The Effect of Multidimensional Factors on Organizational Adoption of Enterprise Architecture: The Moderating Role of Organization Type

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Abstract. This study explains the effects of organization type on the relationship between multidimensional factors and enterprise architecture (EA) adoption from the perspective of the organization. This study employs the Technology-Organization-Environment (TOE) framework to develop and test the model to explain EA adoption intention. Despite the importance of EA adoption in the public sector, very few empirical studies examined the key factors of EA adoption by public sector organizations and there remains a paucity of evidence on the moderating effect of organization type in the adoption of EA. This study underpinned the technology adoption model of TOE framework. A questionnaire was operationalized to measure the perceptions of Malaysian public sector organizations towards factors influencing EA adoption intention. Data collected through a survey covering 255 validated responses were analyzed using SMART-PLS tool. The results of the survey suggest that good governance, expected benefits and moderating effect have significant effects on EA adoption intention. In addition, organization type in the Malaysian public sector plays different roles on the relationships of good governance and expected benefit towards organizations' EA adoption. Interestingly, adequate ICT infrastructure, external support and top management support were found as insignificant factors in this study. The study includes implications for academic researchers, decision-makers and practitioners to understand the influence of multidimensional factors and effectively conclude on the adoption process. The decision-makers can use the EA adoption model as a baseline for boosting EA adoption among MPS organizations.

1. Introduction
Enterprise Architecture (EA) enables organizations to accomplish their needs and fulfill the stakeholders’ demands such as business agility, efficient IT operations and digital transformation. EA integrates technology, business, information, and application domains in the organization and aligns them in accomplishing the organizational strategy \cite{1, 2}. The Technology-Organization-Environment Framework (TOE) developed by Depietro, et al. \cite{3} has been widely applied to understand how the organizational context influences the adoption and implementation of new innovations such as EA \cite{4}. However, very few studies have been conducted on how the public sector organizational context influences EA from the perspective of the TOE framework. This study also examines the moderating effect of organization type in the adoption of EA. In Malaysia context, there are five (5) different organizational types in the public sector with different managerial implications. These are federal, federal statutory body, state, state statutory body, and local authorities. These type of organization for
example, federal and state organizational structure are different in terms of distribution of legislative power, resources, and money [5]. In Malaysia, state statutory bodies and local authorities are under the jurisdiction of state legislative power whereas federal statutory bodies are under federal legislative power. Pudjianto, et al. [6] demonstrated that the E-Government assimilation is diffused asymmetrically in federal and state organizations and [7] claimed that the diffusion of innovation depends on the variables of cultural and political norms, education, policies and financial support [6, 7]. In view of this scenario, knowledge on the influence of EA adoption in the various types of Malaysian public sector (MPS) organizations is scarce [8].

Thus, this study investigates the key factors and moderating effect of organization type in EA adoption by MPS organization, with the aim of developing and testing a conceptual model and test the model in realizing the EA adoption in MPS. Our findings contribute meaningful insights and greater understanding of the integral role of EA among those in decision-making of public sector organizations for delivering their best citizen-centric services through seamless and connected government. The structure of this paper is as follows; the second section highlights the theoretical perspective of this research; the third section describes the research model; the fourth section explains the methodology; the fifth section demonstrates the results; the sixth section presents the discussion; and finally, conclusion, limitation, and future research are shown in Section 7.

2. Theoretical background

Business, information, technology and application systems are domains that make up enterprise architecture [9]. EA facilitates the transformation od the as-is architecture into an ideal form for organizations. This transition is not easy and the process is slow due to potential factors such as poor comprehension about EA and nominal insight on EA. Previous study undertaken by Dang Duong [10] on EA provided insights to the organization as the study involving public sector in three different provinces in Vietnam found that pressure factors affect implementation of EA. Further to that, another study extended the study carried out by Dang Duong [10] with the use of Resource-Based View (RBV) Theory to investigate EA adoption trend of the Vietnamese public sector [2]. Seppänen [11] further enriched the literature by investigating the determination, dexterity, and destination of influencing organizational factors on EA adoption. In addition to that, other influencing factors of organizational change based on structural, political and cultural aspects alongside with the consequent outcomes of EA were found to be significant too [12]. These qualitative and country-specific studies had provided useful and practical insights on EA implementation. However, few works have empirically analyzed factors that affect decision-making or purpose of EA based on a TOE perspective or to make comparison based on organization type (Federal vs. State).

In addition, previous studies such as Bakar et al. [13] was focused on EA post-adoptions but these studies were fragmented as only environmental context [2, 10] or organizational context [11, 12] were considered. There are very few empirical studies that investigated on organizational intention for EA adoption based on multiple contexts or had considered differentiating the intention based on organization type. In the investigation of factors influencing EA adoption in Malaysian public sector organizations, the TOE framework which was initially developed by Depietro et al. [3] was employed to serve as the underpinning theory for this study. The adoption level and social impact supported the guiding principles guided for selecting the appropriate theory in this study. EA adoption requires participation from organizational users in different levels and business functions such as human resource, strategic planning, IT operations, financial and facility. In addition to that, EA has social impact in the sense that people need to change, acquire and use EA. Hence, consistent with past studies, organizational change or transformation can be explained using organizational theories [14]. Common factors were identified in previous studies on EA and TOE framework such as ICT infrastructure, top management support, governance and external support. Indisputably, validation of these factors have been made and they were regarded as crucial elements at play in the adoption of technology such as EA by organization.
3. Research model

The technology adoption model of TOE framework which is a popular underpinning theory in most studies on information system is used as a grounding theory in this study. Independent variables for this study include the three contexts in the TOE framework which are technology, organization and environment whereas the dependent variable is adoption of EA [15]. The contributing factors were identified from prior studies on EA and TOE conducted in varied countries. The technological factors comprise of the characteristic, internal and external technologies that can boost adoption of EA. Technologies is not only about equipment but it also entails the processes being used [3]. As indicated in past studies, technology is considered as a positive influencing factor of innovation adoption at the organizational level [16, 17]. Therefore, this study includes the technological variables of ICT infrastructure [18]. Besides that, firm’s characteristics and resources depict the organizational context as accepted innovation enablers and it is represented by good governance, expected benefits and top management support [19]. Based on past studies, top management support had positively influence radio frequency identification (RFID), software-as-a-service (SaaS), cloud computing and e-government adoption [20]. Top management support was found to be a critical determinant in the adoption of EA [21]. Further to that, expected benefits should also be considered as another organizational factor of EA adoption as it can be regarded as a relative advantage based on the statement made by Everett that innovation such as EA provides greater organizational benefits after transitioning from a status quo situation [7]. Other studies [12, 19, 22] also confirmed the benefits of EA as being instrumental in persuading organizations to adopt it. Although these factors have empirical evidence supporting their significant roles in EA adoption, but the extent to which these organizational factors influence EA adoption has not been extensively explored. Previously, environmental context was more focused on the sector within which the organizations operated in alongside with the external pressures and opportunities influencing EA adoption. Additionally, organizational factors also consider the external support in the public sectors. Therefore, we propose the hypotheses listed as follows:

H1: Adequate ICT infrastructure positively influence EA adoption.
H2: Top management support positively influence EA adoption.
H3: Expected benefit positively influence EA adoption.
H4: Good governance positively influence EA adoption.
H5: External support positively influence EA adoption.

In the Malaysia public services, there are several types of organization that could possibly exude a moderating effect on EA adoption. A moderator is a variable that can either strengthen or weaken the relationship between the independent and dependent variables [23]. MPS comprises of Federal, Federal Statutory Body, State, State Statutory Body and Local Authority. The Federal and State bodies differ in terms of legislative and executive power distribution as well as provision of grants and financial burden, which are stipulated in the Malaysian Federal Constitution [5]. A moderating variable is often considered when it is evident that there is inconsistency in the results from past studies regarding the relationship between these variables [24]. In previous studies, the influence of expected benefits, top management support and good governance on adoption were found to be significant [25] but there are studies which indicated that the relationships were insignificant [26]. Furthermore, Pudjianto et al. [6] indicated in their study on e-government that diffusion of technology occurs unevenly across countries with differing environment, which implied that organization type might be a potential moderator to be considered for public sector organizations [6, 10]. It is expected that there could be asymmetric adoption of EA in Federal and State type of organizations. However, past studies have not explored the buffering effect of organization type in the relationship between TOE factors and EA adoption that we propose the following hypotheses.

H6a: The positive relationship between good governance and EA adoption intention will be stronger for a local authority.
H6b: The positive relationship between top management support and EA adoption intention will be stronger for federal.
H6c: The positive relationship between expected benefits and EA adoption intention will be stronger for federal.

Therefore, as can be seen in Figure 1, a research model with the inclusion of organization type as a moderating effect toward intention to adopt EA is proposed for the present study.

![Figure 1. Research model](image)

4. Methodology
This section provides a description of the methodology that refers to the process involved in this study.

4.1. Procedure and sample
The study population is totaled at 741 comprising of key decision makers such as Chief Information Officer, Director and Head of Department in different types of organization in the public sector. The survey was randomly disseminated between March and July 2019 among Malaysian public sector organizations. G*Power tool was used to determine the minimum sampling requirement based on five predictors, 0.05 error of probability ($\alpha$), and 0.8 power (1-$\beta$). Since this study uses organization type as a moderator, stratified sampling rules was applied based on the calculated total sampling size = 120 into five organization types; Federal, Federal Statutory Body, State, State Statutory Body and Local Authority. The researcher followed universal ethics and set up the procedures of survey method. Further to that, consistency in terms of instrument format, data collection, and survey was also ensured [27]. Key participants of this study were invited to participate via e-mail whereby a link to the online survey was provided in the e-mail. Out of 350 questionnaires distributed, only 285 responded to the survey for further analysis.

4.2. Measures
The online survey was divided into two sections: demographic profiles and identified EA adoption factors using close-ended questions. The measurement items of factors were taken from established journals such as MIS Quarterly. The measurement items were adapted for organizational unit of analysis and then validated through the process of content validation by experts [28]. Such experts have been selected on the basis of their competence in knowledge and experience in different fields, such as information system, EA, research method, statistics, public sector and regularly conduct research in the field of research or method [29, 30]. Therefore, the measurement items were validated and adequate for measuring the perception of factors influencing EA adoption [28]. The demographic profiles of the respondents include age, education level, position, grade, length of working experience, organization.
type, total number of employees and total number of IT employees. Rating for the EA adoption factors was based on a 7-point scale ranging from “strongly disagree” (point 1) to “strongly agree” (point 7). However, organization type was measured using five categorical variables. There were three items for measuring adequate ICT infrastructure such as integrated applications, sufficiency of ICT infrastructure and shared databases for various applications within their organization [6, 31]. In the organizational context, top management support was measured by four items to capture the involvement of the top management team [32]. Expected benefits were measured using five items indicating perceptions of the EA benefits to improve the organization’s service performance and effectiveness [33]. Meanwhile, good governance factor used six items from to assess the perception of good governance element for EA such as EA outcome, accountability, ongoing responsibilities, and systematic procedures [34].

The initial data analysis and descriptive analysis of the variables were carried out using SPSS v25. Data collection issues such as missing data and doubtful response patterns were managed by elimination of data set with zero standard deviation and replacement with mean or mid-point value for Likert-scale type data set with less than 20% missing data. This led to a total of validated responses at 255. Normality test based on z value for skewness and kurtosis for each construct was determined. Two variables exceeded the threshold values of ± 3 and ± 1.96, which are EB = -3.6 and ICT = -2.43 [35]. Therefore, this study has non-parametric data. PLS-SEM does not impose on strict requirement of data normality, but it is still advisable to ensure that outliers are detected and distribution is checked for extreme values [23]. Further to that, common method bias was also examined using two methods – Harman’s one factor test and correlation matrix [36]. The former method indicated no single factor contributed more than 50% of the explained variance while the latter method indicated that all constructs values were significant (p < 0.01 and p < 0.05) which are lower than the cut-off value of r < 0.90 [35, 37]. Hence, problematic outliers were not detected.

5. Result
A systematic process of SEM-PLS assessment based on Hair Jr, et al. [38] and Urbach [39] was followed. This study employed the SmartPLS 3.0 software for assessing the quality of results.

5.1. Measurement model
Composite reliability (CR) was used to complement the conservative measure of internal consistency using Cronbach’s alpha (α) [40] whereby both measurements used a threshold value of 0.7 [38, 41]. Table 1 confirms that all constructs exceeded the threshold of 0.7 and therefore, indicating high internal consistency and construct reliability for the research model.

| Construct | Indicator | Convergent Validity | Internal Consistency Reliability |
|-----------|-----------|---------------------|---------------------------------|
|           |           | Loadings > 0.70     | AVE > 0.50                      | CR > 0.7 | Cronbach α > 0.7 |
| EB        | EB1       | 0.960               | 0.926                           | 0.980    | 0.984           |
|           | EB2       | 0.957               |                                  |          |                 |
|           | EB3       | 0.965               |                                  |          |                 |
|           | EB4       | 0.964               |                                  |          |                 |
|           | EB5       | 0.966               |                                  |          |                 |
| EXT       | EXT1      | 0.830               | 0.629                           | 0.856    | 0.894           |
|           | EXT2      | 0.798               |                                  |          |                 |
|           | EXT3      | 0.702               |                                  |          |                 |
|           | EXT4      | 0.827               |                                  |          |                 |
|           | EXT5      | 0.802               |                                  |          |                 |
| GVR       | GVR1      | 0.873               | 0.834                           | 0.960    | 0.968           |

Outer loading and Average Variance Extracted (AVE) were used to determine the convergent validity of the measurement model. Henseler et al. [42] stated that the threshold for outer loading is 0.70 while
for AVE, the threshold is 0.50 [38]. The results show that loading for every measurement item was more than 0.70, indicating indicator reliability, whereas every construct showed AVE above 0.50. Therefore, convergent validity of the measurement model has been satisfied. This study also reported the discriminant validity for three types of measures called Fornell and Larcker, Cross-Loadings, and HTMT. The result for Fornell and Larcker shows that the square roots of AVE are higher than the bivariate correlation of the constructs [43]. Meanwhile, cross loadings of all measurement items were valued highly on their respective constructs [40]. Also, HTMT ratios were fulfilled with all values less below 0.90 [40, 44]. Hence, discriminant validity of measurement model is met for this research model.

5.2. Structural model

The assessment of the structural model based on the standardized path coefficients indicated that H2, H3, H6a and H6c were statistically significant (t ≥ 1.64; p ≤ 0.05). Meanwhile, H1, H4, H5 and H6b were statistically insignificant (t < 1.64; p > 0.05). The values of EB (β = 0.180, p = 0.023), GVR (β = 0.237, p = 0.011), LA*GVR (β = 0.219, p = 0.008), and Federal * EB (β = 0.147, p = 0.026) positively influence EA adoption intention. Therefore, as shown in Table 2, hypotheses H2, H3, H6a, and H6c are accepted. This supports the argument that EB, GVR and EXT are significant predictors of EA adoption intention. The predictive accuracy ($R^2$) of EA adoption intention is 0.665 which is at a moderate level [42].

Table 2. Hypothesis testing

| H   | Relationship | β     | Std Error | T Value | P Value | Decision |
|-----|--------------|-------|-----------|---------|---------|----------|
| H1  | ICT -> INT   | 0.004 | 0.049     | 0.089   | 0.465   | Rejected |
| H2  | TMS -> INT   | 0.022 | 0.058     | 0.376   | 0.353   | Rejected |
| H3  | EB -> INT    | 0.180 | 0.090     | 2.002*  | 0.023*  | Accepted |
| H4  | GVR -> INT   | 0.237 | 0.102     | 2.314*  | 0.011*  | Accepted |
| H5  | EXT -> INT   | -0.039| 0.061     | 0.643   | 0.26    | Rejected |

5.3. The moderation effects

This study evaluated the moderating effects of organization type (federal, federal statutory body, state, state statutory body, and local authority) on the relationships of expected benefits, good governance, and top management support with EA adoption intention. A two-stage approach was employed to model the interaction effect as organization type is a categorical moderator and the independent variables are continuous variables. The moderator analysis has two measures: the moderation effect analysis and slope analysis. The result of moderation effects using the bootstrapping procedure with 5,000 subsample, BCa bootstrap and one-tailed type at 0.05 significance level is presented in Table 3. As we had hypothesized, the relationship between good governance and EA adoption intention is stronger for Local Authority. In a similar vein, expected benefits has a significant moderating effect which causes the relationship to stronger with EA adoption intention among Federal-type organizations. Conversely, top management support has no effect on the intention to adopt EA for Federal organizations. Therefore, H6a and H6c are accepted, whereas hypothesis H6b is rejected.
Table 3. Result of moderation effect analysis

|   | Relationship          | β  | SE  | T value | P value | Decision |
|---|-----------------------|----|-----|---------|---------|----------|
| H6a | LA*GVR -> INT       | 0.219 | 0.09 | 2.43*  | 0.008*  | Accepted |
| H6b | Federal*TMS -> INT  | -0.028 | 0.049 | 0.569  | 0.285   | Rejected |
| H6c | Federal*EB -> INT   | 0.147 | 0.076 | 1.944* | 0.026*  | Accepted |

The slope plot as shown in Figure 2 indicates the relationship between good governance and EA adoption intention that is significantly moderated for Local Authority organization type. The slope confirms that when good governance is high, this resulted in high intention of adopting EA by the Local Authority compared to other organization types. However, when good governance is low, EA adoption intention is lower for Local Authority compared to other organization types. The slope plot as shown in Figure 3 indicates the relationship between expected benefit and EA adoption intention that is significantly moderated for Federal organization type. The slope confirms that when expected benefit is high, this resulted in a high intention of EA adoption among Federal organizations compared to other organization types. However, when good governance is low, there is no difference in EA adoption intention among the organizations in Federal Government.

5.4. Importance-Performance Map Analysis (IPMA)
Importance-Performance Map Analysis (IPMA) which is an advanced analysis was also carried out in this research. It is less frequently used but serves as a valuable tool in SEM-PLS for identifying critical constructs that should be acted upon (total effect of important) and given attention (index value of performance) [38]. For this analysis however, EXT, ICT and TMS were excluded due to their insignificant relationship with EA adoption intention whereby relationship significance is a basic requirement for IPMA [38]. As shown in Table 4, it is shown that GVR has the highest total effect value at 0.26 followed by EB at 0.187. Hence, GVR is most relevant for managerial actions while EB is the most critical factor for managerial attention. Additionally, EB has a high performance but it is considered not important for predicting EA adoption intention. Therefore, it is advised that not much attention is given by managers or decision makers on EB as it will possibly overkill in public sector services in the case of EA adoption. Instead, more attention should be given to enhance GVR as a means of motivating greater adoption of EA.
6. Discussion
In this study, we have ascertained the factors influencing EA adoption among Malaysian public sector organizations. We proposed a research model adapted from the TOE framework in the context of MPS organizations. As predicted, the constructs of good governance and expected benefits had significant and positive influences on EA adoption intention. The findings were consistent with previous studies. What can be inferred is that public sector organizations in Malaysia are reluctant to adopt EA if there are unclear roles and responsibilities assigned to them. Thus, decision makers may find difficulty in introducing initiatives in their organizations. In addition, ongoing commitment from all stakeholders and different organization types in the public sector are crucial consideration in shaping EA adoption decision. Surprisingly, top management support had an insignificant influence on the intention to adopt EA by Malaysian public sector organizations. This result contradicted previous studies’ finding [12]. A possible reason for this scenario is that EA adoption may be perceived differently by the various types of organization in MPS. In other words, the direction and support from top management teams are different depending on organization type. Another possible reason could be the relative newness of EA that might contribute to a lower degree of commitment from top management as they may prefer to adopt a wait-and-see attitude as they observe how well EA approach is implemented. Then, there would be fewer risks to their organization if the implementation was found to be successful.

There was no evidence that external support has an influence on EA adoption intention in this study. External support was expected to be an important consideration for EA adoption [45], but it could be that the organizations believe in the importance of in-house expertise rather than external support from vendors or third-party providers. We suggest that the in-house expertise should be developed and gained competence before adopting organizational innovations such as EA. Taken together, these results implied the demand for a more pragmatic investigation of EA adoption. Organization type seems to have a significant influence on the relationship between good governance and EA adoption intention. It seems that Local Authority is more willing and ready to adopt EA when roles and responsibility are clearly defined, and procedures and measurement of impact analysis are explicitly and appropriately presented. Federal organizations have a stronger intention to adopt EA when they perceived greater benefits from the implementation of EA. A possible reason could be that the Government of Malaysia practices a top-down approach, and therefore, Federal organizations are more interested to adopt EA if they perceive benefits from EA. Government policy towards citizen-centric services are designed at the Federal or Central Agency level. Therefore, EA must be seen beneficial to the organization’s objective and suit the citizen’s demand. The result from IPMA provided more clarity to the relevance of the influencing factors of EA adoption intention. The map analysis clearly pointed out that good governance is the most important factor to drive managerial actions for EA adoption intention. At the same time, expected benefit is the performance indicator deserving managerial attention for EA adoption intention. Putting it all together, these two factors are both important and indicate high performance. It is therefore imperative that any strategies to motivate higher intention for EA adoption should emphasized on these two factors.

7. Conclusion, limitation, and future research
This study had examined the influencing factors of EA adoption among Malaysian public sector organizations. The results indicated that good governance and expected benefits have positive relationships with EA adoption intention. Interestingly, top management support, adequate ICT infrastructure and external support have no influence to ensure EA adoption intention by organizations in the MPS. In addition, the effect of good governance on EA adoption intention is greater among Local Authorities whereas expected benefits have greater influence on EA adoption intention among Federal

| Constructs | Total Effect (Important) | Index Value (Performance) |
|------------|--------------------------|---------------------------|
| GVR        | 0.26                     | 68.311                    |
| EB         | 0.187                    | 70.227                    |

Table 4. IPMA results
organizations in comparison to other organization types. Given that previous studies focused on post adoption of EA with fragmented perspectives, our study focused on investigating the intention to adopt EA empirically based on multi-dimensional factors. This study is the first to reveal the impact of multidimensional factors from the perspectives of technology, organization and environment and the moderating role of organization type to determine EA adoption intention. The study found that good governance and expected benefits have different moderating effects on EA adoption. The findings provide an important clue for boosting EA adoption among MPS organizations and providing additional insights into the TOE adoption model.

Although there are meaningful implications from the findings, future studies should address several limitations. First, the conclusion may be not the same when respondents come from different industries such as the private sector. Second, different cultural environment may also address different factors of EA adoption. There may need to be an expansion of the multigroup analysis to examine the differences among the category of the Local Authority such as City Council, Municipal and District Council. Multigroup analysis may improve the understanding of EA adoption based on the comparison of the group-specifics. Third, future research could be conducted to compare the influence of EA adoption between the public and private sectors. The findings of this research found inconsistency with past studies pertaining to adequate ICT infrastructure and external support. It is recommended that a moderator should be introduced to explain the nature of relationships of these variables (adequate ICT infrastructure and external support) with EA adoption intention.

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