Exploring the roles of collaboration factors towards ERP adoption

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Abstract. This research was conducted to recognize the antecedents of ERP usage, by using TAM and incorporating collaborative factors as external precursors. In this research, data was collected from a reputable manufacturing organization in Indonesia. A total of 59 individuals from the organization participated in this research actively use ERP in their daily work activities. The qualitative data was then statistically analyzed by using PLS-SEM. The results provided insights into how collaborative factors shape users’ perception of usefulness and ease of use, which in turn affects their behavioral intention to use ERP. Attitude towards use was affected by usefulness and ease of use perceived, whereas behavioral intention towards use was affected by usefulness perceived. Internal collaboration affected both perceived usefulness and ease of use. On the other hand, external collaboration was deemed as insignificant contributors in shaping users’ perceived of usefulness and ease of use.

Keywords—ERP, TAM, collaboration

1. Introduction
Organization A (from here on forwards will be referred to as ‘OA’) is a reputable cosmetics organization in Indonesia, supported by a strong management system, pharmacists as well as experienced and professional staff. OA prioritizes innovation and combines the effectiveness of medicinal raw materials in their manufacturing process of beauty products. Recently, OA decided to implement Enterprise Resource Planning (ERP) system. However, the implementation was problematic because its benefits were not realized, and its acceptance was low amongst end users.

OA’s predicament led the authors to find out about exploring the factors that may affect users’ acceptance of ERP. Technology Acceptance Model (TAM) is one of the most widely used model to explain user behavioral intention for technology adoption. Its robustness in information systems (IS) research is undoubted, as well as in evaluating ERP adoption. For example, TAM can play a critical role in evaluating behavioral intentions of ERP usage [1], underline critical success factors of ERP adoption [2], or even examine external factors that may affect ERP implementation [3].

Even though there have been numerous efforts conducted by previous researchers to understand ERP adoption, there is yet one that discusses collaborative factors as a determinant of adoption. Therefore, this research differentiates itself from other previous works, by specifically focusing on evaluating the roles of collaborative factors towards ERP adoption.
2. Theoretical Background and Hypotheses Development

2.1. Technology Acceptance Model (TAM)
Technological Acceptance Model (TAM) is a model that examines psychological factors that affect technology acceptance. Perceived usefulness and ease of use are considered in determining an individual's intention to use a system, as a mediator of actual system usage, or behavioral intention. Perceived of usefulness is also deemed to have a direct effect to perceived of ease of use [4].

2.2. Collaboration
Collaboration is a process whereby individuals, groups and organizations come together, interact and have psychological relationships for mutual benefits or advantages [5]. Collaboration can be divided into two broad sections; internal collaboration which focuses on collaboration within the organization, and external collaboration which focuses on collaboration beyond the organization [6]. Internal collaboration can be explained in two ways, namely interdepartmental collaboration and intradepartmental collaboration, while external collaboration is characterized by implementation consultant and vendor support.

The previous work defined interdepartmental collaboration as both formal and informal interactions and relationships among departments within the organization [7]. There are several variables that affect interdepartmental collaboration; organizational system, managerial involvement and strategic planning on quality. Intradepartmental collaboration is a limited collaboration in one department where collaboration occurs when two or more people perform or complement task at the same time [8].

Implementation consultant is known as a consultant’s agreement or involvement during the acquisition of ERP system [9]. Organizations often use external consultants not only to obtain software but also to utilize the consultants’ skills and experiences. The consultants may have experience and knowledge in a particular ERP module and may guide the organization in their endeavor to implement ERP. Furthermore, the need for vendor support in ERP implementation is stronger than other IS projects because ERP implementation projects require a variety of technical implementation skills and knowledge [10]. It is uncommon for an ERP implementing organization to internally possess all knowledge of the system. Therefore, organizations implementing ERP should complement their internal-team skills with implementation resources from external vendors or consulting firms that offer the necessary skills and knowledge [11].

2.3. Research Model and Research Attributes
The underlying research model examines user behavior towards information systems based on Perceived usefulness (PU), Perceived ease of use (PEoU), Attitude toward use (ATU) and Behavioral intention to use (BIU). This study incorporated external factors associated with perceived usefulness and perceived ease of use of ERP system. The external factors studied are internal and external collaboration, characterized by interdepartmental collaboration, intradepartmental collaboration, implementation consultant and vendor support.

ERP implementation provides significant benefits for management and organization in the process of integration of both business processes and communication among users [12]. Communication is one of the organizational functions that help the organization to remain efficient and productive. One of the most important forms of organizational communication is communication among departments and within a department. Thus, the following hypothesis was proposed:
H1a: Interdepartmental collaboration has a positive effect on the perceived usefulness of ERP.
H1b: Interdepartmental collaboration has a positive effect on the perceived ease of use of ERP.
H2a: Intradepartmental collaboration has a positive effect on the perceived usefulness of ERP.
H2b: Intradepartmental collaboration has a positive effect on the perceived ease of use of ERP.

External collaboration involves organizational relationship with ERP vendors in this case, the consultants implement ERP. Internal and external collaboration provides synergy, security and assistance in achieving organizational expectations. Hence, it is safe to assume that positive
collaboration is related to perceived usefulness. Additionally, having sound collaboration between end users as internal components and consultants as external components allows ERP system to be perceived as easy, with the hope that end users can feel the benefits of the system. Thus, the following hypothesis was proposed:

H3a: Implementation consultant has a positive effect on the perceived usefulness of ERP.
H3b: Implementation consultant has a positive effect on the perceived ease of use of ERP.
H4a: Vendor Support has a positive effect on the perceived usefulness of ERP.
H4b: Vendor Support has a positive effect on the perceived ease of use of ERP.

Research on TAM has shown strong empirical support for a positive relationship between perceived ease of use, and perceived usefulness towards attitude towards use. Additionally, perceived usefulness and attitude towards use affects behavioral intention to use [4]. Thus, the following hypothesis is proposed:

H5: Perceived ease of use has a positive effect on perceived usefulness of ERP.
H6: Perceived ease of use has a positive effect on attitude toward using ERP.
H7: Perceived usefulness has a positive effect on attitude toward using ERP.
H8: Perceived usefulness has a positive effect on behavioral intention to use ERP.
H9: Attitude toward use has a positive effect on behavioral intention to uses ERP.

3. Research Approach

Researchers distributed close-ended questionnaires to all 281 end users of an ERP system within OA. This distribution process was assisted by OA’s Information Technology division. The questionnaire was distributed in digital format, through email and messaging service. The number of questionnaires collected were 59 questionnaires or 21% of those distributed.

The majority of respondents (52.5%) have previous experience using ERP system, ranging from 1-3 years. In terms of gender, male (67.8%) respondents were the majority, with age of 25 - 34 years old. In terms of formal education, more than half of the respondents have finished their undergraduate degree (52.5%) and are competent in using information technology.

Data was statistically evaluated by using PLS-SEM with SmartPLS 3 tools. As suggested by [13], the analysis will begin with evaluation of measurement model followed by evaluation of structural model to test their hypothesis.

4. Analysis and Results

4.1. Measurement Model (Outer Model)

The measurement model evaluation consisted of reliability and validity examinations. A summary of the measurement model evaluation is presented in Table 1. Composite reliability (CR) for exploratory research should have a value of greater than 0.60 [14], which the data in this research surpassed the prerequisite.

Convergent validity evaluation was conducted to assess the positive effect of each indicator within the same latent variable. Convergent validity was assessed by ensuring all indicators’ outer loading values were greater than 0.70 and Average Variance Extracted (AVE) values of all variables were greater than 0.50, as suggested by [13]. Four indicators had loading factors below the threshold and were excluded from further analysis. Upon exclusion, all indicators and variables have met convergent validity requirements. Furthermore, this research also conducted a discriminant validity examination, measured cross-loading values of all indicators as well as Fornell-Larcker criterion. The cross-loading value must be greater than 0.50. Additionally, cross-loading values and square root of AVE values must be greater to its own construct when compared to other constructs in the model, which was the case found in this research model, hence ensuring discriminant validity of all variables in the model.
4.2. Structural model (Inner Model)

The structural model can be evaluated by several measures, such as the coefficient of determination ($R^2$) and path coefficient value to test the hypotheses [13].

Two endogenous variables, namely perceived ease of use (0.502) and perceived usefulness (0.560) exhibited moderate determination, with $R^2$ values greater than 0.50. Attitude towards use (0.478) and behavioral intention (0.420) showed a slightly lower $R^2$ value and can be categorized as a weak/substantial determination. The $R^2$ values indicated that the overall research model resides on a medium-strength scale in predicting intention to use ERP systems.

Furthermore, hypothesis testing was conducted by referring to t-values and path coefficients values. This research employed a two-tailed test at 95% confidence level, making the threshold t-values for accepted hypotheses be greater than or equal to 1.96. As summarized in Table 2, this research found seven accepted hypotheses while the remaining six were rejected. A visual representation of the resulting research model is exhibited in Figure 1.

5. Discussion and Implications

Attitude towards use was affected by both perceived usefulness and perceived ease of use concertedly. However, this research did not found attitude towards use as a direct antecedent of behavioral intention to use. Instead, behavioral intention to use ERP was affected by users perceived usefulness. Perhaps, this was caused by the imperative nature of ERP usage in OA, making users attitude irrelevant as a precursor of actual usage, and at the same time, allowing perceived usefulness to play a bigger role as antecedent of actual usage. Therefore, this research found it is important for OA to continuously promote and inform end users of the positive potentials that ERP adoption may bring in assisting daily business processes.

Perceived usefulness itself was affected by two antecedents; perceived ease of use and intradepartmental collaboration. Perceived ease of use’s role in shaping perceived usefulness is expected, alike to the arguments of [4]. However, it is interesting to note that intradepartmental collaboration played a key role in deciding users’ perceived usefulness, whereas interdepartmental collaboration was deemed as insignificant towards users’ perceived usefulness. This finding explain that ERP system’s perceived usefulness was driven more by cross-functional / interdepartmental collaboration, which perhaps, is related to the nature of ERP itself that behaves as a system that integrates processes from different aspects of the organization.

| H | Paths | Path Coeff. | T-Value | P-Value | Sig. |
|---|---|---|---|---|---|
| H1a | Interdepartmental Communication $\rightarrow$ Perceived Ease of Use | 0.500 | 3.740 | 0.000 | Accept |
| H1b | Interdepartmental Communication $\rightarrow$ Perceived Usefulness | 0.196 | 1.210 | 0.226 | Reject |
| H2a | Intradepartmental Communication $\rightarrow$ Perceived Ease of Use | 0.397 | 2.330 | 0.020 | Accept |
| H2b | Intradepartmental Communication $\rightarrow$ Perceived Usefulness | 0.297 | 1.980 | 0.048 | Accept |
| H3a | Implementation Consultant $\rightarrow$ Perceived Ease of Use | 0.174 | 1.234 | 0.217 | Reject |
| H3b | Implementation Consultant $\rightarrow$ Perceived Usefulness | -0.109 | 0.784 | 0.433 | Reject |
| H4a | Vendor Support $\rightarrow$ Perceived Ease of Use | -0.044 | 0.287 | 0.774 | Reject |
| H4b | Vendor Support $\rightarrow$ Perceived Usefulness | 0.013 | 0.094 | 0.925 | Reject |
| H5 | Perceived Ease of Use $\rightarrow$ Perceived Usefulness | 0.302 | 1.754 | 0.080 | Accept |
| H6 | Perceived Ease of Use $\rightarrow$ Attitude Towards Use | 0.420 | 2.975 | 0.003 | Accept |
| H7 | Perceived Usefulness $\rightarrow$ Attitude Towards Use | 0.346 | 2.127 | 0.033 | Accept |
| H8 | Perceived Usefulness $\rightarrow$ Behavioral Intention to Use | 0.493 | 2.921 | 0.004 | Accept |
| H9 | Attitude Towards Use $\rightarrow$ Behavioral Intention to Use | 0.217 | 1.406 | 0.160 | Reject |

Table 1. Composite Reliability and AVE values

| Latent Variable | Composite Reliability | AVE |
|---|---|---|
| Attitude Toward Use | 0.888 | 0.664 |
| Behavioral Intention to Use | 0.944 | 0.894 |
| Implementation Consultant | 0.884 | 0.776 |
| Interdepartmental Collaboration | 0.929 | 0.817 |
| Intradepartmental Collaboration | 0.875 | 0.701 |
| Perceived Ease of Use | 0.904 | 0.702 |
| Perceived Usefulness | 0.929 | 0.767 |
| Vendor Support | 0.920 | 0.744 |
Perceived ease of use, on the other hand, was jointly affected by interdepartmental and intradepartmental collaboration. Therefore, good collaboration among users within the same business unit can increase users’ perception of ease in using ERP. Additionally, it is also important to ensure collaboration among users across business units, perhaps by conducting weekly meetings, or promoting knowledge sharing amongst them.

6. Conclusion and future works

This research was conducted to recognize the antecedents of ERP usage, by using TAM and incorporating collaborative factors as external precursors. Attitude towards use was affected by perceived usefulness and perceived ease of use, whereas behavioral intention to use was affected by perceived usefulness. Internal collaboration affected both perceived usefulness and perceived ease of use. On the other hand, external collaboration was deemed as insignificant contributors in shaping users’ perceived usefulness and ease of use.

A few things should be considered for future research. First, similar research should be conducted, across different organizational scale and industrial backgrounds with a larger sample, therefore the invention can have a stronger justification for generalization. We also want other researchers to explore different collaborative factors that may shape users’ adoption of ERP systems.

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References

[1] Gumussoy C A, Calisir F and Bayram A 2007 Ind. Eng. Eng. Manag. 2007 IEEE Int. Conf Understanding the behavioral intention to use ERP systems: An extended technology acceptance model. pp 2024–2028
[2] Bueno S and Salmeron J L 2008 Interact Comput TAM-based success modeling in ER. 20(6) pp 515–523
[3] Sternad S, Gradisar M and Bobek S 2011 Ind. Manag. Data Syst The influence of external factors on routine ERP usage. 111(9) pp 1511–1530
[4] Davis F D 1989 MIS Q Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. 13(3) pp 319–340
[5] Smith K G, Carroll S J and Ashford S J 1995 Acad. Manag. J Intra- And Interorganizational
Cooperation: Toward A Research Agenda. 38(1) pp 7–23

[6] Hillebrand B and Biemans W G 2003 Journal of Business Research The relationship between internal and external cooperation: Literature review and propositions. 56(9) pp 735–743

[7] Kohli A K and Jaworski B J 1990 J. Mark Market Orientation: The Construct, Research Propositions, A Market Orientation: The Construct, Research Propositions, and Managerial Implications. 54(1) pp 1–18

[8] Guastello S J and Guastello D D 1998 Journal of Applied Psychology Origins of coordination and team effectiveness: A perspective from game theory and nonlinear dynamics. 83(3) pp 423–437

[9] Bhatti T 2005 Second Int. Conf on Critical success factors for the implementation of enterprise resource planning (ERP): empirical validation. pp 1–10

[10] Davenport T 2000 Mission Critical: Realizing the Promise of Enterprise Systems. (Harvard: Harvard Business Press)

[11] Willcocks L P and Sykes R 2000 Commun. ACM Enterprise resource planning: the role of the CIO and it function in ERP. 43(4) pp 32–38

[12] Holsapple C W and Sena M P 2005 Decision Support Systems ERP plans and decision-support benefits. 38(4) pp 575–590

[13] Hair J F, Ringle C M and Sarstedt M 2011 J. Mark. Theory Pract PLS-SEM: Indeed a Silver Bullet. 19(2) pp 139–152

[14] Nunnally J and Bernstein I 1994 Psychometric Theory, 3rd edn, 1994 (New York: McGraw-Hill) vol. 3 p 701