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Effect of Ease of Use, Usefullness, Cost Effectiveness, and Compatibility Towards Cloud Computing Usage in Manufacturing Company

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Abstract — Cloud Computing technology can have benefit to company operation, but not all company implement Cloud computing especially in manufacturing company. Many factors effect the decision to use cloud computing technology, and this study analyze the effect of ease of use, usefulness, cost effectiveness, and compatibility towards cloud computing usage in manufacturing company. This study analyze the correlation between each factors toward the usage of technology using Technology Acceptance Theory (TAM), Diffusion of Innovation Theory (DOI) using Principal Component Analysis (PCA) and anova, a statistic method. The results of the study are ease of use, usefulness, cost effectiveness, and compatibility factors have effect and correlated to the usage of Cloud computing in manufacturing company.

Key words - Ease of Use; Usefulness; Compatibility; Cost Effectiveness, TAM, DOI, Cloud Computing

I. INTRODUCTION

Company needs to increase their competitiveness to survive in their industry. Information Technology usage can shape the future of the company in term of effectiveness, efficiency, and operation agility also cost effectiveness. One of the solution are Cloud Computing technology which can help company to better their operation efficiency.

IT Management level needs to have knowledge about the technology will be use and what are the factors that can influence the usage and benefit of the technology used on day to day operation inside company. With so many Cloud Computing solution variance and also provider that give Cloud Computing solution, there is needed criteria for selection to determine why the technology being choose and used in the company. But Cloud Computing technology have its own complexity which causing the maximum benefit can be achieved is limited by the human resource who adapt the technology it self. IT Manager demanded to adjust his capacity by the increasing complexity of the server environment, and the new technology increase responsibility of the manager [1].

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Complexity of a technology can hindering a person effort to implement the technology [2], even it is the newest technology, if to complex, the acceptance and usage of the technology will be slowed down depends on the capability of the person or organization which adapt the technology. By know what influencing and why a decision made to adapt a technology, especially Cloud Computing technology, will make more benefit to business and impact the future because of the technology improvement will impact the organization and can create a new competitive advantage in the organization.

Cloud Computing technology is the trend in Information and Communication Technology (ICT) and is in CIO top priority list in many company based on the survey done by Gartner[3]. In today competitive world and global economy, company demanded to be able to fulfill market needs and competing with other organization to win more customer. Besides faster, better and cheaper, company also need to have efficiency on cost and right technology to support faster business needs, one of it are Cloud Computing technology. With Cloud Computing, company can have a better utilization on hardware resources and save more cost on CAPEX. With options on Cloud Computing usage, company can use the technology and suite to their business needs, either use Software-as-a-Service (Saas), Platform-as-a-Service (Paas), or Infrastructure-as-a-Service(IaaS) [4].

Some of benefits of Cloud Computing technology are cost effective on CAPEX, easy to scale on computing power based on current needs, high availability always on services, and ability to process big size of data. The biggest effect are the cost which make small company can have big resources with lower cost the same as big company have, and for big company also means big cost reduction on CAPEX and also OPEX [5,6]. Cost are one of the aspects that attracts Cloud Computing technology usage.

Another factor that can affect the adoption of Cloud Computing technology are the ease of use of technology and the technology usefulness, which had been used to explain why a technology can be accepted by its users. These two factors was introduces by Davis which are called Technology Acceptance Model (TAM) [7]. TAM theory can be use to explain about technology acceptance by general, and can explain about user behavior in bigger population and bigger scope. TAM theory explain many factors can influence the intention to use the technology which including external factors, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Study shows that Perceived Usefulness is the most biggest factor in influencing the intention to use a technology [8].

TAM studies also show that Ease of Use have positif impact to the Perceived Usefulness which influence the intention to use a technology.

An adoption on new technology also have its own level of adoption, which have been studied by Rogers in Diffusion of Innovation theory (DOI). DOI theory brought by Rogers since 1962, where DOI evaluate why, how, and at which level an organization using a technology [9]. Rogers identified 5 category of technology adoption level which are 1). Innovator, 2). Early Adaptor, 3). Early Majority, 4). Late Majority, and 5). Laggards.

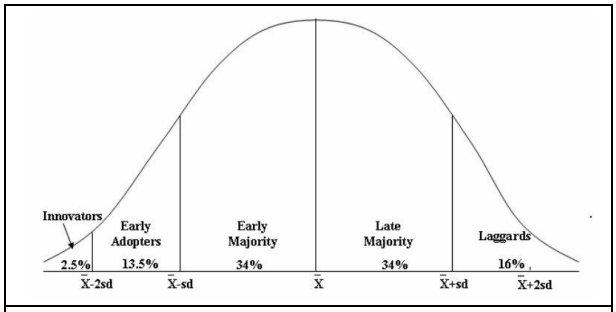

Fig 1: Category of technology Adoption level [9]

Besides individual characteristic on changes, DOI theory also admit that technology adoption influenced by internal environment of organization (level of formality, complexity and organization size, department relationship, and organization characteristic with external party). Level of adoption are the level where an individual or organization adopt a new technology before other member of a system adopt the technology. For Rogers, level of adoption can help on understanding the intent and main behavior on the process to decide adopting a new technology.

Based on TAM and DOI theory, this research analyzing factors that effect the usage of Cloud Computing technology in manufacturing company which are 1). Ease of use of technology, 2). Usefulness of technology, 3). Cost effectiveness of technology, and 4). Compatibility of technology. Previous research have been done using TAM and DOI theory on technology adoption. A previous research by Koehler Et al [10] study about the usage of Cloud Computing from user perspective. Factors that used in the research were Cost Saving, High Availability, Performance, and Consumption Based Pricing. Findings from the study was Cost Saving factor have 34% influencing the decision to investing in Cloud Computing usage by the user. In the study also including survey by IDC which state that Competitive Pricing factors (83%) was the important attribute in decision to use cloud computing. Based on the study, this research include Cost Effectiveness as the independent variable.

Another study on Cloud Computing adoption which use Ease of Use as the factors that influencing the decision to use Cloud Computing also found that Ease of Use is the most important factors and have high score compared with other factors in the study[11]. The study also include the survey result done by CIO Magazine, which found that Ease of Use was the most popular and have highest score when Cloud Computing technology evaluation conducted where senior IT Manager and middle level (both with 63% result) tend to agree that Ease of Use was the most important compared with the respons from other IT Professional. The Cost factor also included on the survey.

Study which using TAM and DOI theory also have been done on server virtualization technology [12] which including factors that influence the decision on using virtualization technology. The factors that been used were Usefulness, Ease of Use, Compatibility and Cost Effectiveness. The study findings were Cost Effectiveness and Compatibility can influence the decision to adapt the technology. Another study also had been done using the TAM and DOI and combined with Grounded Theory on technology adoption on government sector [13]. The study including factors such as Compatibility, Ease of Use, Triability, Observability which adapted from DOI theory, also other factors such as Availability, Awareness, Legislation, Economical Aspects, Social and Cultural Aspects which adapt from TOE theory. The study also adapt TAM theory to build its model, which were Ease of Use and Usefulness of technology. From the study, combining from more than 1 theory can be done and resulted a study that have multiple point of view on factors that influencing technology usage.

On this research, the theory combined were TAM theory, and DOI theory which are Ease Of use, Usefulness, Compatibility and Cost Effectiveness on the influence of Cloud Computing usage in Manufacturing company. Below is the research model used.

Based on the TAM theory, DOI theory, and Cloud Economoy, the following hypotheses are suggested :

H1. Perceived ease of use of Cloud Computing positively influence the usage of technology.

H2. Perceived usefulness of Cloud Computing positively influence the usage of technology.

H3. Compatibility of Cloud Computing positively influence the usage of technology.

H4. Cost effectiveness of Cloud Computing positively influence the usage of technology.

H5. Perceived ease of use of Cloud Computing positively influence the usefulness of technology.

With these study, new cloud computing users will benefit from these study as factors such as ease of use, usefulness, compatibility, and cost effectiveness been analyzed in this study on the usage of cloud computing technology. Readers will have new perspective of the effect of these factors on the usage of technology. For vendors of cloud computing also will have better picture on what factors they can improve to increase the usage of cloud computing technology from ease of use, usefulness, compatibility and cost effectiveness factors.

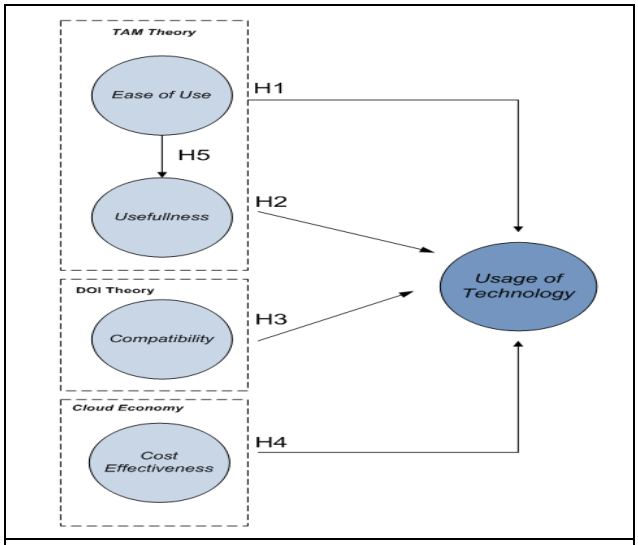

Fig 2. Research model used

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II. METHODOLOGY

The study collect data by survey which develop based on the findings from related literature. The questionnaire was pre-tested among a group of IT executive experienced in Cloud Computing to get the feedback and improve the readability and quality of the survey items. As a result we have 5 questions related to ease of use factors, 6 questions related to usefulness factors, 5 questions related to cost effectiveness, 4 questions related to compatibility factors, and 4 questions related to usage of technology, with the total of 24 questions. In addition, 5-point Likert scales, ranging from 1(strongly disagree) to 5 (strongly agree) were adopted. The data collected from 106 respondent via web survey and targeting manufacturing company.

The data collected then tested using Kaiser-Mayer-Measure of sampling adequacy (KMO) and Bartlett's test of sphericity before processed using Principal Component Analysis (PCA) using SPSS v.16. Afther the data qualified and pass the KMO and Bartlett's test, PCA was done to reduce the total number of variable within a group. Then after have the reduced variable, we proceed to do ANOVA method to find out the correlation between dependent and independent variable. From 24 variable, PCA reduced the variable to 5 items which represent ease of use, usefulness, compatibility, cost effectiveness, and usage of technology.

III. RESULTS AND DISCUSSION

We collect the data using online survey and processed using SPSS statistic software package. Based on the data collected and processed using SPSS, the demography of the respondent base on experience on Cloud Computing were 34% have 3 years experience. Total of 28% have less than 2 years, and 72% have more than 2 years experience as we can see on table 1.

Table 1. Experience in Cloud Computing

Cloud Computing Experience	Frequency	Percentage	Total
< 1 years	32	20.8 %	20.8 %
< 2 years	8	7.5%	28.3%
< 3 years	36	34%	62.3 %
< 4 years	20	18.9%	81.2 %
< 5 years	10	9.4%	90.6 %
< 6 years	7	6.6%	97.2 %
0 year	3	2.8%	100 %
Total	106	100%	

On size of organization 50% have more than 300 employee, and the biggest are 43%, were the organization have more than 500 employee as we can see on table 2. And the respondent position in organization we have were 50% in managerial level which influence the decision on using Cloud Computing technology as shown in table 3.

Table 2. Organization Size

Total Employees	Frequency	Percentage	Total
10 – 50	20	18.9 %	18.9 %
51 – 100	13	12.3 %	31.2 %
101 – 300	14	13.2 %	44.4 %
301 – 500	13	12.3 %	56.7 %
> 501	46	43.4 %	43.4 %
Total	106	100 %	100 %

Table 3. Position in Organization

Position	Frequency	Percentage	Total
IT Manager	53	50 %	50 %
IT Supervisor	22	20.75 %	70.75 %
IT Staff	16	15.1 %	85.85 %
Lainnya	15	14.15 %	100 %
Total	106	100 %	

And based on the KMO and Bartlett's test the results were .916 from data collected. The minimum recommended value are .5 and value between .5 and .7 categorized as medium, value between .7 and .8 categorized as good, value between .8 and .9 categorized as very good, and value above .9 categorized as very good. We can see the result in figure 3.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.916
Bartlett's Test of Sphericity	Approx. Chi-Square	2.099E3
	df	276
	Sig.	.000

Figure 3. KMO and Bartlett's test result

And in PCA we reduced the variable from 24 into 5 variable that represent each group of the factors. We get the biggest value on the correlation coefficient on each of the group and use it for the next Anova analysis. The correlation coefficient from the PCA value can be seen on table 4.

Table 4. PCA Analysis Results

Variable	Factor	Correlation Coefficient
Cloud Computing Technology can be used in long term for company benefit	Usage of technology	0.795
Cloud Computing usage cost (OPEX) is lower than conventional computing system cost	Cost effectiveness	0.798
Cloud Computing technology have similiarity with current computation usage	Compatibility	0.816
Cloud Computing Technology ease to use for company needs	Ease of use	0.756
Cloud Computing Technology more useful for company then conventional computing technology	Usefulness	0.799

With the result from PCA, we got 5 variable which represent each factors. Then we do Anova analysis to the variable. The dependent variable was the usage of technology, and the independent variable was ease of use, usefulness, compatibility and cost effectiveness factors. We can see the result of Anova on table 5.

Table 5. Anova Analysis results

		Sum of Squares	df	Mean Square	F	Sig.
Ease of use – Usage of technology	Between Groups	18.360	4	4.590	8.041	.000
	Within Groups	57.650	101	.571		
	Total	76.009	105			
Usefulness – Usage of Technology	Between Groups	35.194	3	11.731	29.318	.000
	Within Groups	40.815	102	.400		
	Total	76.009	105			
Cost effectiveness – Usage of Technology	Between Groups	18.951	3	6.317	11.293	.000
	Within Groups	57.058	102	.559		
	Total	76.009	105			
Compatibility – Usage of Technology	Between Groups	35.476	3	11.825	29.757	.000
	Within Groups	40.534	102	.397		
	Total	76.009	105			
Ease of use – Usefulness	Between Groups	14.567	3	4.856	8.462	.000
	Within Groups	58.527	102	.574		
	Total	73.094	105			

The result of Anova between ease of use and usage of technology shows that the significant value .000 which < .05, meaning there are significant correlation between these 2 factors. The usefulness and usage of technology also have same result with the significant value .000 which < .05, meaning there are significant correlation between these 2 factors. Cost effectiveness and usage of technology have significant value .000 which < .05 and have meaning that there are significant correlation between these 2 factors. For compatibility and usage of technology, we have significant value .000 which < .05 and there are significant correlation between compatibility and usage of technology. And ease of use factor with usefulness of technology have Anova test result .000 which < .05, meaning there are significant correlation between these 2 factors. These findings align with previous study on technology acceptance, which these factors have correlation with the usage of technology [14, 15, 16, 17, 18, 19].

IV. CONCLUSION

From this study we can conclude that factors such as ease of use, usefulness, compatibility, and cost effectiveness have effects on the usage of technology. Each factors give contribution to the usage of technology decision. With ease of use, user will get more result from the usage of technology, therefor will have more productivity and results, and will impact the perceived usefulness of the technology. The compatibility factors also contribute to the usage of technology, as decision makers will consider their already available technology and process. And also the Cost on technology usage will impact the decision on whether company will use the technology.

With this study, new cloud computing users will have a perspective on what factors need to be considered before using the technology. Some other factors not covered in this study and can be used also in the next study. For vendors also can add perspective on what needs to be improved for increasing the usage of cloud computing from factors like ease of use, usefulness, compatibility and cost effectiveness. Next study can go further with adding new factors like environment, regulation, reliability, readiness of resources, and other factors that can influence the usage of technology with the model already used in this study.

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