3.58.

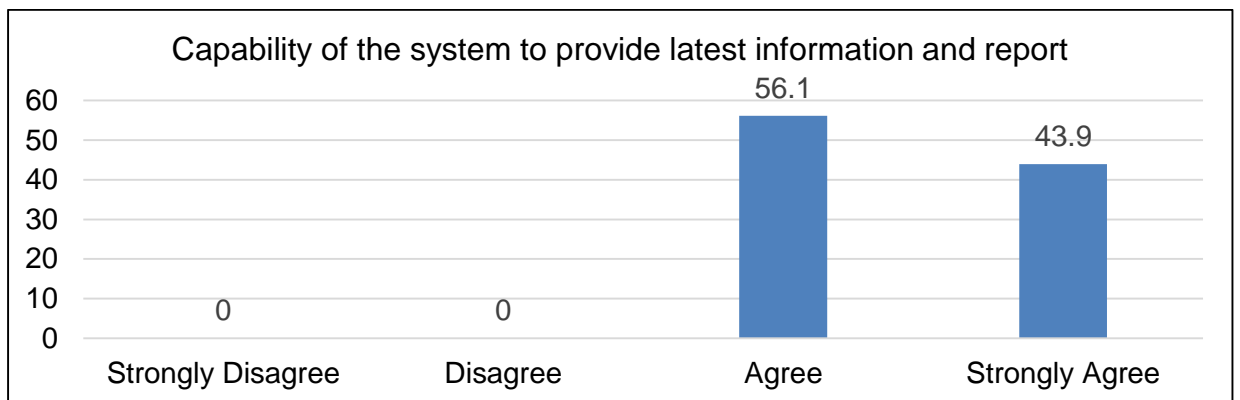


Figure 5.2.3 (e) Percentage of Capability of the system to provide latest information and report

Respondents also answered question about the system's ability to provide the latest information and reports. The mean score obtained is 3.44. The highest percentage is 56.1% where respondents agree that this system can provide the latest information and reports. Meanwhile, respondents who voted strongly agreed as much as 43.9%. From the findings researcher can conclude that the system is always up-to-date.

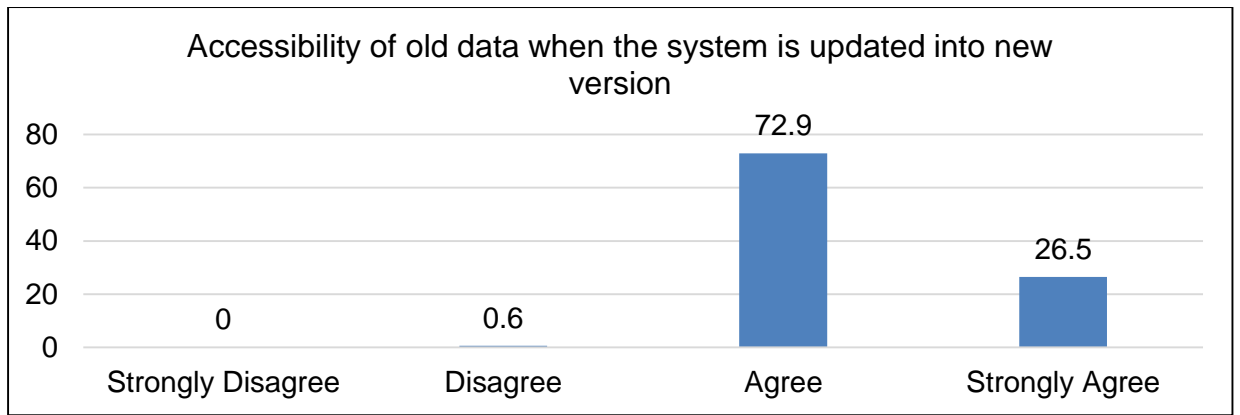


Figure 5.2.3 (f) Percentage of Accessibility of old data when the system is updated into new version

The next part of the section is whether old data retrieval is available when the system is updated to the new version? A total of 72.9% of agreed responses were received while a total of 26.5% strongly agreed responses were accepted for this view. Based on the above findings, it shows that this system has no problem of data loss when updated to the new version. Mean score for this section is 3.26.

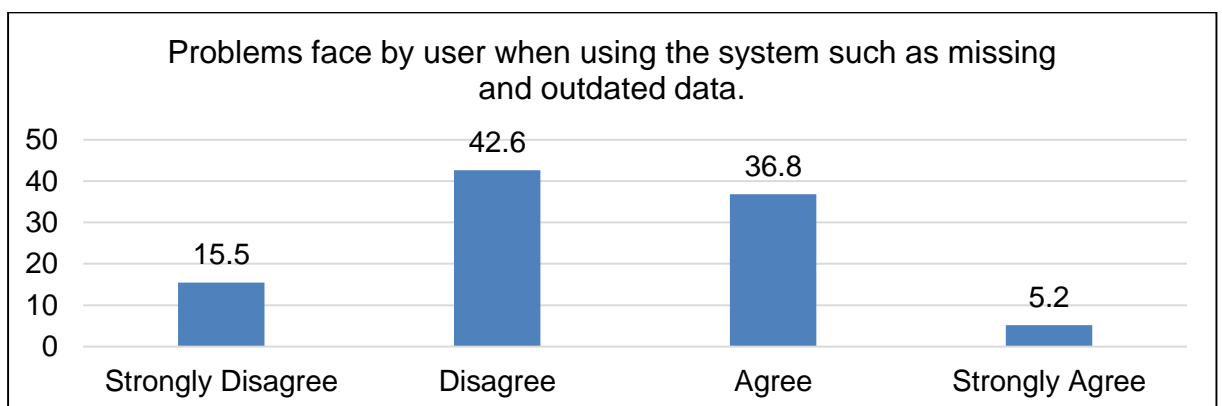


Figure 5.2.3 (g) Percentage of Problems face by user when using the system such as missing and outdated data.

The next part that is asked to the respondents in the questionnaire is whether the respondents have experienced problems such as data loss or irrelevant data when using this system. The highest percentage is 42.6% where respondents do not agree that they have experienced problems as stated when using the system and the lowest percentage is 5.2% where respondents strongly agree that they have experienced problems when using the system. Mean score is 2.32 for this finding.

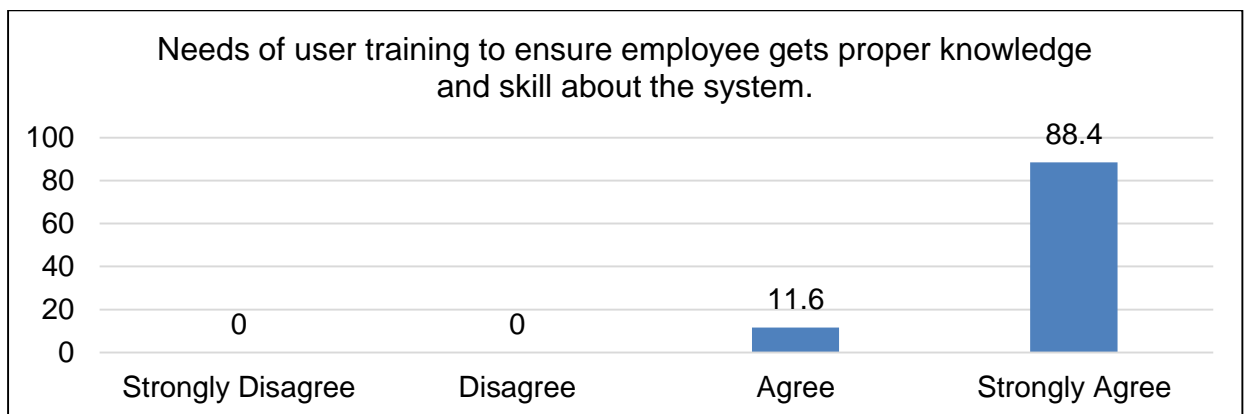


Figure 5.2.3 (h) Percentage of Needs of user training to ensure employee gets proper knowledge and skill about the system.

The last part for Section B is about the need for user training on how to use this system to ensure that employees can use the system comprehensively and practically. A total of 88.4% of respondents voted strongly agree with the importance of user training and as many as 11.6% agreed on this matter. This division got a mean score of 3.88

5.2.4 DATA ANALYSIS FOR OBJECTIVE 3

This section aims to suggest improvement toward implementation of Information Technology in Facilities Management industry. The content analysis approach used to accomplish the third objective using the results of the analysis described in the conclusions of the first and second objective studies. The data obtained were quantitative and the data were analysed using SPSS software. The instrument used to obtain the data was to disseminate survey forms to selected respondents.

The findings for this section is made to suggest improvement toward implementation of Information Technology in Facilities Management industry. The data is gained from the respondent from six different organization that had been selected by the researcher.

Table 5.2.4 Mean of Improvement toward implementation of Information
Technology in Facilities Management industry

NO	ITEM	DETAILS	MEAN
1	D1	Needs of Computer Aided Facilities Management (CAFM) system application in smartphone	3.84
2	D2	Combination of other management feature such Human Resources Management in the Computer Aided Facilities Management (CAFM) system	3.45
3	D3	Offline accessibility of Computer Aided Facilities Management (CAFM) system	3.55
4	D4	Importance of user training	3.86
5	D5	Student accessibility to use Computer Aided Facilities Management (CAFM) system for learning purpose	3.57
TOTAL MEAN			18.27

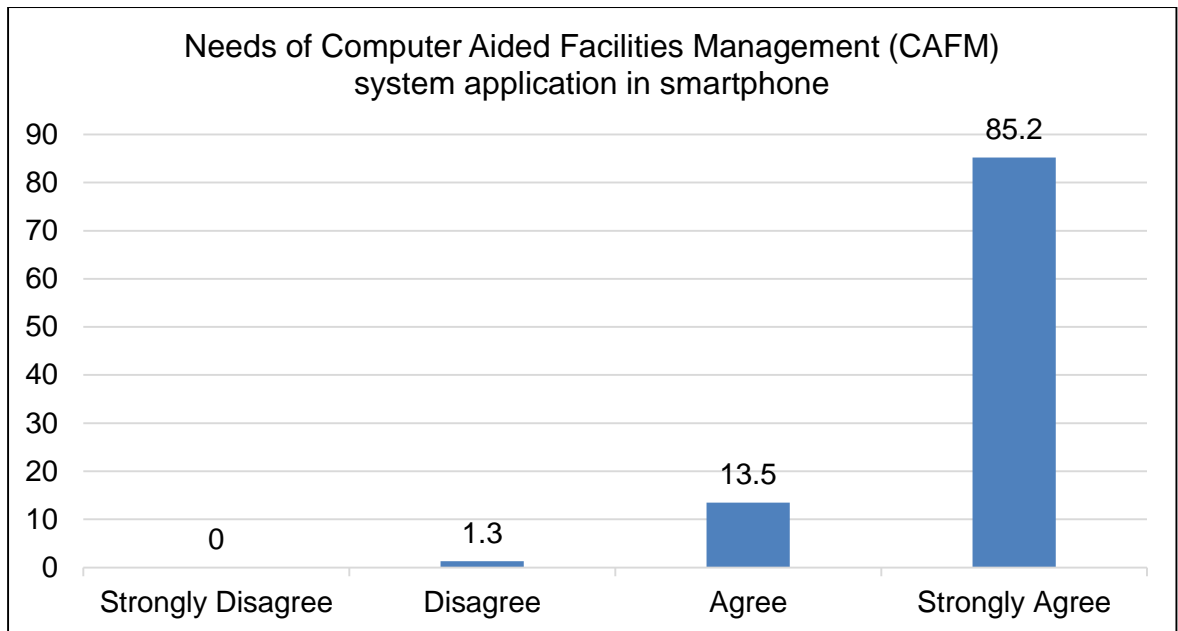


Figure 5.2.4 (a) Percentage of Needs of Computer Aided Facilities Management (CAFM) system application in smartphone

The first Section C, respondents were asked if they agreed if this system needs a smartphone application version. As many as 85.2% strongly agree that this system should be built with a smartphone version of the application. While 13.5% agreed and respondents who disagreed were 1.3%. Mean score is 3.84

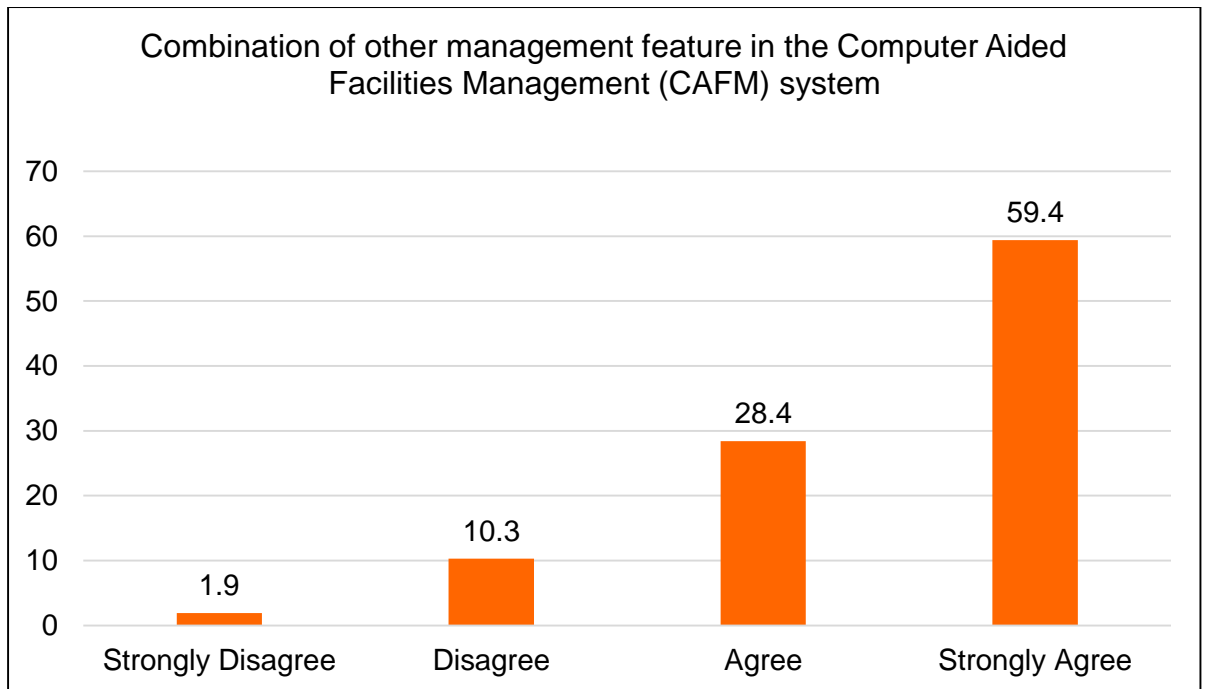


Figure 5.2.4 (b) Percentage of Combination of other management feature in the Computer Aided Facilities Management (CAFM) system

Next, respondent is asked about the combination of other management feature in the Computer Aided Facilities Management (CAFM) system. Other management features are like Human Resource Management feature and Financial Management feature. 59.4% of respondents are strongly agree with the idea while 28.4% respondents agree. Meanwhile, 10.3% respondents are disagree with the idea and 1.9% responded to strongly disagree to combine other management feature in the same system built. The mean score for this finding is 3.45.

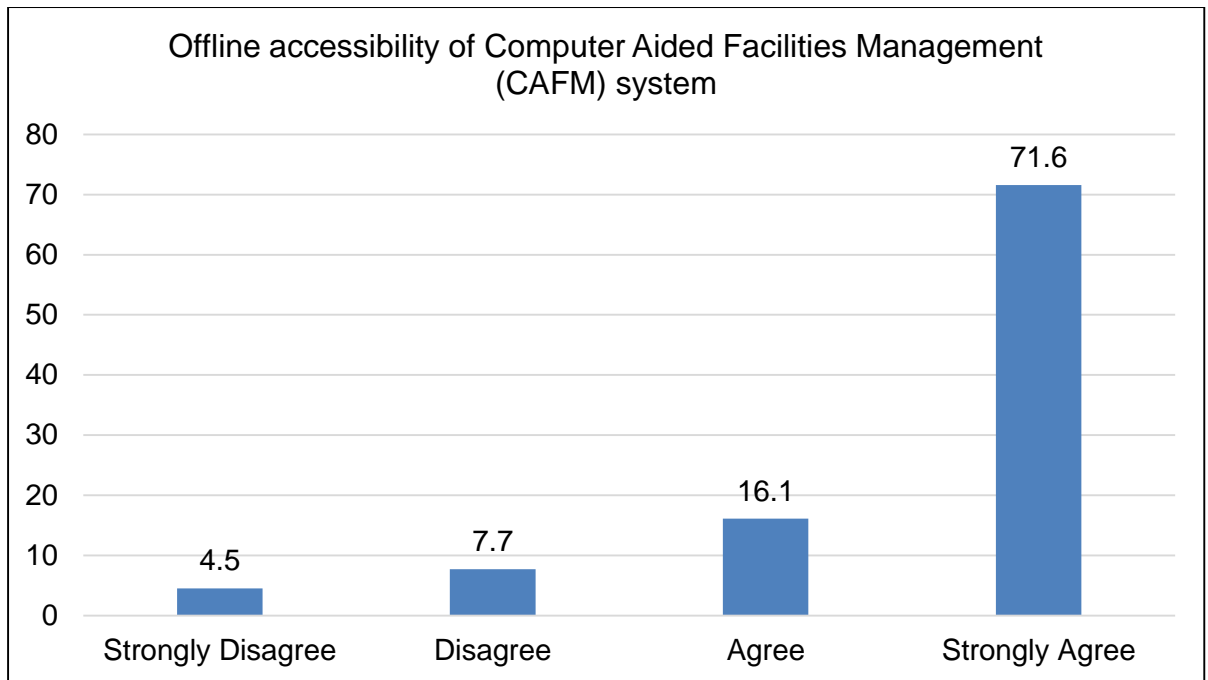


Figure 5.2.4 (c) Percentage of Offline accessibility of Computer Aided Facilities Management (CAFM) system

Third item for this section is question about offline accessibility of Computer Aided Facilities Management (CAFM) system. 71.6% of respondent strongly agree and 16.1% is agree for the system to be built with offline accessibility. Meanwhile, there are 7.7% respondent disagree and 4.5% from the sample size strongly disagree for the system to be offline accessible. The mean score for this item is 3.55

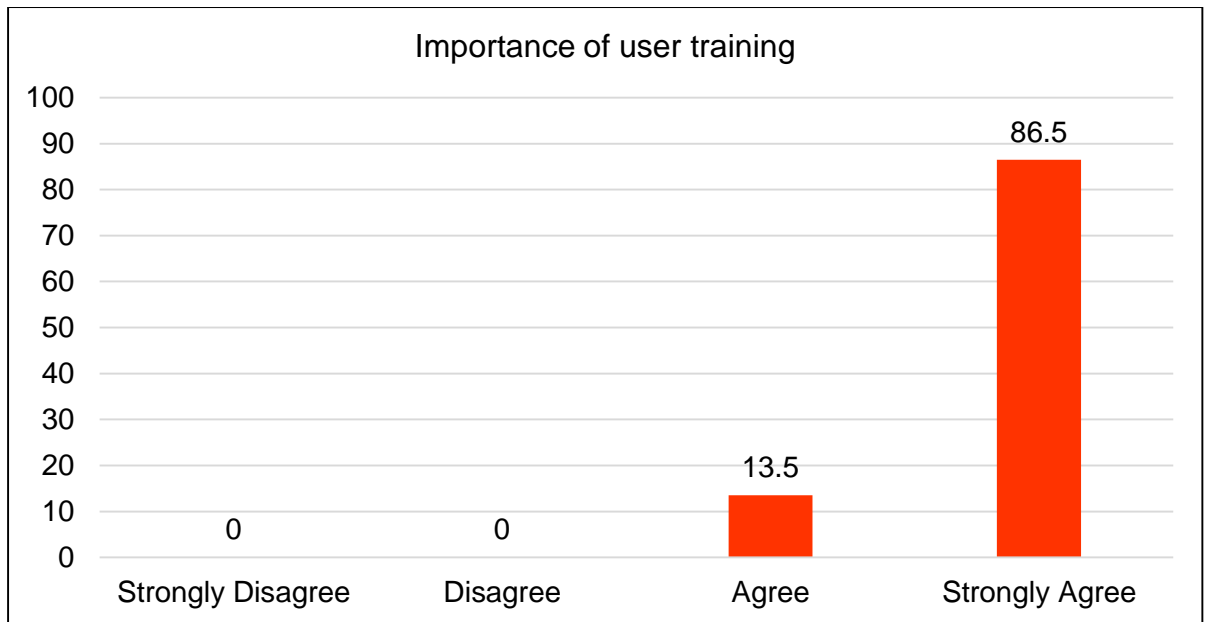


Figure 5.2.4 (d) Percentage of Importance of user training

The fourth item in Section D is the importance of user training. The mean score of this item is 3.86. 86.5% of the findings show that respondents are strongly agree about the importance of user training to be provided to the employees and 13.5% of respondents are agree too.

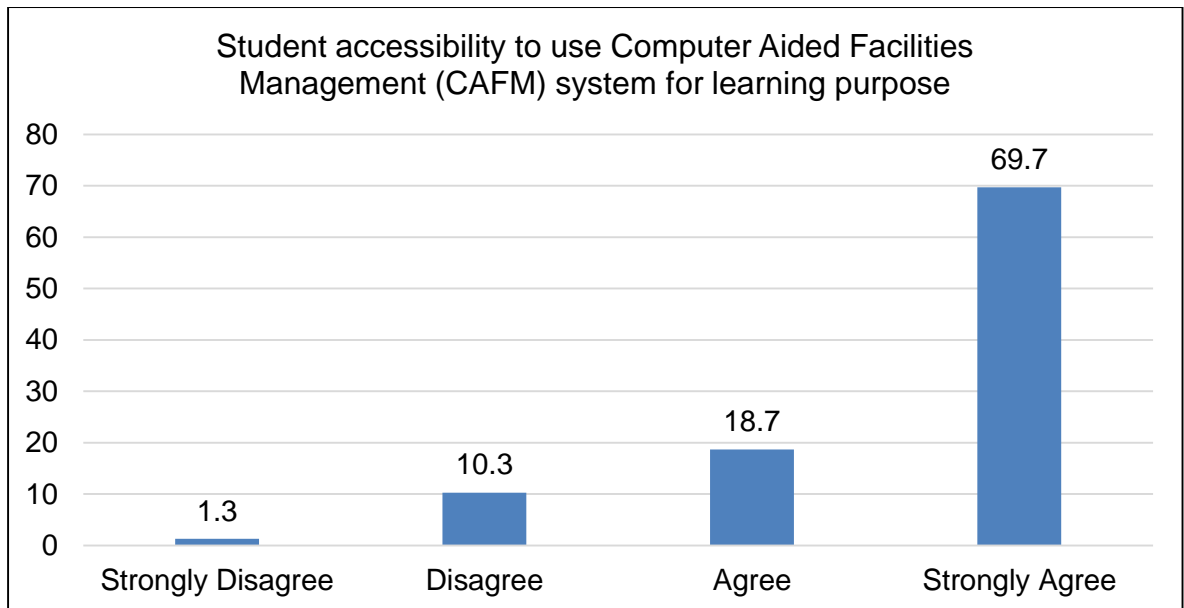


Figure 5.2.4 (e) Percentage of Student accessibility to use Computer Aided Facilities Management (CAFM) system for learning purpose

Next, respondent is asked about the student accessibility to use Computer Aided Facilities Management (CAFM) system for learning purpose. 1.3% of respondents are strongly disagree with the suggestion and 10.3% respondents are disagree. Meanwhile, 18.7% respondent are agree with the suggestion and 69.7% responded to strongly agree to give the student accessibility to use Computer Aided Facilities Management (CAFM) system for learning purpose. Mean score for this item is 3.57.

5.3 INTERVIEW

Interview session is done for the researcher to gain better understanding on the issues that is search to answer the three research questions of the research. It is also a method to explore the respondent's opinions, experiences and about the study.

Table 5.3 Interviewee Opinion and View about the Research

No	Interview Question	Interviewee	Interviewee Opinion and View
1	<p>In a survey session involving 155 respondent, they had responded to the question regarding features in Information Technology application that is used in the organization operation.</p> <p>From the survey result, there is some information that is lack in the application. Some of it is:</p> <ul style="list-style-type: none"> d) Occupancy of Room/Area e) Status of Room/Area f) Human Resources features <p>In your view, will the combination of management and operational features in one application can make the working process manageable and smooth?</p>	A	<p>Interviewee agreed that the combination of both aspects is an excellent idea. However, these two features are divided in the organization to facilitate management in the analysis of employee and job related data.</p> <p>The operating system currently in use is for their branch site only. Meanwhile, the system for Human Resources Management is used for all sites under the company. So it is convenient to separate both features.</p>
		B	<p>The interviewee does not agree to combine many features in one system because it will make the system too crowded and heavy for the server to accommodate.</p>

		C	<p>The interviewee mentioned that currently the system upgrading process is still in R&D stage. The target is to add in the 360° view of the area in the building which means the user of the system can view the room just like the actual view when they in the room. This process takes time to be generate in the system as they need to upgrade the server in order to avoid the system from crash. The interviewee also added that, every company will find ways to upgrade their tools, equipment or system that is consider as their asset but everything need to be done in proper ways and good planning should be propose for a long run.</p> <p>Combining both operational system together with other management features are good idea but everything go back to good planning and financial of the company.</p>
		D	<p>Interviewee said that to maintain data security, it is better if features involving Human Resources</p>

			<p>Management are isolated rather than merged with the other operational features. This is because for the company's system, subcontractor and vendors can access the system for work purposes. If these two features are combined, it is feared that the company's internal information data will leak to the vendor. Undoubtedly, the combination of these two features will make it easier for employees. But data security is the main concern of the company.</p>
2	<p>Moving forward IR 4.0 that requires establish and high speed internet connection, how does your organization overcome issue related to poor internet connection that affect Information Technology application effectiveness during the operation process?</p>	A	<p>So far, interviewee's team have never had issues about poor internet access in this building that affects the operational work. The interviewee claims that it is also very important to emphasize networking installation issues during pre-design stage because it involves building and installation of cable networks such as fiber optics and so on. When modifications or adjustments have to be made after completion of the building and the equipment, a certain amount of expenses may be involved in the process. The</p>

			<p>cost may be higher than the previous build or deployment costs.</p>
		<p>B</p>	<p>Although once in a while there is a signal network interruption due to weather factors but the organization does not suffer from severe network interference because the building is located in the middle of a strategic city and has a stable and strong signal network. However, if this problem occurs, the team will work manually while waiting for the weather to return to normal.</p>
		<p>C</p>	<p>The government readiness for development of 5G internet speed all over Malaysia is one of the reason why the current internet speed is not very satisfied at certain area or region. For this organisation, to overcome this issue, company will provide the employees with private Wi-Fi and WLAN in the office and building. This way, the employees do not have to share the connection publicly with other occupant in the building.</p>

		D	<p>This site had been in the situation whereby the internet connection signal is poor and unstable. This issue not only disturbed the operational process, but also management process. The solution had been done is that, more internet booster devices are installed in the building, especially at the spot where the signal and network is weak and unstable.</p> <p>Currently, the management team is proposing to change the telecommunication company service. This is to ensure the telecommunication service receive worth the price the organisation pay</p>
3	69 over 155 respondents responded that, when using the application, they had face issues such as irrelevant and outdated data. In your opinion, why does this happens and what is the solution?	A	IT Engineer should be aware and prepare to handle the system during peak hour time to avoid system to be down or crash
		B	Interviewee said that, one of the reason that the issue happened is because of human error. Everything that we see in the

			<p>system is key in or set up by a human, so there is potential the data is not completed or inaccurate.</p> <p>Therefore, to prevent this from happening, every employee should always keep on updating the latest information to the IT team so that they can update the data information in the system.</p>
		C	<p>According to interviewee, human should never rely on Information Technology system because problem like this do happen. Sometimes, it's happen due to server crash or the system is crash due to heavy traffic. The simplest solution that you can do is to always keep the raw file of the data information. For instance, on asset. Every engineer should keep raw file of Asset Listing Report to be used for updating the daily report. Another option would be adding the server capacity. It requires the creation of a fund which may take time before it can be completely exploited.</p>

		D	Interviewee has same point of view as Interview B
4	136 respondents agreed that the Information Technology application should be available offline without the internet. Was it possible to incorporate them in your opinion?	A	Interviewee said that it is impossible to have a system that operates offline because every item updated in the system requires internet to be generated, shared and stored by the users of the system. The lack of internet will result in the work that needs to be done to be disrupted and not updated to the latest information.
		B	<p>The needs of internet is very critical in the interviewee's view. This is to ensure that the program used will function comprehensively. Any piece of information that needs updating, searching or sharing requires secure Internet connection. Information such as work order instructions from users also requires internet to be shared with the staff involved.</p> <p>So if a program were to be built without the internet, that is like</p>

			<p>having the traditional information technology software application like Microsoft Office Word and Microsoft Office Excel, which is only beneficial to one person because it cannot be shared with other people at the same time so there is no reason for the organization to spend capital to produce a system that cannot do more than that.</p>
		C	<p>Moving towards IR 4.0 it is impossible for the organization not to use the internet. The interviewee stated that most of the work need the internet to be proceed and operate smoothly especially in terms of management stage. Sharing information to all level of employees need internet connection so that it can be spreads faster and accurate. It also saves time and energy. Thus, to not use the internet facilities is such a wrong decision since it helps the operational process a lot.</p>
		D	

			Interviewee D stated that it is not possible to have a hybrid accessibility of a system, whereby user can access system both in offline and online ways. It is just the organization need to specifically decide which part of the system should be available offline and online. For example, reports that do not need to be updated daily. Reports like this may be accessible offline because the data is not crucial.
5	User training not only provides insight and knowledge about the Information Technology application but can also increase the employee's technical skills. What are the obstacles to the workers being provided with adequate training?	A	In the viewpoint of the interviewee, the company must still provide coaching irrespective of the challenges. The problem is whether the workers can implement what they have been trained and told in their training with the company. But, as a result of cost considerations and the lack of credentials, interviewees did not dispute that there are organizations that cannot offer training as they should.
		B	Every training that needs to be attended by the employee involve cost such as fees, transportation

			<p>and accommodation cost. Interviewee stated that is the biggest barrier to make it accomplish. Moreover, some of the training take certain duration of time to be completed. For instance, it takes one week to complete a safety certificate by DOSH. So during the absence of staff that is sent for training, replacement staff should be available at the site in order to perform the work of the staff who are undergoing the training. Often, short of manpower can also be the barrier from the organization to send the employee for training.</p>
		C	<p>Interviewee C point of view is the same with Interviewee B whereby he agrees that cost is the main issue.</p>
		D	<p>Interviewees mentioned that one of the biggest challenge to organize a training is to coordinate with everyone's schedule but this can be overcome by planning the training earlier than it supposed to be conducted.</p>

6	<p>Only 1 out of 6 organizations involved in the survey session has a smartphone version for their application in Information Technology. Application for smartphone versions is essential in Industrial Revolution 4.0, which emphasizes the use of digitalization information exchange. Does your organization have any plans regarding this issue?</p>	A	<p>Interviewee mentioned that currently the organization is review the contract since the client side request for the team to develop the smartphone application. Why they need to review the contract again? This is because before this there is no part in the contract mentioned about smartphone version for the system. So if they want to develop or create it, additional fund is needed for the project. Thus, it need proper planning of it.</p>
		B	<p>Interviewee said that smartphone application requires more effort in term of manpower, skills, knowledge and most importantly, cost. The costing is not only involved in the stage of designing, developing and building the application but also the after use of the application. Maintaining the application also requires cost that needed to be paid to the related parties such as Google. So far, the main barrier to develop their own smartphone application version for</p>

			the system is the cost that the organisation need to be spent.
		C	For a time being, there is no planning own developing smartphone application for the system. It is just upgrading the current system into better version with additional features that will help in operational work process for the business.
		D	From interviewee view, smartphone application is very convenient to be used in the operational and management works. In order to generate it, which involve amount of cost, their team have to submit proposal to their headquarters. Client also have requested for them to upgrade the system but it is still in discussion since the process involve cost and skilled employees to monitor the apps.

5.4 SUMMARY

In conclusion, it was clearly explained and interpreted via the questionnaire method, based on the study findings obtained by the researcher. Using SPSS, all data is stored and analysed. Tables and diagrams made using Microsoft Word and Microsoft Excel are used to explain the findings of this analysis. Estimates, percentages and comparisons of mean scores were made as standard. From the findings, researcher able to find the answer for all three research questions and objectives of the study.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 INTRODUCTION

Based on data analysis in the previous chapter, researcher will discuss the findings and draw conclusion related to the study that had been conducted. This chapter will focus on translating limitation, conclusions, implication and recommendation as a whole. Additionally, researcher also include some suggestion that could be useful for new studies related to best approach to implementation of Information Technology application in Facilities Management in Malaysia.

6.2 SUMMARY FINDING FOR RESEARCH QUESTION

6.2.1 Research Question One

The first question for this study is to know the type of Information Technology application in Facilities Management industry. Researcher has listed features that involve scope in Facilities Management and asked respondents to mark in the section involved. Through the answers that have been received, the researcher can find out what features are actually set in their respective systems. Each system set features according to the scope in Facilities Management as recommended. However, after reviewing the findings from the questionnaire, for the researcher, there are some improvements that can be done to further enhance the maximum capacity of Information Technology in Facilities

Management as recommended by organizations such as the British Institute of Facilities Management (BIFM) and the International Facility Management Association (IFMA)

6.2.2 Research Question Two

To answer second research question, effectiveness of the Information Technology application in Facilities Management industry, the findings is gained from the questionnaire distributed to the respective respondents. Respondent agree that the current Information Technology application system that is been using by the organisation is quite effective but it is suggested for both employees and business owner to increase their knowledge on the topic Information Technology in Facilities Management so that they will have the insight of the importance of the effectiveness of the Information Technology application in Facilities Management industry in Malaysia. Once they have the knowledge of the topic, the effectiveness of the Information Technology application can be improve.

6.2.3 Research Question Three

The findings for third research question for this study indicated ideas to improve the level of application in Information Technology aspects toward implementation of Information Technology in Facilities Management. Research question three is how to improve the implementation of Information Technology application in Facilities Management, whereby researcher needs to find out is there any applicable method to improve the issues. Questions like the needs for the system to have smartphone application

6.3 IMPLICATION OF RESEARCH

From the findings, researcher has suggested that the features and scope that should be included in the Information Technology application in Facilities Management. Organizations that use Information Technology application in Facilities Management in work operations should be willing to make improvements as suggested in this study.

6.4 LIMITATION OF RESEARCH

This study did not examine Information Technology application system that is being using for operational work. For instance, Building Automation System (BAS) or also known as Building Management System (BMS). Besides that, during the data collection process, researcher and worldwide citizen facing a global pandemic, Covid-19. The pandemic has cause global issues such as Movement Control Order (MCO) and lockdown as restricted the government. MCO has been causing difficulties for the researcher to gain data especially for interview session, whereby the respondents are reluctant to meet the researcher in person to avoid contact during the pandemic.

6.5 RECOMMENDATION AND SCOPE FOR FURTHER STUDY

From the results of the questionnaire and interview session, the researcher identified few recommendations that is applicable to any organization in this field of Facilities Management.

6.5.1 Recommendation

- i. The organization's readiness to encounter and embrace improvements to the application of Information Technology
- ii. Organization should allocate capital to implement the best Information Technology application for business use

6.5.2 Scope for Further Study

It is recommended for the future study that the researcher can focus on the barriers that prevents Facilities Management organizations in Malaysia to provide the best Information Technology application system compares to European countries that have pioneered the Facilities Management industry.

6.6 SUMMARY

To be conclude, this chapter discussed the summary of the whole study from beginning to the end, discussions on the main findings, and discussions on the implications and as well recommendations that were suitable for every part in the facility management company.

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SECTION A: Respondent's Demographic

Please answer following question by tick in the box of your selection of answer.

1.1 Highest academic qualification

- SPM
 Certificate
 Diploma
 Degree
 Master
 PhD

1.2 Position in the company:

- Facility Manager
 Engineer
 Technician
 Other (*Please state*):

1.3 Years of working experience

- Less than 5 years
 From 5 to 10 years
 From 11 to 15 years
 More than 15 years

1.4 Which industry are you employed?

- Healthcare
 Manufacturing
 Commercial
 Education
 Other (*Please state*):

1.5 Does you able to access Computer Aided Facilities Management (CAFM) system in the organization?

- Yes
(Please proceed to next sections)
 No

1.6 Please select the name of Computer Aided Facilities Management (CAFM) use in the organization

- ARCHIBUS
 CAMSIS
 CMMS
 CWORK
 GEMS
 NIAGARA

SECTION B: Feature in Information Technology Application in Facilities Management

Please answer following question by tick on features found in the computing system - Computer Aided Facilities Management (CAFM) used in your organization working by category. You can select more than one (1) answer for each category.

Asset Management

- Asset Registration
- Asset Statutory & License
- Asset Status & Placement
- Asset Maintenance
- Asset Disposal (Beyond Economic Repair)
- Inventory & Store Management

Space Management

- Drawing Plan
- Location Code
- Space Usage Status
- Occupancy Number Status

Helpdesk/ Administration

- Work Order Management
- Customer Complaint
- Operation Data Information Update
- Information Update on Building & Organization

Operational Process Report

- Customer Complaint Report
- Work Order Report
- Inventory Report
- Planned Preventive Maintenance Report
- Asset Management Report

SECTION C: Effectiveness of Information Technology in Facilities Management

Please indicate your opinion to the following statements by tick (√) at the scale box based on your experiences and knowledge.

Strongly Disagree	Disagree	Agree	Strongly Agree
1	2	3	4

	SECTION C : Effectiveness of Information Technology in Facilities Management	Scale			
		1	2	3	4
C1	Does the system accessible through computer?				
C2	Does the system accessible through phone?				
C3	Does the system has an intuitive interface (user friendly)?				
C4	Do you need high speed internet to use this system?				
C5	Does the system able to provide latest information and report?				
C6	Does retrieval of data is available whenever the system is updated into new version?				
C7	Have you experienced any problem while using the system such as missing data and outdated data?				
C8	Do you agree that training courses (user training) on how to use this system should be conducted periodically to ensure that employees can use the system comprehensively and practically?				

SECTION D: Improvement for Information Technology Application in the Facility Management Industry

Please indicate your opinion to the following statements by tick (✓) at the scale box based on your experiences and knowledge.

Strongly Disagree	Disagree	Agree	Strongly Agree
1	2	3	4

	SECTION D: Improvement for Information Technology Application in the Facility Management Industry	Scale			
		1	2	3	4
D1	Do you agree that this system needs to have a version of the smartphone app?				
D2	Do you agree that the system created should combine overall operations and management features such as Human Resource (HR) & Financial Management features?				
D3	Do you agree that this system should have the ability to be accessed without using the internet (offline)?				
D4	Do you agree that user training courses using the system conducted by the company can help employees use this system in a more accurate and practical way?				
D5	Do you agree if students in the field of engineering & facilities management such as students from the Bachelor of Facilities Management can access this system for learning purposes?				

Questionnaire Form

No.	Question	Objective to be achieved
1	<p>In a survey session involving 155 respondent, they had responded to the question regarding features in Information Technology application that is used in the organization operation.</p> <p>From the survey result, there is some information that is lack in the application.</p> <p>Some of it is:</p> <ul style="list-style-type: none"> g) Occupancy of Room/Area h) Status of Room/Area i) Human Resources features <p>In your view, will the combination of management and operational features in one application can make the working process manageable and smooth?</p>	Objective 1
2	<p>Moving forward IR 4.0 that requires establish and high speed internet connection, how does your organization overcome issue related to poor internet connection that affect Information Technology application effectiveness during the operation process?</p>	Objective 2
3	<p>69 over 155 respondents responded that, when using the application, they had face issues such as irrelevant and outdated data.</p>	Objective 2

	In your opinion, why does this happens and what is the solution?	
4	136 respondents agreed that the Information Technology application should be available offline without the internet. Was it possible to incorporate them in your opinion?	Objective 3
5	User training not only provides insight and knowledge about the Information Technology application but can also increase the employee's technical skills. What are the obstacles to the workers being provided with adequate training?	Objective 3
6	Only 1 out of 6 organizations involved in the survey session has a smartphone version for their application in Information Technology. Application for smartphone versions is essential in Industrial Revolution 4.0, which emphasizes the use of digitalization information exchange. Does your organization have any plans regarding this issue?	Objective 3