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Contents

Cloud Computing Adoption Strategies at PT Taspen Indonesia, Tbk Julirzal Sarmedy; Bachtiar H. Simamora	35-43
Measurement of Application of ISO 27001 of Customer Cellular Card Confidentiality Data in PT. XYZ Area Jakarta Krishna Rahadian; Ahmad Juang Pratama	44-54
The Effect of Lecturer's Professionalism and Student's Study Interest and Motivation on Academic Achievement of Bachelor Degree Student in Online Learning in Binus University Trivena; Harisno	55-61
Database of Migration and Replication with Oracle Golden Gate Suharjito; Raymond; Ida Ratna	62-67
Development of Customer Relationship Management System to Improve Service Quality in PT Manulife Life Insurance Indonesia Chriswanto	68-75
Development of Food Security Information System Based on Business Intelligence in Food Security Agency, Ministry of Agriculture, Indonesia Manise Hendrawaty; Harisno	76-84
INDEKS	85-88

CLOUD COMPUTING ADOPTION STRATEGIES AT PT TASPEN INDONESIA, Tbk

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Abstract: PT. Taspen as Indonesian institution, is responsible for managing social insurance programs of civil servants. With branch offices and business partners who are geographically dispersed throughout Indonesia, information technology is very important to support the business processes. Cloud computing is a model of information technology services that could potentially increase the effectiveness and efficiency of PT. Taspen information system. This study examines the phenomenon exists at PT. Taspen in order to adopt cloud computing in the information system, by using the framework of Technology-Organization-Environment, Diffusion of Innovation theory, and Partial Least Square method. Organizational factor is the most dominant for PT. Taspen to adopt cloud computing. Referring to these findings, then a SWOT analysis and TOWS matrix are performed, which in this study recommends the implementation of a strategy model of cloud computing services that are private and gradually in process.

Keywords: Cloud Computing; Technology-Organization-Environment Framework; Diffusion of Innovation Theory, Partial Least Square; Taspen

INTRODUCTION

Indonesian Internet Service Providers Association (APJII) records of Internet users in Indonesia continues to grow gradually for each year. In 2012, Internet users in Indonesia reached 63 million people [1]. It is predicted to continue to increase significantly by 2015. From these data, it is clear that there is a growing Internet technology in Indonesia. The growth of the Internet technology is of course also helped encourage the development of other information technology extensively, especially cloud computing services which relies on the Internet. According to Adi Kusma, as president director of Biznet Networks, cloud computing is a potential solution when Indonesian economy crisis [2]. Of survey ever conducted on 150 IT decision makers of large and medium enterprises in Indonesia, 45% of whom stated that cloud computing services is the first priority in 2013 [3].

IS/IT infrastructure development is one of the discourse strategies, policies, and working programs of top level management at PT. Taspen. As state institution, the IS / IT is a critical component in its business processes. Referring to the duties and responsibilities of the IT Division of PT. Taspen, to assess the innovation of new technologies and systems that analyze and technology by way of outsourcing, cloud computing services can certainly be the potential and challenges for PT. Taspen in strategic planning of IS/IT based on company needs.

Until now PT. TASPEN still not adopting cloud computing services. However, with more observation, cloud computing services will realize the potential for existing tasks. A lot of alignment between the benefits of cloud computing with IT department task, to solve the problems of IS / IT at PT. TASPEN, such as assessing new information technology innovation, outsourcing, long-term plan, collaboration, and change management.

From the technical aspect, there were no new elements of this type of technology in cloud computing. However, its capacity can provide cost reduction, rapid scalability, and flexibility, has the potential to stimulate the economy as a revolutionary [4]. Research conducted in Korea reveals the fact that the organization, adoption of cloud computing is influenced by several factors such as organization character, the process of decision making within an organization, implementation phase, competitive effects, services availability, economic factors (price), and managerial support.

In Indonesia, the ministry of communication and informatics count the cloud computing trend on the agenda "Indonesian Communication and Information Technology White Paper 2010" [5]. Mentioned that the driver of cloud computing trend is saving the customer investment, need for efficiency, increased reliability through the elastic resource availability, reduce the threat of single-point-of-failure, and increased utilization.

However, despite such promising benefits of cloud computing services, the availability of fast internet, the level of awareness and knowledge of cloud computing benefit is still a barrier factor [6].

To make decision to implement an information system, it is influenced by several factors. There are several theoretical models that can be used to assess the factors that influence and how far it is influenced. Models such as TAM (Technology Acceptance Model), TPB (Theory of Planned Behaviour), DOI (Diffusion of Innovation), and TOE (Technology Organization Environment), are the most popular theory and framework used by previous research. TOE and DOI is the most relevant theory to examine the factors that affect the success of the implementation of IS / IT at firm level, compared with TAM and TPB which more suitable on the individual perspective [7].

Research Question

By those theory, observation, and concern, therefore several research questions arise as follows:

1. What factors affect the PT. TASPEN in adopting cloud computing services in the context of technology?
2. What factors affect the PT. TASPEN in adopting cloud computing services in the context of the organization?
3. What factors affect the PT. TASPEN in adopting cloud computing services in the context of the environment?

Research Objective

The main purpose of this research is to study what factor is influencing PT. TASPEN to adopt cloud computing by using TOE framework bound with DOI theory. And at the end, hopefully this research can give some recommendation with SWOT and TOWS matrix analysis.

Literature Review

Technologies contained in cloud computing is not something new. The concept of cloud computing has long been put forward by a scientist named John McCarthy in 1960, who said that the future of computing will be available and maintained as a public service [8].

Cloud computing

Here is the final draft of the NIST definition of cloud computing, issued in September 2011 [9]:

“Cloud computing is a model for enabling a ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (eg, networks, servers, storage, applications, and services) that can be provisioned and released Rapidly with minimal management effort or service provider

interaction. This cloud models is composed of five essential characteristics, three service models, and four deployment models.”

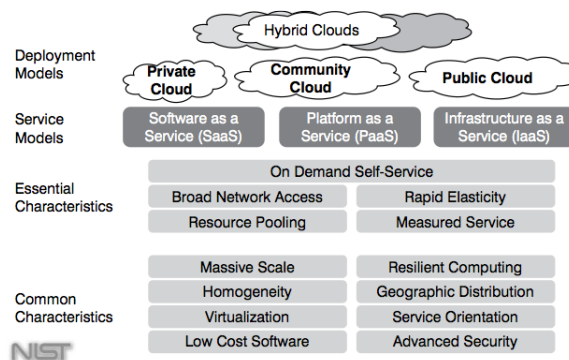


Fig. 1: Cloud computing framework [10]

Cloud computing consist of five main characters as follows: on-demand self-service. broad network access, resources pooling, rapid elasticity, and measured service. There are three types of services, such as software as a service, platform as a service, infrastructure as a service. Cloud computing can be implemented by four models, private cloud, community cloud, public cloud, and hybrid cloud.

The benefits of cloud computing services can be viewed from four different sides [10]: financial, technology, operational, and environment. Despite to its benefits, cloud computing also has a drawback such as security, control, cost, openness, compliance, and service-level agreements.

Diffusion of Innovation Theory

In many previous studies, DOI is one very popular theory to uncover an individual factor in adopting a technological innovation [11]. Roger identified five factors or attributes that influence a person to adopt a technology:

- Relative advantage
The benefits of a technological innovation to reduce costs and increase operational benefits [12] (Lian et al, 2013). With cloud services, companies can reduce the cost to pay experts to do the installation, maintenance, and update or upgrade information systems [13].
- Complexity
The new technology will cause problems or difficulties because the necessary expertise to implement [14].
- Compatibility
The new technology is expected to correspond with someone who is already accustomed to the activity undertaken, so it does not cause a significant change [15].

- **Triability**
A technological innovation will be assessed on the level of ease for someone to do the test [16].
- **Observability**
Success in adopting an innovation is influenced by a person's communication technology towards each other. The influence could be positive or negative [17].

From the five attributes mentioned above, some studies have also found that the element of trust or confidence is an indicator that is influential in the decision to adopt a technology [18]. To take decisions in adopting cloud computing technology innovation, human factors as a leader (CIO) within an organization also affect significantly [19].

TOE framework

Empirically, the TOE framework has been widely used and tested in numerous studies in the field of information technology [19]. DOI theory and TOE very related and identical to each other. In theory DOI, adoption of a technological innovation assessed by looking at the internal and external factors of the technology concerned. Through the TOE framework, Tornatzsky and Fleischer added that the technology factor is also associated with the external factors of the technology itself, such as business, industry, competitors, and government [20].

Explained that for the organization in the context of the TOE framework, there are several reflective indicators:

- **Size**
The size of a large or small an Organization also influence the decision to adopt a technological innovation. Small companies are more likely to adopt a technology, where large companies are more likely to not make changes [21].
- **Top management support**
The owner of a company or the leaders at the level of directors and managerial very influential to other members within organization [22].
- **Innovativeness**
There are two characters on an innovative leader. In this case consists of two types of CEO, the CEO is looking for a solution that was reasonably well understood and tested, and more CEOs have the willingness to create innovation faster and adopt information systems [23].
- **Prior technology experience**
Successful implementation of cloud computing in an organization is influenced by the skill of workers and management perceptions and understanding, so as to produce a strategic decision, a creative and innovative environment [24].

- **Observability**
Successful implementation of cloud computing in an organization is influenced by the skill of workers and management Perceptions and understanding, so as to produce a strategic decision, a creative and innovative environment [24].

Based on the results of previous studies, environment factors are described with some indicators as follows:

- **Competitive pressure**
Competitive pressures force companies to be more innovative in order to survive in the business world. According to the theory's Five Forces (Porter), two of which are: Rivalry Among companies and the threat of substitution. Cloud computing is a paradigm that is most popular in the field of IT to achieve competitive advantage [25].
- **Industry**
Adoption of information systems innovations are influenced by the types of industry in which the company operates and how to manage these types of industry information [26].
- **Market scope**
By adopting cloud computing, is expected to reduce the external costs and make the company does not rely on geographic location [27].
- **Supplier computing support**

Successful implementation of technology innovation is supported by the availability of infrastructure available.

- **Government policy**
Regulatory policy, governance, and compliance can make businesses reluctant to adopt cloud computing because of the lack of legislation governing the ownership and data privacy, as well as auditing and reporting of data access rights [28].

SWOT/TOWS matrix analysis

In his dissertation, Shimba states to begin adopting cloud computing services must begin with the analysis phase [29]. From the results of his research, adoption of cloud computing strategy consists of five phases, namely analysis, planning, adoption, migration, and management. This strategy was later called ROCCA (Roadmap for Cloud Computing Adoption) and developed into a framework called the RAF (Rocca Achievement Framework). Later, this framework ranging widely used as a research reference.

SWOT analysis is a relevant tool to develop strategies in the decision-making process [30]. In general SWOT analysis related to cloud computing can be seen from the characteristics of the technology

itself, associated benefits and drawbacks, as well as the potential benefits and risks that affect users [31].

To develop strategies based on existing data, the TOWS matrix analysis is one approach for researchers to produce a strategy for a company or organization. Basically this is the use of TOWS matrix strength to create opportunities, minimize weaknesses, and avoid external threats [32].

Research model and hypothesis

Grounded from prior research, this study develop the model based on TOE framework and DOI theory. After build the model, there are three hypothesis to be confirmed:

- H1: Technology factor affecting PT. TASPEN significantly to adopt cloud computing.
- H2: Organization factor affecting PT. TASPEN significantly to adopt cloud computing.
- H3: Environment factor affecting PT. TASPEN significantly to adopt cloud computing.

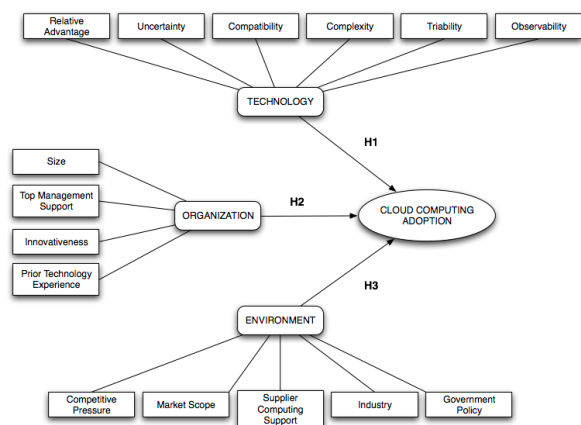


Fig.2: Research model

METHOD

The purpose of this study is to test the hypothesis, by looking at the relationship factors that exist within an organization currently [33]. The study was conducted at the headquarters of PT. TASPEN on Jl. Lt. Suprpto No. 45, Cempaka Putih, Central Jakarta, in the period for approximately three months. Beginning in mid of May to August 2014 [34].

This quantitative research, using statistical science to manage the data associated with hypothesis. The population in this study is the organization of PT. TASPEN overall. The sampling technique used in this study is a nonprobability sampling is purposive [35]. Due to avoid some bias the results of the study, the sample is determined to a group of people who have sufficient knowledge in the field of IS / IT.

There are three independent variables in this research:

- a. Technology (X1): technology factor which is affecting PT. TASPEN to adopt cloud computing.
- b. Organization (X1): organization factor which is affecting PT. TASPEN to adopt cloud computing.
- c. Environment (X3): environment factor which is affecting PT. TASPEN to adopt cloud computing.

And one dependent variabel:

- a. Cloud (Y): the intention PT. TASPEN to adopt cloud computing.

The collected data will be processed using statistical methods based Structural Equation Modeling Component or better known as Partial Least Squares method and use SmartPLS program version 3.1.3. SEM is the second generation of multivariate as Principle Component Analysis, Factor Analysis, and Discriminant Analysis. In some studies, SEM is widely used because it is able to do path analysis with latent variables and has high flexibility for connecting between theory and data [36].

RESULTS AND DISCUSSION

Samples were taken from all employees in the Information Technology Division amounted to approximately 45 people. From the 45 questionnaires distributed, the successful respondent data collected as many as 38 people. With a total sample is then confirmed that the most appropriate method to be used is the Partial Least Squares [37].

In the conceptualization models, need to design two sub-models, namely [38]:

- The design of a structural model (inner model), the relationship or the effect of exogenous variables on endogenous variables.
- The design of the measurement model (outer model), the relationship between the indicator variables. This relationship can be either reflective or formative.

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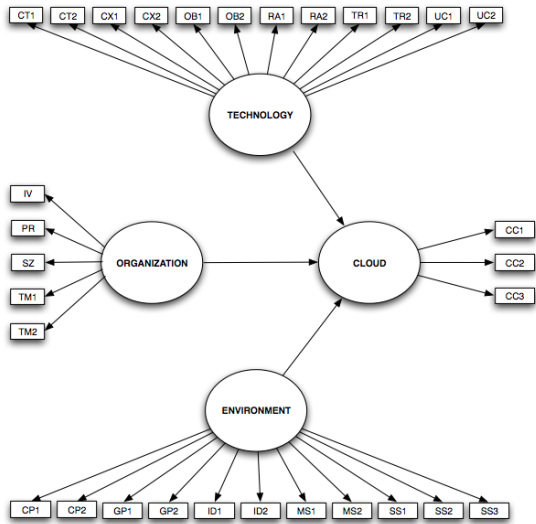


Fig. 3: Conceptual model

Inner model is constructed by three exogenous variables (Technology, Organization, and Environment), affecting to one endogenous variable (Cloud). Outer model is constructed by each indicator as described in table 1, 2, 3, and 4.

By using SmartPLS program, three options available methods of analysis algorithms that can be used. Path or structural weighting PLS analysis algorithm scheme suggested by Wold is using a path or structural weighting method [39]. Data analysis using bootstrap resampling method.

Table 1: Outer model of Technology variable

Variable	Indicator	Code
Technology	Relative advantage	RA1 RA2
	Uncertainty	UC1 UC2
	Compatibility	CT1 CT2
	Complexity	CX1 CX2
	Triability	TR1 TR2
	Observability	OB1 OB2

Table 2: Outer model of Organization variable

Variable	Indicator	Code
Organization	Size	SZ
	Top management support	TM1 TM2
	Innovativeness	IV
	Prior technology experience	PR

Table 3: Outer model of Environment variable

Variable	Indicator	Code
Environment	Competitive pressure	CP1 CP2
	Industry	ID1 ID2
	Market scope	MS1 MS2
	Supplier computing support	SS1 SS2
	Government policy	GP1 GP2

Table 4: Outer model of Cloud variable

Variable	Indicator	Code
Cloud	Adoption	CC1 CC2 CC3

Measurement model evaluation

Model evaluation is done by assessing the PLS outer and inner model of the model. Measurement or outer model evaluation is done by assessing the model validity and reliability. Outer models with reflective indicators evaluated by finding the value of convergent validity, discriminant validity, Cronbach's alpha and composite reliability.

Figure 4 is the first attempt of PLS calculation. Some indicator is removed due to insufficient to fulfill the threshold of Rule of Thumb (loading factor > 0,6). The result can be seen in figure 5.

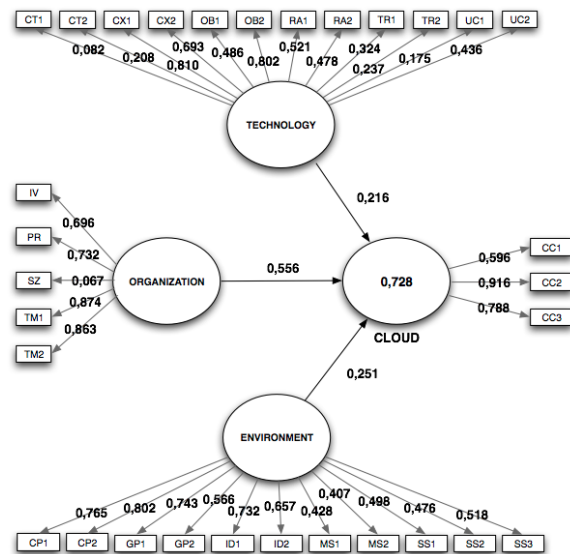


Fig. 4: First attempt PLS calculation

Convergent validity can be done as well by finding the average variance extracted value. Referring to Rule of Thumb, convergent validity is met if the AVE values greater than 0.5. Table 6 shows that the measurement model by AVE is valid for all those variables.

In the model, for each manifest variable should not be correlated. To test this principle it is necessary to test discriminant validity by finding the value of cross loading or square root. Square root of the value of each variable is greater than the value of the correlation [40]. Thus, all the variables in this model is valid.

In addition to testing the validity, reliability test should also be done. This test is done to prove the accuracy, consistency, and precision instrument to measure the construct or variable [39]. Reliability test is done by finding the value of Cronbach's alpha (must be greater than 0,7).

Results of Cronbach's alpha values stated for all reliability indicators have values above 0.7. Thus stated that reliable models.

Other than Cronbach's alpha, composite reliability testing can use for testing reliability (must greater than 0,7). In PLS with SmartPLS program, Cronbach's alpha values will give a lower value of the composite indicator of reliability in reliability testing [39].

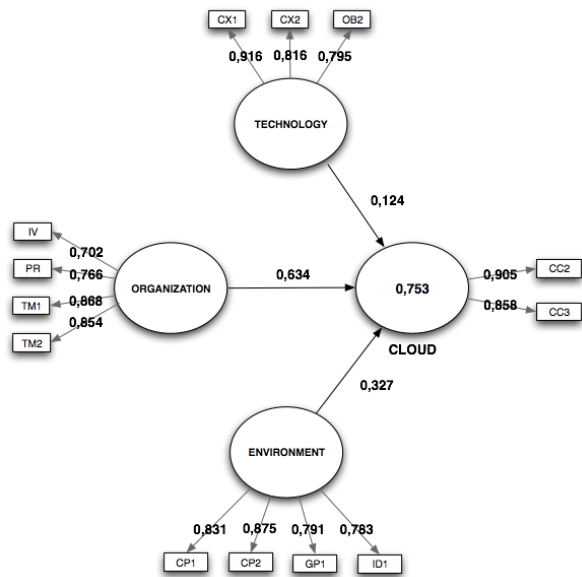


Fig. 5: Convergent validity

Table 5: Convergent validity (loading factor)

Latent Variable	Indicator	Outer Loading	Convergent Validity Supported
Technology	Complexity 1	0,916	Yes
	Complexity 2	0,816	Yes
	Obervability 2	0,795	Yes
Organization	Innovativeness	0,702	Yes
	Top Management Support 1	0,868	Yes
	Top Management Support 2	0,854	Yes
Environment	Prior Technology Experience	0,766	Yes
	Competitive Pressure 1	0,831	Yes
	Competitive Pressure 2	0,875	Yes
Cloud	Government Policy 1	0,791	Yes
	Industry Adoption 2	0,783	Yes
	Industry Adoption 3	0,905	Yes

Table 6: Convergent validity (AVE)

Latent Variable	AVE	Convergent Validity Supported
Technology	0,712	Yes
Organization	0,641	Yes
Environment	0,674	Yes
Cloud	0,777	Yes

Table 7: Discriminant validity

Square Root	Cloud	Technology	Organization	Environment
Cloud	0,882			
Technology	0,627	0,821		
Organization	0,770	0,339	0,800	
Environment	0,475	0,678	0,202	0,844

Table 8: Reliability (Cronbach's Alpha)

Latent Variable	Cronbach's Alpha	Reliability
Technology	0,881	Yes
Organization	0,876	Yes
Environment	0,892	Yes
Cloud	0,875	Yes

Table 9: Reliability (Composite Reliability)

Latent Variable	Composite Reliability	Indicator Reliable Consistently
Technology	0,881	Yes
Organization	0,876	Yes
Environment	0,892	Yes
Cloud	0,875	Yes

Structural model evaluation

Evaluation of structural models or inner models can be done by testing the value of R-Squares, effect size, predictive relevance and significance. This value is also called the inner workings of the model, the predictive power of structural models. Changes in the value of R-Square explained the effect of exogenous variables on endogenous variables.

The coefficient of determination (R²) of Cloud as endogenous latent variable of 0.753. Under the Rule of Thumb, indicating that strong models. Thus can be explained the same time that the factors Technology, Organization, and Environment, is a variant of the substantive nature of Cloud 75.3% (Table 10).

Effect size or value of the F-Square is interpreted as a large or small effect or latent predictor variables in structural models (table 11).

Predictive relevance is one aspect that can be studied in the inner models. Predictive relevance or Q-Square is also called predictive relevance reuse. This technique is obtained by the procedure in the program blindfolding SmartPLS.

Table 10: R-Square

Latent Variable	SSO	SSE	1- (SSE/SSO)
Technology	76.000	6.715	0.517
Organization	152.000	52.000	
Environment	152.000	52.000	
Cloud	114.000	14.000	

Table 11: Effect Size

Latent Variable	Effect Size	Result
Technology	0,034	Moderately affecting to Cloud
Organization	1.440	Very strong affecting to Cloud
Environment	0,216	Moderately affecting to Cloud

Predictive relevance value is 0,517 or greater than 0. It means model has strong predictive relevance.

Hypothesis can be tested using resampling bootstrapping. Bootstrapping will give the value of T-Statistic from each relation of exogenous to endogenous variable.

Table 12: Bootstrapping result

Inner Model Path Coefficient	Standard Error	T-Statistic
Technology -> Cloud	0,126	0,985
Organization -> Cloud	0,072	8.828
Environment -> Cloud	0,120	2.731

From the result of bootstrapping above, hypothesis can be tested with these rules:

- Significance (two-tailed) level 10% is 1,65.
- Significance (two-tailed) level 5% is 1,96.
- Significance (two-tailed) level 1% is 2,58.

Table 13: Results of hypothesis testing

Hipotesis	R ²	T-Value	Supported
TH1		0,985	No
H2	0,753	8,828**	Yes
H3		2,731**	Yes

**Significance at P < 0,05, **Significance at P < 0,01*

Referring to table 13, therefore:

- H1: Technology factor does not affecting PT. Taspen to adopt cloud computing.
- H2: Organization factor affecting significantly PT. Taspen to adopt cloud computing.
- H3: Environment factor affecting significantly PT. Taspen to adopt cloud computing.

CONCLUSION

From the analysis using Structural Equation Modeling - Partial Least Square, it can be concluded as follows:

- Organization is the most influencing factor for PT. TASPEN to adopt cloud computing.
- From the organizational factors, the most driving for PT. TASPEN to adopt cloud computing is the support from top management, organization innovativeness level, and the provision of skills possessed.
- Factors environment ranks second influencing factor for PT. TASPEN to adopt cloud computing. Competitive pressure, type of industry, and government policy, is a strong indicator of these factors.
- Character of cloud computing technology does not affect the trend of the PT. TASPEN to adopt cloud computing.

Referring to these finding, by using SWOT and TOWS matrix analysis, this research give two main recommendation for PT. Taspen:

- To do implementation of private cloud computing.
- Gradually adopting cloud computing, start from non critical business application.

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