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Analysis of Cloud-Based Human Resource Information System Adoption Factors Prioritization in Micro, Small, and Medium Enterprises

Mohammad Izzat Raihan Imron[1], Achmad Nizar Hidayanto[1], Widia Resti Fitriani[1], Widijanto Satyo Nugroho[1], Dedi Iskandar Inan[2]

[1]Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia
[2]Faculty of Engineering, Universitas Papua, Manokwari, Indonesia
Email: mohammad.izzat@ui.ac.id, nizar@cs.ui.ac.id, widiaresti@cs.ui.ac.id, wnugroho@cs.ui.ac.id, d.inan@unipa.ac.id

Abstract—**Indonesia economics is dominated by micro, small, and medium enterprises (MSMEs). One of many ways to develop SMEs in Indonesia is to develop the quality of human resource (HR) development. Human resource information system (HRIS) can help HR development process to be more effective, efficient, and productive. Cloud-based HRIS is one of the solutions that can be used by MSMEs since it's more affordable than HRIS in general. There are many factors influence MSMEs to adopt cloud-based HRIS. This research discussed about factors ranking of cloud-based HRIS adoption by SMEs in Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek). The factors were adopted from many theories and implemented using technology-organization-environment (TOE) framework. This research used analytic hierarchy process (AHP). Semi-structured interview also used to validate the results. The results concluded that organization factor is the most important factor to adopt cloud-based HRIS.**

Keywords— human resource information system; human resource; organization; technology adoption; cloud computing

I. INTRODUCTION

Organization consists of people with formally assigned roles who work together to achieve the organization's goals which managed by a manager. Most experts agree that *managing* involves five functions: planning, organizing, staffing, leading, and controlling [1]. One of the most important in managing is human resource management (HRM). HRM is the process to acquiring, training, appraising, and compensating employees, and of attending to their labor relations, health and safety, and fairness concerns [1]. A good HRM can avoid personnel mistakes, improve profits and performance, and reduce time spent [1].

Indonesian economics is dominated by micro, small, and medium enterprises (MSMEs) which have 99.9% proportion of total business units [2]. MSMEs also absorbs more than 111 million labors (97.05% proportion) [2]. The facts indicate MSMEs are one of the most important pillars in Indonesian economics and the government wants to improve this sector by developing the human resource [3]. Organizations are becoming increasingly reliant on human resource information systems (HRIS) [4]. The MSMEs could give more focus on the main business rather than took a lot of resources to work on the human resource things by using HRIS.

HRIS is a specialized information system within the traditional functional areas of the organization which can support the planning, administration, decision-making, and control activities of HRM [5]. The functionality of Human Resource (HR) functions in today's organizations has been increasingly transformed by HRIS [6]. HR professionals are now able to perform HR functions efficiently and effectively since using HRIS which wasn't feasible in manual information processing and sharing [6]. In recent years, cloud computing and the related "Software as a Service" (SaaS) products have experienced unprecedented growth, including cloud-based HRIS [7]. Cloud-based HRIS can give more advantages than on-premise HRIS such as reduction in cost significantly, fast implementation, easy to get any updates or version changes [7]. There are only 14% MSMEs adopted cloud computing and only 3% who really know what the cloud computing is, it's included HRIS and other services [8]. It indicates there may obstacle for MSMEs to adopt cloud-based HRIS.

There are many factors which influence adoption of HRIS in organizations. For example, factors which influence adoption of HRIS in Indonesia public organizations are budget, decision making, trust, and experiences of other organizations [9]. Within bank or financial organizations, factors which influence adoption of HRIS are social influence and behavioral intention [10]. Factors which influence the adoption of HRIS in hospital organization are perceived cost, top management support, relative advantage, staff's capabilities, and compatibility [11]. Other researches were using adoption theories such as Diffusion of Innovations (DOI) [12], Technology Acceptance Model (TAM) [13], and Technology-Organization-Environment framework (TOE) [14]. This study explores several factors using TOE framework and apply multi dimension criteria decision analysis (MCDA). The factors are arranged by using Analytical Hierarchy Process (AHP) method. This paper focuses on analyzing the prioritization of factors for adoption of HRIS by MSMEs in Indonesia.

II. LITERATURE REVIEW

A. Human Resource Information System

DeSanctis [15] defined HRIS as "a specialized information system within the traditional functional areas of the organization, designed to support the planning, administration,

decision-making, and control activities of HRM". Aptly Kavanagh, Thite, and Johnson [16] described HRIS as a computer system used to acquire, store, manipulate, analyze, retrieve, and distribute information related to human resources. People, forms, policies, procedures, and data also part of HRIS.

HRIS has been evolved that include transaction processing system (TPS), decision support system (DSS), communication system, and artificial intelligence [17]. Currently, HRIS also deployed in the cloud, and gives many advantages than on-premise HRIS such as reduce cost, fast implementation, and easily get update [6]. The most interesting part of cloud-based HRIS is the ability to integrate data from many information systems effectively using application programming interface (API) [18].

B. Micro, Small, Medium, Enterprises

Micro, small, and medium enterprises (MSMEs) have a vital role in Indonesia economics. The government reported MSMEs comprised 99% of total business units and contribute around 58% gross domestic product in Indonesia. Indonesian MSMEs employed above 97% of the total workforce.

There are several definitions of MSMEs issued by different government institutions such as Law No. 20/2008, Ministry of Cooperatives and SMEs, and Central Bureau of Statistics. This paper used definition issued by Central Bureau of Statistics [18]. This institution categorized MSMEs based on number of employees: micro-firms are business entities of between 1-4 employee(s), small-firms are business entities of between 5-19 employees, and medium-firms are business entities of between 20-99 employees.

C. Adoption Models

This study adopted Tornatzky and Fleischer's [14] Technology, Organization, and Environment (TOE) framework, complemented by Rogers' [12] Diffusion of Innovations Theory, privacy calculus [19], technical knowledge and know-how [20], and network externalities [21]. The TOE framework has been employed in many studies [22]. This study shows the usefulness of deploying DOI, privacy calculus, technical knowledge and know-how, and network externalities as complementary theoretical lenses to better understand the underlying mechanisms affecting cloud-based HRIS adoption. TOE is used as an overarching framework to guide the exploration of various influential adoption factors.

The diffusion of innovation (DOI) Theory proposed by Rogers [12], it has been widely used to understand and explain the adoption and diffusion of technological and organizational innovations [23,24]. Diffusion defined as *'the process by which an innovation is communicated through channels over time among the members of a social system'* by Rogers [12]. The diffusion process of innovation is a function of four elements: innovation, communication channels, time, and social system. DOI explains the adoption pattern, diffusion mechanism, and predict how innovation can be succeed [25]. There are five key characteristics of the innovation that affect innovation adoption are relative advantage, complexity, compatibility, trialability, and observability. Communication channels used within the social system to share information about the innovation

internally and externally. Finally, the social structure such as distribution of work and power, interconnectivity, communication structure, and the norms of members as well as the existence of opinion leaders, influences adoption. The DOI fits well within the TOE framework, which can be used to understand the influence of technological, organizational, and environmental factors [26].

The term of privacy calculus first used to explain "calculus of human behavior" [19]. Privacy calculus recognizes the contribution of expectancy theory that explained human act to maximize positive output and minimize negative output. The main constructions of this theory are privacy risk and perceived benefit.

Attewell [20], explained in technical knowledge and know-how theory that innovation isn't only adopted because of the awareness of its benefits. The organization knowledge and technical know-how are also affected the adoption. The vendors should share the knowledge when selling and convincing the innovation to the organizations [20]. Network externalities theory [21], emphasize the importance of technical standard and innovation integration. This theory seems to rectify social aspect of organizational innovation adoption with focusing on how communication and network built between the vendor and the organization. It elucidates that support from vendor in adoption process is important. It also shows that price factor affects the decision of adoption in organization. These theories thus can be used to understand the environmental factors within TOE framework.

D. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a popular multi criteria decision analysis (MCDA) technique that can help in decision-making effectively for solving complex problems [27]. The AHP, introduced by Thomas Saaty, hierarchically divides problem into sub-problems which can be analyzed independently [28]. Saaty [28], defined hierarchy as a representation of complex problems in a multi-level structure which the first level is the objective, the second level is the factor, then the criteria, the sub-criteria, and so on until the last level is the alternative. Human judges evaluate alternatives, including soft issues, using pairwise comparison of the entire options in each sub-problem [29]. The AHP has three principles process: (1) construct the hierarchy structure. (2) Establishing priorities by a comparative judgment of criteria and alternatives using Saaty [28] scale pairwise comparisons with the value of 1 through 9. And (3) logically consistency for checking the consistency of the evaluation measures and alternatives, thus reducing bias in decision making [30].

E. Theoretical Framework

TOE framework, which originated from the study of Tornatzky and Fleishcer [14], has been widely used in many technology adoption studies to identify various factors that contribute and affect in technology adoption at the organizational level. This study adopts this framework to help us understand the adoption of cloud-based HRIS of MSMEs in Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) in a structured manner. Moreover, to develop a better understanding, this study also uses the DOI, privacy calculus,

technical knowledge and know-how, and network externalities within the TOE framework. Table I below shows the research framework and the explanation about the factors of this study. Our framework is briefly discussed below.

TABLE I. RESEARCH FRAMEWORK

Factor	Theory	Description
Technology Context		
Compatibility	Diffusion of Innovations [12]	The extent to which cloud-based HRIS is perceived as being consistent with existing values, past experiences, and needs of organization.
Complexity		The extent to which a cloud-based HRIS is perceived as difficult to understand and use.
Trialability		The extent to which a cloud-based HRIS may be experimented with on a limited basis
Relative Advantage		The extent to which a cloud-based HRIS as better idea it supersedes.
Security	Privacy Calculus [19]	The extent to which a cloud-based HRIS can save organization data from threats and attacks.
Privacy		The extent to which organization data can be accessed to several roles and cloud-based HRIS can save it from data leaks.
Organization Context		
Technological Readiness	Diffusion of Innovations [12]	Organization readiness towards cloud-based HRIS adoption from technology infrastructures and resource perspective.
Top Management Support		Active role from top management to decide and support the adoption of cloud-based HRIS
Firm Size		Organization's numbers of employees, numbers of assets, or numbers of revenues.
Environment Context		
Vendor Reputation	Technical Knowledge and Know-How [20]	Cloud-based HRIS vendor skills, knowledge, experience, and prestige.
Perceived Price	Network Externalities [21]	Cloud-based HRIS price that organization perceived.
External Support	Diffusion of Innovations [12], Network Externalities [21]	Vendor support before, when being, and after implementation of cloud-based HRIS.

There are several factors which influence the technology adoption from technological context. This study divides the technological context into two criteria, innovation criteria and trust criteria. Within the innovation criteria, there are four factors in line with DOI theory, such as relative advantage, compatibility, complexity, and trialability. Within the trust criteria, there are two factors in line with privacy calculus, such as security and privacy.

Within the organizational context, there are several factors that affect the adoption of cloud-based HRIS. DOI theory which explained that social structure, including top management opinion, way of work, norms, communication structure, and interconnectivity, is employed in this study. This theory also mentioned that the size of challenge will influence the adoption process, in this context, the firm size [22]. This context represented by organization criteria which has three factors, including technological readiness, top management support, and firm size.

The environmental context is represented by vendor criteria. There are three factors, such as vendor reputation, perceived price, and external support, which adopted from DOI theory, network externalities theory, and technical knowledge and know-how theory. Network externalities theory help to understand the influence of support from vendor and price to innovation adoption within organization. The technical knowledge and know-how theory help to understand the influence of skill and knowledge of vendor influence organization to adopt innovation.

The research framework developed using TOE framework and arranged based on AHP hierarchy structure. The main objective of this structure is cloud-based HRIS adoption in MSMEs in Jabodetabek. Fig. 1 shows the research framework of this study.

Fig. 1 Research Hierarchy Structural Model

III. METHODOLOGY

This paper used both qualitative and quantitative method. The qualitative approach used to confirm the proposed AHP hierarchy model to three experts and to confirm the result of AHP analysis to three different experts. The quantitative method used to emphasize objective measurements and the statistical or numerical analysis of data collected through an online questionnaire and offline questionnaire.

A. Setting

This study developed to identify the ranking of factors prioritization in cloud-based HRIS adoption. The literature review conducted to discover insight from previous research related to innovation adoption in organization. Semi-structured interviews with open-ended questions technique used as an interview technique to investigate and explore the factors which influence the cloud-based HRIS adoption and confirm the result of factors prioritization analysis. The quantitative approach used the AHP technique and Saaty's scale pairwise comparison [28] to establish priorities.

B. Participants and interviews

The interviews were conducted in two stages, first to confirm the proposed AHP hierarchy model, and second to confirm the result of factors prioritization analysis. The first stage was conducted with three experts. The second stage was conducted after analyzing the result of questionnaires with three experts which were the respondents of the questionnaire. The average duration of the interview process was approximately 30-45 minutes.

The questionnaire consists of two sections, first for respondents' profile and second for judgment of pairwise comparisons for criteria and sub-criteria. We conducted a readability test to seven respondents before distributing the questionnaire. The questionnaires were distributed online and offline.

AHP method accentuates the data quality of the respondents and doesn't depend on the quantity [28]. The questionnaires were distributed only to respondents who has capability, knowledge, and right to decide according to human resources in their organization. There were 254 responses collected, but only 52 respondents completed the survey, and 5 respondents weren't eligible to fill the survey due they weren't match with the questionnaire criteria, thus there are only 47 respondents' data could be processed. The demographics are shown in Table II.

TABLE II.   RESPONDENT'S DEMOGRAPHIC

	Frequency	Percentage
Respondent's Role		
Owner/C-Level	27	57.4%
Top Manager	13	27.7%
HR	7	14.9%
Respondent's Age		
< 20	0	0%
20-30	35	74.5%
31-40	3	6.4%
41-50	7	14.9%
>50	2	4.3%
Firm Size		
Micro	15	31.9%
Small	20	42.6%
Medium	12	25.5%
Organization's Domicile		
Jakarta	14	29.8%
Bogor	6	12.8%
Depok	18	38.3%
Tangerang	6	12.7%
Bekasi	3	6.4%

IV. ANALYSIS, FINDINGS, AND DISCUSSION

A. Hierarchy Structure Model Validation

The hierarchy structure model in this paper initially contains five criteria and 15 sub-criteria based on the literature review. Then each of sub-criteria validated with the expert using in-depth interview. They were asked to review the factors, which factor should be added, subtracted, or replaced. The result from interviews underlies the final hierarchy structure model shown in Fig. 1.

B. Pairwise Comparison Matrix

The highest level of the hierarchy is the objective – cloud-based HRIS adoption. We establish pairwise comparisons between criteria in the form of a matrix. The value of the comparisons obtained from questionnaire. The diagonal value of the matrix between criteria filled in with the weight from respondents. The results are shown in Table III.

TABLE III.   CRITERIA PAIRWISE COMPARISON MATRIX

Criteria	Organization	Trust	Innovation	Vendor
Organization		2.02806	1.73631	2.49702
Trust			1.75348	2.02202
Innovation				1.78277
Vendor				

C. Overall Factors Prioritization

Each criterion and sub-criterion can be prioritized by calculating their weight. The weight is obtained by calculate the eigenvalue of each criterion and sub-criterion in each criterion. Table IV shows the results of the prioritization.

TABLE IV.   SUB-CRITERIA EIGENVALUE

Criteria	Sub-criteria	Eigenvalue
Organization	Technological Readiness	0.320
	Top Management Support	0.408
	Firm Size	0.271
Trust	Security	0.474
	Privacy	0.526
Innovation	Compatibility	0.267
	Complexity	0.120
	Trialability	0.208
	Relative Advantage	0.404
Vendor	Vendor Reputation	0.259
	Perceived Price	0.329
	External Support	0.412

After we calculated each eigenvalue, the researchers should test the consistency ratio to ensure the result are consistent. The consistency ratio shouldn't be higher than 0.1. The consistency ratio calculated from the calculation of criteria's weight is 0.02. Then we could compare the prioritization in global view and get each sub-criterion eigenvalue towards the hierarchy objective. Table V shows the result of the prioritization globally.

TABLE V.   SUB-CRITERIA EIGENVALUE AND RANK GLOBALLY

Sub-criteria	Eigenvalue	Rank
Technological Readiness	0.136	2
Top Management Support	0.173	1
Firm Size	0.115	4
Security	0.104	5
Privacy	0.116	3
Compatibility	0.058	7
Complexity	0.026	12
Trialability	0.045	10
Relative Advantage	0.088	6
Vendor Reputation	0.036	11
Perceived Price	0.046	9
External Support	0.057	8

The table V shown that the most important sub-criteria globally is top management support from organization criteria with eigenvalue of 0.173. The most important sub-criteria from trust criteria, privacy, ranks third globally with eigenvalue of 0.116. The least important sub-criteria globally is complexity from innovation criteria with eigenvalue of 0.026. After we got each weight, then we calculate the consistency ratio and got 0.02. The consistency ratio shows that the result is consistent enough.

V. DISCUSSION AND IMPLICATIONS

This paper has investigated factors prioritization of cloud-based HRIS adoption for MSMEs in Jabodetabek using AHP method. The factors categorized in 4 dimensions. Among the dimensions, the result indicates that organization is the most significant dimension, in line with Liang, Qi, Wei, and Chen's study [31] which said that organization had an important role in deciding to adopt or not. The experts, who have been interviewed before, agree with this result. They argued their organization needs and resources become the reason for deciding the adoption. Moreover, it's also in line with van de Weerd, Mangula, and Brinkkemper's research [32].

Within organization dimension, top management support become the topmost factor, technological readiness factor and firm size factor. The experts accord with this result, they encountered the role of top management in supporting and deciding the adoption is the most impactful act in the organization. It's in line with Alam, Masum, Beh, and Hong's [11] research which said that top management support is the most influencing factor in hospital to adopt HRIS. Other researches, such as van de Weerd, Mangula, and Brinkkemper's research [32] and Oliveira, Thomas, and Espadanal's research [26] also in line with this result.

This study found that privacy become the most considered factor in trust dimension, in line with Xu's [33] study and Li, Wu, Gao, and Shi's [34] study. They [34] said that privacy has negative impact towards the intention of health wearable device adoption. This study concluded that privacy is more important than security factor, which oppose with Alkhater, Walters, and Wills' study [35] and Gupta, Seetharaman, and Raj's study [36] which said that security is more important than privacy. The experts stated why privacy factor is more important in this case is because HRIS stores organization sensitive data, which not all the employee could see. They

added HRIS need to ensure the segregation of the users and roles, thus the privacy of the data will be safe and assured.

Relative advantage has become the most important factor in innovation dimension. It's in line with Alam, Masum, Beh, and Hong's [11] research which has found that relative advantage influences the adoption of HRIS in hospital. Liang, Qi, Wei, and Chen's [31] research also agreed that relative advantage become a significant indicator to stimulate cloud adoption. Obeidat's [37], said that relative advantage, trialability, and compatibility affect the adoption but not the complexity. It's also in line with the finding in this research which complexity become the least important factor in innovation dimension. The experts said that the organization needed to ensure the innovation would bring many benefits to the organization.

Vendor dimension, which represented the environment dimension, become the least important dimension based on this study. Alam, Masum, Beh, and Hong [11] also stated that environment dimension is less important than technology and organization dimension. Despite of the fact, external support found as the topmost factor in this dimension, got higher eigenvalue than perceived price and vendor reputation. Roumani, Nwankpa, and Roumani [38] concluded that support from vendor influences the system trust and impact to the intention to adopt indirectly. It's also in line with Ahmadi, Nilashi, Shahmoradi, and Ibrahim's [39] study which stated vendor support affected the adoption of information system in hospital. All experts said that they preferred to choose vendor that had a better support although it would be costive.

The result of this study, from theoretical view, contributes to information system literature. There are still a few researches that study the adoption of cloud-based HRIS in developing countries and MSMEs. The majority, the researches study about the adoption of HRIS in developed country and big corporations. This study used TOE framework, integrated with other adoption theory to identify the factor prioritizations of cloud-based HRIS adoption by MSMEs in Jabodetabek. It thus provides the insight to the vendor of cloud-based HRIS to give more attention to educate the top management about the privacy, benefit, and after-sales service of the vendor.

VI. CONCLUSIONS

This study used AHP method to identify the factors prioritization in cloud-based HRIS adoption by MSMEs in Jabodetabek. We also used the semi-structured interview as a qualitative approach to get more insights from the expert about the hierarchy model and the result of factors prioritization. Organization aspect become the most important criteria to adopt cloud-based HRIS in Jabodetabek MSMEs. Before adopting cloud-based HRIS, MSMEs in Jabodetabek assess organization needs, will, and resources first. Top management support, a sub-criterion from organization criteria, became the most considered factor compared to all factors, it means the top management of MSMEs has the most important role to decide and support the adoption of this innovation. From the trust criteria, privacy became the most important factor among other sub-criterion in the criteria, based on the experts' opinion, it's because cloud-based HRIS stores organization's sensitive data.

Relative advantage factor became the most pondered factor in innovation criteria, it means the organization needs to assess the benefit of this innovation. The most important factor in vendor criteria is external support. The experts' said that external support, such as assistance in implementation, customer service, and give training, would ease the process of adoption. The result of this study is acceptable since the consistency ratio is 0.02, less than 0.1. Possible future research can use other method like analytic network process and focus in one type of MSMEs.

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