Priority Factors for the Adoption of Cloud ERP Based on the Perspective of Consultants and SMEs

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Abstract—The presence of cloud computing technology is driving changes in the way ERP vendors design, develop, implement, develop and sell ERP products that were previously treated as goods into services. The existing ERP product players who previously provided on-premise ERP solutions are now also providing SaaS solutions to compete with new players providing SaaS solutions. Previous research on the adoption of cloud computing-based ERP has always looked at the adoption factor from the SMEs side, even though the success of implementation is largely determined by the consultant. This study aims to see if there are differences in the priority factors for the adoption of cloud computing-based ERP. This is important because there is a change in the role of consultants who previously played a lot in technical matters for implementing on-premise ERP to SME business process management in SaaS ERP implementation because the technical complexity has been handled by the Vendor. This study uses descriptive statistics to perform different tests and the Entropy method to determine the priority weights of cloud computing-based ERP adoption factors. The results of the study indicate that there are differences in the priority of adoption factors from the consultant's side, the largest is the regulation factor and from the SME side is available resources. For the lowest priority, it turns out to be the same in terms of consultants and SMEs, namely data control.

Keywords— Adoption Factor, Consultant, ERP, SaaS ERP, SMEs, consultant, Adoption factor, Entropy.

I. INTRODUCTION

Enterprise resource planning (ERP) applications in the past were installed on on-premise systems, where ERP applications were run from computers and infrastructure owned by users.

ERP is known as a business software package designed to integrate and improve the performance of business processes and transactions in the company which includes modules with different functions such as procurement, accounting, production, warehouse, sales [1][2][3][4]. The purpose of ERP is to improve company performance.

For SMEs, ERP is very important to improve business performance, especially for SMEs that are already using e-commerce. Without ERP, SME businesses with e-commerce will be hampered because without integration that unifies business processes for recording transactions, inventory systems and customer service [5]. ERP also makes business efficient and effective, but the cost of adoption becomes a barrier for SMEs to adopt ERP [6][7].

Many SMEs have not implemented ERP because other than SMEs they can still operate without ERP, ERP installation costs are high despite limited financial capabilities, and ERP implementation is too complex for SMEs with limited IT HR capabilities. SMEs in general experience problems related to the limited availability of infrastructure and lack of ability to carry out maintenance due to limited IT human resources [8].

With the presence of cloud computing technology, application provider companies are starting to use an application distribution model to new users, namely Software as services (SaaS)[9][10][11]. This distribution model involves a third party, namely the Cloud Provider, who provides the infrastructure and platform that allows software applications to be accessed and used over the internet [10][12]. The phenomenon of the development of cloud computing is changing the way ERP applications are designed, developed, implemented, managed and paid for.

The majority of current ERP providers have added a SaaS ERP solution in addition to their on-premises ERP. Meanwhile, new ERP providers enter the market with the SaaS business model [13].

ERP applications and data can be accessed via the internet as SaaS with conditions controlled by the Cloud provider. Payment for this application service is made on a monthly subscription basis[14][15][16]. The financing model for ERP adoption with the SaaS model is considered profitable by SMEs because of the change in financing from the previous accounting side from asset purchase costs to operational costs. Companies adopt SaaS ERP to reduce implementation complexity and costs. With SaaS ERP, companies no longer need to be preoccupied with software problems, hardware, software upgrades and Information Technology staff support. Thus ERP implementation can be done easily and quickly because of the support for productivity, scalability and flexibility of SaaS ERP. By adopting SaaS ERP, SMEs can make efficient use of IT resources and gain access to system functionality and service data [17][18][19].

Previous research has shown that the cloud computing-based field has given rise to many areas of research on new technologies, security needs and future expectations in a rapidly changing environment. Previous research has shown many factors that make cloud computing-based technology very suitable for the profile and ability of SMEs to adopt technology [20]. Many studies have discussed the adoption of cloud computing-based ERP, in this case SaaS ERP from different perspectives. SMEs adopt SaaS ERP because of competition, business needs, and maintaining market share and consumers. Many studies of SaaS ERP adoption [21][22] use the TOE (Technology Organization Environment) framework to explain the factors of SaaS ERP adoption by SMEs because it is considered the most appropriate because it explains factors within the company and also the environment outside the company, this is in accordance with SaaS technology. involving third parties, namely cloud service providers in the provision of ERP application services [23][24][25].

Cloud computing-based technology is still relatively new, SMEs' understanding of SaaS ERP is still limited. In this case the expertise and knowledge of consultants is very important and needed in understanding the needs and expectations of SMEs from SaaS ERP. Thus, consultants also play an important role in the adoption of SaaS ERP by SMEs [26].

There are many studies that explain the factors of SaaS ERP adoption from the side of SMEs and consultants, but not many explain whether there are differences in the priority factors of SaaS ERP adoption from the consultants and SMEs side considering the changing role of consultants [32]. Currently the ability of consultants to understand the management of SME business processes is more important than understanding the technical aspects of SaaS ERP applications that have been handled by vendors.

II. LITERATURE REVIEW

SaaS, ERP and SMEs

According to Robert P Desisto [28], SaaS is defined as a software application that is owned, distributed and managed remotely by one or more providers. Based on the maturity Level of SaaS [29][30][31], there are 4 levels as seen in table I:

TABLE I
MATURITY LEVEL OF SAAS

SaaS Maturity Level	Level Characteristic	Maturity characteristic			
		Code	Configuration	Deployment	Scalability
Level 1	Ad Hoc/Custom	single Code for each tenant	unconfigurable	deploy application for single tenant	can not scalable
Level 2	Configurable	single code for all tenant	configurable - limited - vendor side	deploy application for each tenant	can not scalable
Level 3	Configurable and Multi-tenant efficient	single code for all tenant	configurable	deploy application for all tenant	need to upgrade hardware for scalability
Level 4	Scalable, Configurable and Multitenant efficient	single code for all tenant	configurable	deploy application for all tenant	high degree of scalability (Automated Upgrade)

Although there are opinions that say if the installation of software on the infrastructure provided by the user is a distribution model with ASP (Application service provider), then it is not included in the SaaS category[28], but according to several authors [29][30][31] who categorize ASP as a SaaS with maturity level 1. Service providers use maturity level 1 to provide services to customers who for some reason require specially customized software according to unique business processes and cannot use applications with common data definitions like other customers generally. In contrast to on-premises, in a SaaS environment, customers have the freedom to switch services to other providers easily.

International Journal of Emerging Technology and Advanced Engineering

Website: www.ijetae.com (E-ISSN 2250-2459, Scopus Indexed, ISO 9001:2008 Certified Journal, Volume 11, Issue 12, December 2021)

This encourages service providers to compete to innovate by continuously updating products and services through application updates, providing backup and disaster recovery plans as well as in terms of data and system security [15].

In terms of cost SaaS has the impact of reducing costs significantly at the beginning of the installation because it does not require a large initial capital investment for infrastructure procurement. However, operational costs will remain and tend to increase in accordance with the development of organizational needs. For SMEs, SaaS is very helpful, especially because of limited IT resources both in terms of infrastructure and human resources for on-premise software implementation [28]. SaaS operational costs include software subscription fees which are calculated based on usage from the module side as well as the number of users in accordance with negotiations with service providers [28] [31].

Nieuwenhuis et al. found that [32], with the change in the business model of service providers that previously provided services with an on-premise model to the SaaS model, there was a change in the contribution of consultants who previously played a lot from the technical side to the business process management side. This will also change the consultant's perspective on the SaaS ERP software adoption factor.

Adoption technology

The author uses the TOE (Technology Organization Environment) model to explain the SaaS ERP adoption factors from the side of SMEs and consultants. Theories and models of technology adoption are widely used by researchers to explain the dynamics of the spread of technological innovation [24]. The reason the author uses the TOE model is because from several previous studies [15][34][35], TAM, TRA and TPB are mostly used to explain technology adoption from the individual side, while TOE and DOI are used to explain technology adoption from the company side. According to Gangwar et al., Oliveira et al. and Awa et al. [24][34][36] TOE model becomes a general theory of technology adoption that can be relied upon for research related to companies compared to TAM, TRA and TPB. Several previous studies on the adoption of ERP systems [24] [36], cloud computing-based systems [37] [38] and SaaS ERP [15] [39] also used TOE.

Technology, Organization and Environment (TOE)

Tornatzky and Fleischer in 1990 developed a TOE framework for studying information systems and information technology products [23]. With this framework the explanation and prediction of possible adoption can be explained with a generic set of factors introduced for the first time [24]. The overall impact of adoption on company activities during and after adoption after adoption and implementation of new technologies can be seen holistically using the TOE framework [40]. In this framework an explanation of the aspects of Technology, Organization and Environment are identified as aspects that affect the process of technology adoption by companies.

This TOE framework is suitable for explaining the adoption of SaaS ERP because it also describes the company's internal and external technology, which in this case is a cloud computing-based environment. These contexts include such as perceived usefulness, technical and organizational compatibility as well as complexity and learning curve [24]. Talking about the size and quality of human resources, the complexity of the management structure, organizational culture, business scope and support from the company's top management can be reflected in the context of the organization. The relationship between the organization and its facilitators and the factors that support or hinder the company in managing its business can be seen from the environmental context [23].

III. RESEARCH METHODOLOGY

All The research methodology was Quantitative method and comprised of literature review, an SLR approach, descriptive statistical analysis, and Entropy. The literature studies of factors that influence the adoption of SaaS ERP by SMEs in the context of TOE, begin with systematic literature review using the method developed by Kitchenham et al.[41]. After finding the factors in the TOE technology adoption model framework, it was confirmed to consultants and SMEs through questionnaire data processing [42]. The next stage is to test whether there are different views on the adoption factor from the consultant's and SME's side.

The method used is the Paired Sample T Test or Wilcoxon Signed Rank analysis model depending on the distribution of the data, the analysis is carried out using the SPSS software program.

International Journal of Emerging Technology and Advanced Engineering

Website: www.ijetae.com (E-ISSN 2250-2459, Scopus Indexed, ISO 9001:2008 Certified Journal, Volume 11, Issue 12, December 2021)

The collected data will be analysed in stages by doing descriptive statistical analysis first. Furthermore, statistical tests were carried out with the normal distribution test using the Kolmogorov-Smirnov test.

The next step is testing the partial hypothesis for each research variable using the Paired Sample T-Test analysis test if the data is normally distributed and the Wilcoxon Signed Rank analysis test model if the data is not normally distributed. To find the priority weight of the important factors for the adoption of SaaS ERP in the TOE framework, the next thing to do is to process the ranking of importance data using the Entropy method [42].

IV. RESULT AND DISCUSSION

Factors regarding the adoption of SaaS ERP by SMEs that already exist in previous studies were explored using a systematic literature search method [41]. The factors obtained can be seen in the table III.

From previous research, it can be seen that the adoption of SaaS ERP by SMEs is only confirmed from the perspective of SMEs, whereas according to Nieuwenhuis et al.[32]. In SaaS ERP there is a fundamental change in the role of consultants who were previously involved in the technical side for ERP implementation with an on-premise system to become the business process management side of the implementation using this SaaS system. At the higher maturity level, the less contribution of technical knowledge the consultant provides[29][30]. For this reason, questions about the importance of the SaaS ERP adoption factor were also asked to consultants and SMEs simultaneously.

The profiles of the respondents for 42 SMEs and 49 consultants can be seen in the table II for SMEs and the table IV for consultants.

The validity and reliability tests were carried out with the results of the R value > 0.25 which indicated all data were valid and the Cronbach alpha value was above 0.7 [60] which indicated reliable data as shown in the table V.

The following issue is if there is a distinction between consultants and small and medium-sized businesses. As a result, a separate test was conducted. Prior to performing the difference test, a normality check was performed, as shown in the accompanying table VI. The P value of 0.05 indicates that the data are not normally distributed. The Mann-Whitney technique [43] is used to conduct a t test on non-normally distributed data, as seen by the findings in table VII. The P value for the Technology and Environment factor is greater than 0.05, indicating that there is no difference in relevance between consultants and SMEs. While the organizational factor reveals a difference with a P value of 0.05.

Given the results that SMEs and consultants have divergent perspectives on the SaaS ERP adoption factor, it is vital to examine the relative relevance of each component from both the SME and consultant perspectives. Separate questionnaire responses from Consultants and SMEs were analysed using the Entropy approach [43] to determine their relative relevance. The results of entropy processing are shown in Table VIII for SMEs and Table IX for consultants. The Entropy index demonstrates the disparity in priority between SMEs and consultants. For SMEs, the most important factor is available resources, whereas for consultants, the most important factor is government regulation. Data Control, consultants and SMBs agree, is a low priority.

International Journal of Emerging Technology and Advanced Engineering

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TABLE II
ADOPTION CLOUD ERP'S FACTORS

No	Factor	Sub Factor	Indicator	Reference
1	Technology	Cost	Low Hardware Cost	[44]
2			Low Startup Cost	[44]
3			Maintenance Cost	[44]
4			Training Cost	[44]
5		Scalability	No of Module	[45]
6			No Of User	[45]
7		Rapid Development	Comprehensive solution	[46]
8			Complete Product	[46]
9			System Rollout and Configuration	[47]
10		Business Focus and Continuity	Rapid Deploy	[48]
11			Constant Maintenance	[48]
12		Accessibility	Bandwidth	[49]
13			Usability	[50]
14		Data Security	Data Protection	[44]
15			Data Authorization in Company	[44]
16			Data Authorization in Cloud Provider	[44]
17		Data Privacy	Transparency	[44]
18			Data Control	[44]
19		IT Infrastructure	Hardware	[51]
20			Software	[51]
21		Interoperability	Vendor Lock-in	[52]
22			Internal-Intraorganizational	[53]
23		Integration	Low Erp Compatibility	[44]
24			Different IS Infrastructure and Platform	[44]
25			IT Structure and Legacy System	[47]
26		Mobility	Access Thru Web	[44]
27			Access Thru mobile devices	[44]
28		System Upgrade	Multi site	[44]
29			Automated	[44]
30		Performance	Response Time	[44]
31			Data Processing Speed	[44]
32			System acceptance and usage	[47]
33		Availability	Monitoring/Masurement of Performance	[47]
34			Data	[45]
35		System	System	[45]
36	Organization	Top Management Support	Top Management Commitment	[54]
37			Available resources	[47]
38		Change Management	Best Practice	[55]
39	Environment	Organizational Readiness	Technical Readiness	[56]
40		Competitive Pressure	Competitor/Competitive strategy	[57]
41		Government	Regulation	[58]
42		Vendor	Relationship	[47]
43			Legal/Contract restriction	[44]
44			Product Customization support	[59]
45		Implementation Support	Implementation Support	[47]

TABLE III
SME'S RESPONDENT PROFILE

Type Of SMEs	Number of Respondent	Proportion
Small	17	40%
Medium	25	60%

TABLE IV
CONSULTANT'S RESPONDENT PROFILE

Experience	No Of Respondents	Proportion
< 5 years	13	27%
5 – 10 years	12	24%
> 10 years	24	49%

TABLE V
Validity Test

TABLE VI
NORMALITY TEST

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Technology	0,126	91	0,001	0,929	91	0,000
Organization	0,186	91	0,000	0,906	91	0,000
Environment	0,103	91	0,018	0,963	91	0,011

TABLE VII
T-TEST

Test Statistics^a			
	Technology	Organization	Environment
Mann-Whitney U	825,500	731,000	977,000
Wilcoxon W	1728,500	1634,000	1880,000
Z	-1,621	-2,406	-0,416
Asymp. Sig. (2-tailed)	0,105	0,016	0,678

TABLE
SME's Entropy IndexError! Not a valid link.

VIII

V. TABLE IX
CONSULTANT'S ENTROPY INDEXError! NOT A VALID LINK.CONCLUSION

ERP is sold as a product in the on-premise model, but as a service under the SaaS model. The SaaS model enables SMEs to implement ERP since the primary impediment to on-premise systems, cost and complexity, are removed under the SaaS model.

However, the divergent perspectives of consultants and SMEs as a result of the shift in the role of consultants, who formerly offered extensive technical help to aid with business process management, resulted in disparate weightings of significance for the SaaS ERP adoption factor.

Vendors, as SaaS ERP service providers, provide a range of ERP system services. Not every provider offers ERP system services at every maturity level. By analyzing SMEs' preparedness to embrace SaaS based on adoption characteristics at the SaaS maturity level, it will tell suppliers about which SMEs are fit to utilize their services. For the subsequent study, SMEs and suppliers will benefit from the SME readiness assessment methodology for SaaS ERP adoption based on SaaS maturity level. SMEs may give maturity level preference information based on SaaS ERP adoption criteria, and vendors that provide SaaS ERP services that align with SMEs preferences can assist SMEs in adopting SaaS ERP.

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