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Implementation of The Computerized Maintenance Management System (CMMS) In Government Hospital Facility Management Services (FMS)

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Abstract: Facility Management Services (FMS) is one of the Hospital Support Services (HSS) available in the government hospitals. There are three private companies located in Peninsular Malaysia were granted with the concessions by the Ministry of Health (MoH) to manage FMS in the government hospitals. As dictated in the Concession Agreement (CA), these companies need to established new Management Information System (MIS) which called Asset & Services Information System (ASIS) as their Computerized Maintenance Management System (CMMS). This paper discusses the implementation of the CMMS in government hospital FMS. The purpose of this study is to identify the CMMS designation used by FM staffs in government hospital FMS and to determine the effectiveness and the challenges of the implementation of this system. There are 150 set of online survey were distributed to the all staffs whom also the CMMS users in the 3 HSS providers and interview sessions was also conducted. The Cronbach's Alpha test and Descriptive Analysis was conducted in order to measure the reliability of the survey form and to provide essential analysis on the CMMS designation and implementation. The survey proven to be reliable. Also, the Work Order Tracking is the most effective aspect while Concerns about Cyber-Security is the greatest challenge of executing CMMS. These 2 aspects was found highly affected by the CMMS Designation.

Keywords: FMS, CMMS, HSS, Government Hospitals

1. Introduction

The trickiest, expensive and complicated buildings to manage in general are hospitals and medical facilities and, as a result, the management of the facilities should work well to deal with these. Back then, Facility Management (FM) in government hospitals is unstandardized and in unacceptable level of service with the title of public hospitals [1].

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By granting the Concession Agreement (CA) to selected Concession companies, Ministry of Health (MoH) privatized the Hospital Support Services (HSS) in which the companies will provide Facility Management Services (FMS) in the government hospitals in order to give a better FMS service than before.

Currently there are 3 Concession companies granted with the concession agreement located in peninsular Malaysia named Faber Medi-Serve Sdn. Bhd., Radicare (M) Sdn. Bhd. and Medivest Sdn. Bhd. In order to manage numerous maintenance works flawlessly, these companies operate with the aid of the Computerized Maintenance Management System (CMMS).

CMMS work the best to centralize all the important information on the maintenance operations related. Utilizing this CMMS involving recording data, analyzing, calculating and also generating reports. This software consists of quite numbers of module features that will assist in many aspects from planning, management and administrative.

Also referred as Centralized Management Information System (CMIS) few years back where separated CMMS system used by each of the companies before they changed to ASIS (Asset & Services Information System) in 2015. Meanwhile, ASIS serve as centralized CMMS and also a single monitoring system that can be used by all of the concession companies involved that also come in Mobile ASIS version. Thus, optimize the FM service delivery in the government public hospitals.

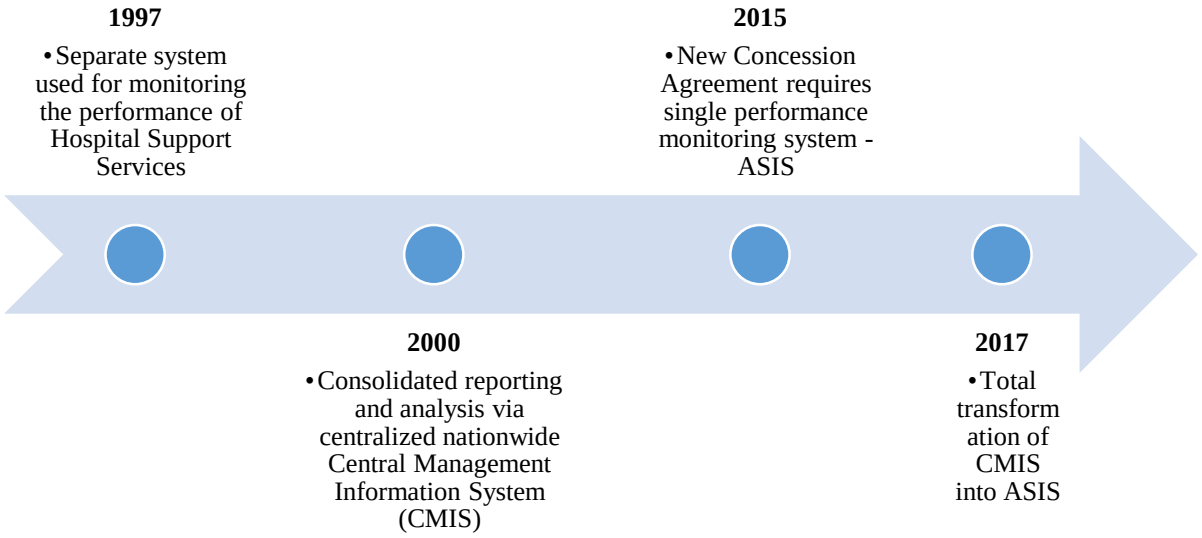

Figure 1: Transformation of CMMS Used by the HSS Providers

1.1 Problem Statement

This paper is all about to know how impactful the effects of the implementation of CMMS in Government Hospital FMS in this modern era in term of its CMMS Designation are. CMMS is very well-known for its benefits to manage work and asset data in facility management but it is also important to know the barriers of the CMMS utilization either for PC CMMS or Mobile CMMS.

1.2 Objectives

The objectives shall be as follows:

i. To identify the CMMS designation used by FM staffs in government hospital FMS.
ii. To determine the effectiveness of the implementation of CMMS in government hospital FMS.
iii. To determine the challenges of the implementation of CMMS in government hospital FMS.

2. Literature Review

For FM companies, the services that they will be providing is non-clinical [2]. To be exact, they are performing non-clinical Hospital Support Services (HSS) that include FM services which will supervise another 5 services under FMS [3].

The services are Facility Engineering Maintenance Services (FEMS), Biomedical Engineering Maintenance Services (BEMS), Cleaning Services (CLS), Linen and Laundry Services (LLS) and also Healthcare Waste Management Services (HWMS) [3].

To smoothen the FMS works, CMMS was introduced to the industry. When using a CMMS, most of companies claim that only 5.00-10.00 % from all of the features available will be used [4]. Thus preventive maintenance, accompanied by asset management, work order management an inventory is the most sought-after CMMS features [5]. There so many features available in the CMMS, thus attract various industries to utilize this technology in their factories or offices.

Vitally, CMMS purposes are to keep the maintenance works operate at an optimum cost. Thus, in order to achieve that, common benefits expected from the software are increase availability of equipment, reduce spare part inventory, reduce emergency work, reduce cost and reduce downtime [9]. By combining the results of CMMS together with the manpower and processes, CMMS become a powerful tool that improve FMS work efficiency.

However, it is not uncommon to have drawback for any technologies including CMMS. Cyber security concern is a real deal when it comes to a system like CMMS. Threats can be in many type of forms such as faulty acts that trying to obtain, damage, corrupt and also destroy valuable data. It is also found that if CMMS was under-used or even misused, it could lead this software to be used as a tool of "Work Order System" only. And the worst could happen is when the FM services delivery become worse because of the staffs that failed to understand and execute CMMS in a proper way initially [6].

3. Methodology

There is flow chart provided below on the strategies and the methods in order to get reliable and sufficient data to be discussed and analyzed. There are actually few methods in order to collect data in this research paper. To achieve the objectives of this research paper, the methodology adopted for this research is divided into two method of data collection. The primary method is questionnaire and also interviews meanwhile the secondary method is literature review form journals and research papers. Then, after primary and the secondary data collected, Reliability Test and Descriptive Analysis was executed by Statistical Package for the Social Sciences (SPSS) software.

Regarding on the questionnaire survey conducted, 150 survey form was distributed in three different Concession companies serving FMS in government hospitals. The respondents for this survey are the FM staffs that utilize CMMS in their job scopes. It can be from the off-site(Managers) and on-site work position (Engineer, Supervisor, Technicians and Others).

The site selected is the Headquarters (HQ) of those three Concession companies mentioned previously named Company A, Company B and Company C. They were chosen because larger range of position of the respondent can be achieved since HQ or Human Resources (HR) Department can have direct access to the CMMS users in their companies. Thus, respondents from high level position such as Manager to low level position can be reached. Also, because of these companies were in-charged to serve HSS in different states all around Malaysia's Peninsular.

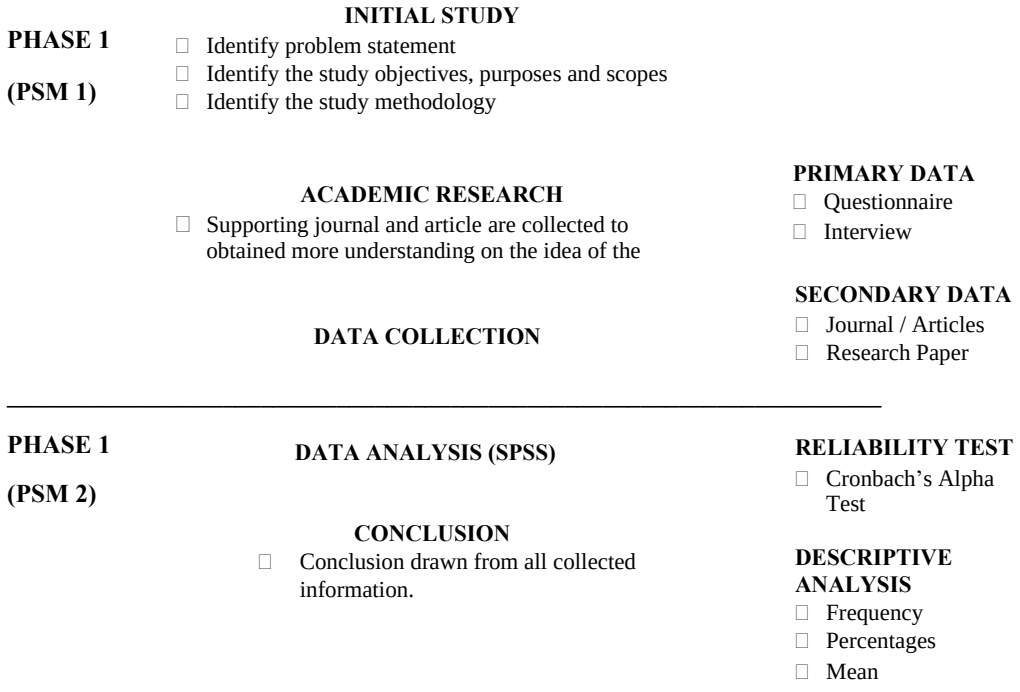

Figure 2: Overall flowchart of this project

4. Results and Discussion

So, from the total number of 150 survey forms distributed, only 39 response received. To have 100.00 % response rate, at least 108 responses need to be received [7]. Thus, with the 39 responses received during the research make the response rate to be 36.00 % which make the data is acceptable and sufficient to be analyze as the response data are more than 30.00 %.

Table 1: Population and sample needed [7]

Population (P)	Sample Needed	
	N	%
150	108	100

Reliability test (Cronbach's Alpha test) was performed on Part C and D in survey. This is because the Cronbach's Alpha will only need to be done on variable that have Likert scale for their answer choices.Both of the parts passed the reliability test where the values of the Cronbach's Alpha for both parts are more than 0.6. The Cronbach's Alpha value obtained Part C and C are 0.895 and 0.707 respectively which also stated GOOD and ACCEPTABLE result based on the rule of thumb [8].

Table 1: Reliability test

PART	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	Internal Consistency
C	.891	.892	6	GOOD
D	.707	.713	6	ACCEPTABLE

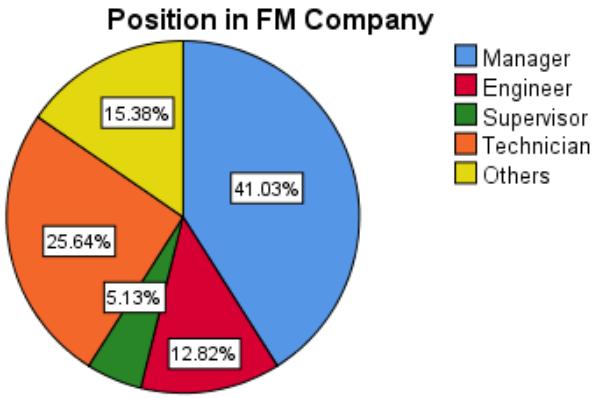

Figure 3: Position in FM Company

For the respondent background, more than half of the responses (58.93 %) received from on-site staff which is the combination of Engineer, Supervisor, Technician and Others position. On-site FM staffs are the individuals that responsible to execute all FMS and the maintenance works directly on the hospital buildings. There are actually more than half of the respondent have 10 years and more experience thus make the result obtained from the survey more reliable.

4.1 CMMS Designation (Part B)

In the online survey form, there are 3 parameters that they can choose. The parameters are PC CMMS, Mobile CMMS and PC & Mobile CMMS. But, only 2 of the parameters were chosen by the respondents except the Mobile CMMS.

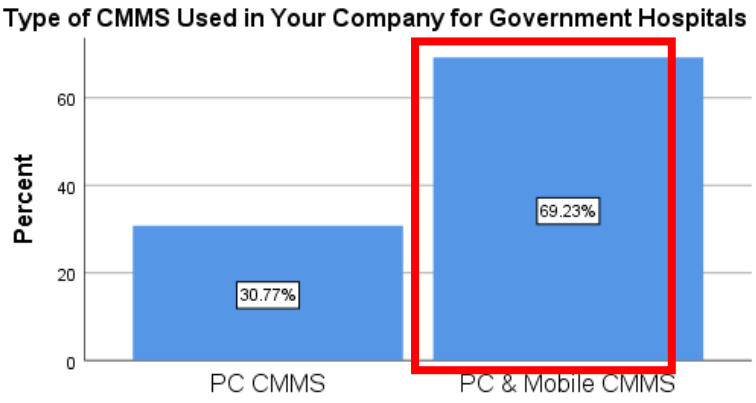

Figure 4: Type of CMMS used in your company for government hospitals

It was found that great number of respondent use a combination of both PC & Mobile CMMS for the FMS jobs in the public hospitals which is 27 respondents (69.23 %) from 39 respondents. And the rest of them (30.77 %) used only PC CMMS in their daily FMS in the hospitals.

This also show that Malaysia FM industry especially in healthcare sector is moving forward and have a good effort in their technology development. Thus by having Mobile CMMS implementation surely give a more positive impact especially the FMS effectiveness instead of using PC CMMS solely.

This type of CMMS used will be highly influenced in the effectiveness and challenges of implementing the technology while conducting FM services in government hospitals and this will be further explained in the Part C and Part D.

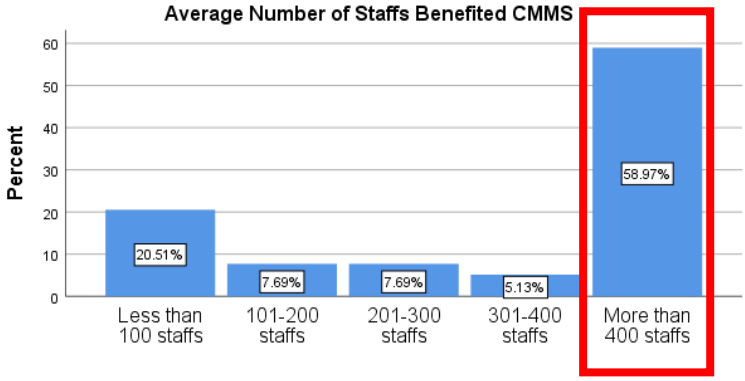

Figure 5: Average number of staffs benefited CMMS

From the survey conducted, it is found that this software was benefited to than 400 staffs (59.00 %) and recorded that most of the respondent (66.67 %) chose Always as their Personal CMMS Usage Frequency Per Month.

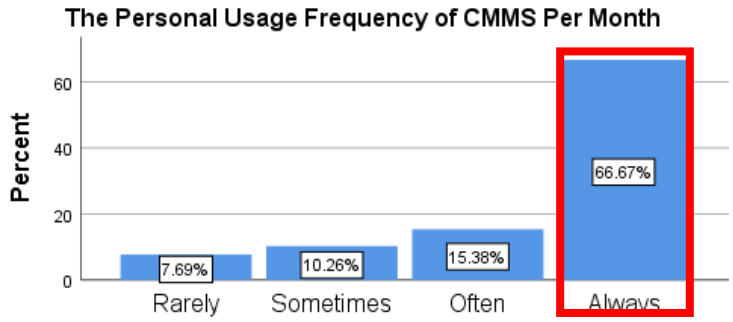

Figure 6: The personal usage frequency of CMMS per month

The Work Order Management variable recorded as the most used features (35.90 %) in CMMS for FM services in government hospitals. This is supported by the fact that the majority of this respondents are them who work on-site. Thus, they will need to use Work Order Management feature often in their daily work routine. This feature also can be assessed by anyone in the company that is why this feature chosen the most by the respondent.

Table 2: The most used features in CMMS

The Most Used Features in CMMS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Work Order Management	14	35.9	35.9	35.9
	Work Request Management	6	15.4	15.4	513
	Purchasing	2	5.1	5.1	56.4
	Predictive Maintenance	2	5.1	5.1	61.5
	Preventive Maintenance	4	10.3	10.3	71.8
	Asset Management	8	20.5	20.5	92.3
	Inventory Control	3	7.7	7.7	100.0
	Total	39	100.0	100.0	

4.2 The Effectiveness of Implementation of CMMS in Government Hospital FMS (Part C)

On this part, Likert scale will be used to measure the level of agreement of each element. The scale used in this are 1 to 5 which represent Strongly Disagree to Strongly Agree. From the Descriptive Analysis on the SPSS, the Mean for each of the elements in this part is generated.

As for the Likert Scale type of question, it is better to go through the analysis by focusing on the mean and the highest scale selected. This is due to the fact that Mean is greatly affected by number of people selecting larger number in the Likert scale. In this part, the largest scale used is 5 which stand for Strongly Agree. Thus, this depict that element which larger Mean value will portray stronger agreement towards the element [8].

Table 4: Likert scale used in Part C

Likert Scale				
1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Table 5: The effectiveness of implementation of CMMS in government hospital FMS

The Effectiveness of Implementation of CMMS in Government Hospital FMS											
Elements	Likert Scale										Mean
	1		2		3		4		5		
	F	%	F	%	F	%	F	%	F	%	
Reduced Downtime	0	0	1	2.6	3	7.7	18	46.2	17	43.6	4.31
Well Managed Asset Management	0	0	1	2.6	3	7.7	12	30.8	23	59.0	4.46
Standardize Maintenance Work	0	0	2	5.1	7	17.9	18	46.2	12	30.8	4.03
Cut Maintenance Costs	0	0	0	0	6	15.4	17	43.6	16	41.0	4.26
Get Control Over Inventory	0	0	0	0	7	17.9	18	46.2	14	35.9	4.18
Work Order Tracking	0	0	0	0	4	10.3	11	28.2	24	61.5	4.51

Work orders that can be tracked rank as the top in effectiveness aspect due to this features usually used by the FM on-site executors with 4.51 Mean value. In which this is supported by the fact that the most used CMMS feature is Work Order Management and the majority of the respondent in this research such as engineer, supervisors and technicians. Thus, CMMS become more useful and efficient when specific individuals can check work assigned themselves and be more prepared to do that task [5]. Interview session done with one FM staff from Company B mentioned that Work Order Tracking was the most obvious positive impact that can be felt while executing this software.

Meanwhile, Well Managed Asset Management recorded the second highest Mean among the other variables which is 4.46. CMMS can simplify the asset management works by offering so much tools such as the asset registry, asset contracts, asset modification and asset spare parts [4]. As a big scale FM company in Malaysia, the respondents in the interview session stated that this CMMS come in handy when they need to track or record their company real time asset's data.

Reduced Downtime also obtained quite high Mean value (4.31) in terms of CMMS effective aspects. Next, the following effective aspect with reasonable high Mean values are Cut Maintenance Costs (4.26), Get Control Over Inventory (4.18) and Standardize Maintenance Work (4.03).

From looking at the table shown above, not a single respondent take Strongly Disagree in the Likert scale for each of the effectiveness aspect. Therefore, it also shown that CMMS give great impacts into FM service in the government hospitals and highly affected by the CMMS Designation especially The Most Used CMMS Feature Used.

4.3 The Challenges of Implementation of CMMS in Government Hospital FMS (Part D)

Again, similar with Part D, the Descriptive Analysis that researcher used was comparison of Mean values. The Mean scores were generated by entering all the data collected into the SPSS software and can be used to rank the type of challenges to depict the impact levels of the challenges faced by the respondents. The table below depicted the Likert sale used and the challenges of CMMS implementation.

Table 6: Likert scale used in Part D

Likert Scale				
1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Table 7: The challenges of implementation of CMMS in government hospital FMS

The Challenges of Implementation of CMMS in Government Hospital FMS											
Elements	Likert Scale										Mean
	1		2		3		4		5		
	F	%	F	%	F	%	F	%	F	%	
Concerns Over Cyber-Security	0	0	3	7.7	7	17.9	15	38.5	14	35.9	4.03
Lack of Knowledge/ Training	2	5.1	6	15.4	11	28.2	11	28.2	9	23.1	3.49
Workload Increased	3	7.7	16	41.0	8	20.5	9	23.1	3	7.7	2.82
Lack of Communications	1	2.6	12	30.8	17	43.6	6	15.4	3	7.7	2.95
Lack of Implementation Time	2	5.1	14	35.9	14	35.9	6	15.4	3	7.7	2.85
Lack of CMMS Mobility	3	7.7	10	25.6	19	48.7	5	12.8	2	5.1	2.82

Concern Over Cyber-Security rank the top for the challenges of CMMS utilization in Public Hospitals FMS as 35.90 % of the respondents chose Strongly Agree on that that challenge. This is due to the fact that while uploading the data to the cloud, there are a threats of security during the process. That is why that this CMMS software need to be updated regularly with the security patches to avoid any cyber security threat and risk [9]. One of the respondents said during interview that the company that they are working are a large scale companies, hence the data that the company got from ASIS was extremely big in number thus the security worries become overblown due to the data values.

Next, the following challenges are with Mean value are Lack of Knowledge / Training (3.49). This can be one of the causes for the CMMS utilization. Training can be provided by CMMS vendors or training by the experienced CMMS users themselves.

If we look carefully, the Mean for few types of challenges are quite low that is below 3.00 which is Lack of Communications (2.95) and challenges with the same Mean value, 2.82 that is Workload Increased, Lack of Implementation Time and Lack of CMMS Mobility.

The reasons they are choose Disagree and Neutral choices when answering this part probably because they are the respondents whose companies implement PC & Mobile CMMS in their daily work routine. Therefore, they are kind of disagree with the statement shown in challenges type.

Especially for the challenges like Lack of Communications and Lack of CMMS Mobility, they respondents that have been using both PC & Mobile CMMS in their work scopes must be felt that this challenges are not necessary. Since they can use Mobile CMMS, they would not find that communication and mobility are challenges that they encountered.

Based on the result obtained, it depicted that challenges of CMMS implementation in Government Hospital FMS highly dependent on the CMMS Designation especially the CMMS Types.

4.4 Summary Findings

To summarize, the chapter has the documented few statistics using Descriptive Analysis on each topic. 39 responses received from 108 surveys distributed and it is considered acceptable because it is more than 30.00 % response estimation rate. Followed by the reliability test that also been done for 2 part which is Part C and D that consist of Likert Scale that resulting a reliable score. Descriptive Analysis using Frequency is conducted to study on the Respondent Background and the CMMS Designation. Instead for another 2 Parts, The Effectiveness and The Challenges of Implementation of CMMS in the Government Hospital FMS, the Descriptive Analysis used was using Mean values.

For the CMMS Designated, it was found that most of respondents used combination of both PC & Mobile CMMS. Also, the personal usage frequency for CMMS per month recorded the highest for ‘Always’ using it and also this CMMS benefited more than 400 staff chosen the most by the respondent. The highest percentage also stated for Work Order Management as the most used CMMS feature used for the FMS in government hospitals.

As for the effectiveness of The CMMS implementation in public hospitals FMS, the respondents agreed that work order tracking gave the most effective impact. This statement supported by the fact that the most used CMMS feature is Work Order Management. Thus the CMMS effectiveness was highly dependent on The Most Used Feature in CMMS. Meanwhile, Concern Over Cyber-Security ranked the op for CMMS implementation challenges. However, the other challenges except that one was highly affected by CMMS Designation of the Type of CMMS Used.

5. Conclusion

From the survey conducted, can be concluded that FM companies that serve FMS in government hospitals have move forward to a more modern approach [4] which is the combination of both PC & Mobile CMMS. This is a great CMMS Designation as the utilization of technology are flexible and not limited to use only 1 type of CMMS.

The most used feature in CMMS was Work Order Management. The supporting fact on this statement is because the range or of staffs that can access to feature are the largest regardless of level of position [6].

The effectiveness of the CMMS is proven to be impactful to the government hospitals FMS for either PC CMMS or Both PC & Mobile CMMS. However, the challenges of implementing this software

varies between the CMMS type used. PC CMMS users encounter a higher level of challenges when executing the software.

Hoping that results depicted can spread awareness of the so that the challenges of the CMMS can be lessened in the future. Great helps from the governments and industrials practitioners needed in order to reduce the issues arises.

Acknowledgement

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