

Ascertaining Factors that Influence the Intention to Adopt Enterprise Architecture Among Malaysian Public Sector Organisations – A Pilot Contemplation



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Abstract: Enterprise Architecture provides a holistic view that effectively integrates different domains in business, data, application, and information in organisations. Different notions of Enterprise Architecture (EA) models could be found in the literature which are primarily based on various factors and fragmented perspectives. However, current EA models are more focused on the post-adoption or implementation phase of EA. There is little attention paid on the adoption model of EA. It is also found that the organisational adoption of EA is still missing from technological, organisational, and environmental perspectives. Based on inferences from previous study, very few had attempted to find significant factors using the theoretical approach of Information Systems in the context of EA adoption. Therefore, this research is designed to investigate the factors that influence EA adoption at the organisational level and propose a conceptual model during adoption phase and early phase of the EA cycle. The research method used questionnaires administered to key participants from 23 Malaysian public sector organisations. The findings have shown significant factors influencing the intention to adopt EA. The strength of relationship in coercive pressure was the highest, followed by mimetic pressure. Furthermore, the complexity of EA did not have significant influence on the intention to adopt EA. Therefore, this study has addressed factors from the technological, organisational, and environmental perspectives that could influence the intention to adopt EA among Malaysian public sector organisations. The findings indicate that various pressures were the greatest influence in the adoption of EA.

Keywords: Intention to Adopt EA, Technological, Organisational, Environmental, Pressures

I. INTRODUCTION

This research has investigated factors influencing EA adoption among Malaysia Public Sector (MPS) organisations. The purpose of this study is to build and test a model in order to provide guideline for EA introduction and anticipate factors that are important in realising its benefits. Despite the benefits that EA can deliver [1-4], very few research have been published regarding its usage or adoption in developing countries like Malaysia. Although studies can be found from Finland [5] and Norway [6] in

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terms of EA adoption, results from these developed countries cannot be applied in the Malaysian context. Furthermore, previous studies only provide insights from fragmented contexts such as organisational or technological context [7]. There are three groups of adoption phases: pre-adoption, adoption, and post-adoption [8]. Pre-adoption refers to motivation, conception, and proposal. Adoption is decision or intention to adopt, while post-adoption includes confirmation of innovation, user acceptance, and actual use of innovation [9]. There are insufficient benchmarked proposed solutions found in the previous studies for EA in the adoption phase in organisations [7, 10]. According to an expert from Lead Agency in MPS, although Malaysia Government Enterprise Architecture (MyGovEA) had been introduced in 2014 and many awareness programmes had been conducted until 2018, the EA adoption level in public sector organisations is still low [11, 12]. In fact, only two agencies have adopted MyGovEA in their organisations. Since Malaysia is a developing country and its organisation type consists of federal and state government [13], it is essential to conduct this study as the results might be different from the previous studies. In addition, research in the context of EA and public sector [14], as well as Southeast Asia region, especially in MPS are limited.

II. PROBLEM BACKGROUND

Enterprise Architecture provides a holistic view that integrates different domains in business, data, application, and information in organisations. Through this, business and technical people can have mutually understandable language in their communication to achieve the organisation's goal, for example, decision-making and citizen-centric services. However, based on inferences from the literatures, the motivation to carry out this research is based on the premise that there are insufficient attention and inadequate references in terms of the EA adoption [14]. Specifically, the relative impact from multiple contexts and factors on the EA adoption by public sector organisations remains largely unexplored.

This matter is one to which this study contributes. The study refers to a set of issues and factors related to the contexts of the new practise or technology (T), the organisation (O), and the environment (E). The literature review has shown that several issues are mainly centred on non-technical aspects of organisational and environmental contexts.



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These include misconception of EA, lack of business-IT alignment, lack of management support and organisational procedures, and lack of EA use [7]. The literature review has also shown that the misconception of EA is a critical problem that was highlighted by previous research, followed by organisational rule, lack of business and IT alignment, unclear leadership, lack of management support, and governance. It has been observed that there are common factors identified, for instance, good governance [15, 16], clear communication [16-18], top management support [5, 15, 19, 20], EA knowledge and skills [5, 21, 22], and other organisational-related factors. These factors are important in the future, as guidelines for the decision makers in implementing strategic plans for the EA adoption in MPS. Therefore, as one of the developing countries, the government has allocated large investment in the development of MyGovEA. MyGovEA is one of the enabling ecosystem towards achieving initiatives in the Digital Government agenda for the public sector as stated in the Malaysian Public Sector ICT Strategic Plan 2016–2020 [23]. However, a report that was prepared by MAMPU Malaysia in 2014 revealed that the EA Capability Maturity Assessment in MPS with regards to the adoption of EA practices is moving towards Level 2 (Formalized Stage) [12]. The government targeted 25 public sector agencies to be ready to implement EA in their business and ICT functions by the end of June 2016, but to date only two public sector agencies implemented EA [12]. Although MAMPU has actively implemented awareness and transfer of knowledge (ToK) programmes for MyGovEA to all ministry levels in MPS since 2014, the number of MPS adopting EA in their organisations remains the same [11]. The decision to institutionalise EA in the organisation seems to be difficult in MPS. In addition, a few studies have been conducted to investigate significant influencing factors among three contexts over the EA adoption in MPS. Thus, it is important for us to investigate which factors would drive public sector organisation to adopt EA strategically.

Based on the SLR findings, we identified issues and factors are from fragmented contexts across Information System studies [7, 10]. Therefore, the present study employs variables from Technology, Organisation, and Environment (TOE) framework to discover the contributing factors in the EA adoption. The aim of the research is to develop conceptual EA adoption model from the TOE perspective. This study includes the organisational level of adoption in understanding factors that influenced the EA adoption in MPS organisations. The research underpins the theory of TOE framework and the inclusion of institutional theory. The inclusion of organisation type is a vital variable to measure the moderating effects in EA adoption. The organisation type (federal vs. state government) may enhance the relationship between TOE factors and EA adoption. Furthermore, past literature did not demonstrate the buffering effect of organisation type as an important variable in the relationship between TOE factors and EA adoption in the organisation. Since there are no studies that investigate EA adoption among MPS organisations, this research attempts to fill this gap.

III. LITERATURE REVIEW

Factors of EA adoption

The researcher had conducted a preliminary study from primary and secondary sources [7, 10]. According to Sekaran and Bougie [24], primary source can be obtained from interviews, organisation records, and archives while secondary source is taken from published works available from the Internet or organisation websites. Unstructured interviews with experts and Systematic Literature Review (SLR) were conducted to identify and review current evidences regarding issues, challenges, and factors influencing EA adoption. This preliminary research helped the researcher to seek current information, reviews of innovation, and IS adoption literature [24]. Table.1 presents the identification of issues and challenges faced by organisations with regards to EA adoption from the literature review. These identified issues and challenges are grouped into four contexts namely Technology, Organisation, Environment, and Pressures.

Table.1 Issues and Challenges Identified From the Literature Review

Context	Issues and challenges	Source(s)
Organisation	Poor Governance	[6], [17], [25], [26]
	Insufficient resources	[6], [17]
	Lack of business-IT alignment	[6], [27], [28], [17], [26]
	Misconception of EA	[6], [25], [26], [29], [30], [5]
	Lack of EA knowledge and skill	[17], [5]
	Lack of management support	[6], [25], [5], [31]
	Unclear leadership	[6], [25], [31], [5]
	Huge programme scope	[6]
	Communication failures	[6], [30], [17]
	Lack of awareness and readiness	[25], [31], [17]
Environment	Lack of EA use	[6], [25], [32]
	Organisational procedure	[6], [25], [27], [33], [31]
	Competition with other best practices	[6]
Technology	Rigid and incompatible IT systems	[28], [17], [6]
	Difficulties in modelling	[6]
Pressures	Lack of perceived value	[6], [5], [25]
	Legislation and mandate or coercive	[5], [25], [31]
	Lack of motivational factors	[6]
	Mimetic	[31], [32]

Through a combination of primary and secondary sources, unstructured interviews with EA experts, and SLR of EA adoption, the present research has suggested the TOE



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Context	Factors	SLR																Interview	Prior studies on TOE Framework																			
		[35]	[19]	[6]	[26]	[15]	[21]	[5]	[16]	[20]	[17]	[18]	**[36]	**[22]	[37]	[38]	Expert 1		Expert 2	Expert 3	*[39]	[40]	[41]	[42]	[43]	[44]	[45]	[46]	*[47]	[48]	*[49]	*[50]	[42]	**[51]	*[52]	**[53]	**[54]	[55]
Environment	Vendor Support/ External support				√				√								√										√	√	√	√								
	Mimetic Pressure	√													√	√	√	√				√	√						√									
	Coercive Pressure	√													√	√	√	√				√				√			√	√				√				
Organisation type															√							√																

*Malaysia context

**Malaysia Public Sector

Technology Adoption Models

TOE framework is an organisation-level theory that consists of Technological (T), Organisational (O) and Environmental (E) contexts [34]. It has been described as a generic theory as it allows easy inclusion of additional constructs or factors [57]. The TOE framework is consistent

with the theory of Diffusion of Innovations (DOI), as the DOI adoption is comparable to the TOE organisational and technological contexts [58]. Indeed, the TOE framework has

proven to be useful for a wide range of innovations and contexts, well-established, and broadly supported by empirical work [59].

The adoption of innovations is affected by technological, organisational, and environmental contexts within a firm [8, 58]. Many Information System studies have utilized the TOE framework in different settings such as Halal warehouse services [39], Electronic Customer Relations Management (e-CRM) [48], e-Procurement by [60], RFID [61], e-government [41], Open Government Data (OGD) [42], open platform [43], Software as a Service (SaaS) [62], and Internet of Things (IoT) [45]. Similarly, institutional theory focuses on organisational pressures (P) such as coercive, normative, and mimetic pressures [63].

The institutional theory is an approach in analysing diverse sectors and organisational fields. It probes how organisational pressure is adopted, and adapted over space and time by rules and regulations, cultural expectations, and imitations from other organisations[64]. Pressure appears to be an influential factor for an organisational reform [25, 35, 38]. Pressure was examined to be a motivational factor in green IT and suggested to be a motivational factor for EA adoption as well [6]. Other information studies have analysed organisational pressures in different contexts such as IT Green [65], ecological sustainability [64], and public sectors [35]. From the theoretical lens, EA requires a wide-ranging theory to explain its adoption challenges in an organisation. However, there are limited studies that analyse the determinants from the perspective of pressure in EA adoption [25]. Prior research on the adoption of EA also revealed that there is a dearth of environmental and

organisational pressure factors. Therefore, this study has chosen the TOE framework and the institutional theory to investigate EA adoption in the context of influencing factors within this scope.

Process of adoption

Although different scholars have categorised the adoption process from different perspectives, there are similarities. These similarities are grouped into three adoption phases: pre-adoption, adoption, and post-adoption [8]. These phases are also often referred to as initiation, adoption, or decision and implementation [66]. In contrast to Damanpour and Schneider [8], Kamal [9] maintained that the taxonomy of IT innovation adoption processes in the government sector can be grouped into two phases namely, pre-adoption and post-adoption. Pre-adoption consists of motivation, conception, proposal, and adoption decision, while post-adoption includes confirmation of innovation idea, user acceptance, and actual use of innovation [9]. Damanpour and Schneider [8] as well as Kamal [9] discussed that the level of adoption for organisation is done during the pre-adoption phase, whereas the level of adoption for individual happens during the post-adoption phase. However, the present research focuses on the adoption stage where organisations make the decision or intention to adopt EA. Both studies by Damanpour and Schneider [8] and Kamal [9] take place in the “adoption” phase definition. The organisation is the adoption level for the present research as proposed by Kamal [9] at the adoption phase [8] and the appropriateness in MPS context.

IV. RESEARCH MODEL

This present research has taken into consideration two of technology adoption models, which are the TOE framework and the institutional theory which have been widely adopted for Information System (IS) studies in organisational context. Adoption is frequently observed as a dependent variable (DV) in related literature [70], while independent variables (IV) are categorised into the three contexts of TOE: 1) Technology, 2) Organisation, and 3) Environment. The factors found were from prior research in EA and TOE conducted across industries in different countries. The technological context



includes characteristics, internal, and external technologies that are relevant to the firm. Technologies may include both types of equipment and processes [34]. Previous studies argued that technology plays an important role and suggested its positive effects in innovation adoption at organisational level [39, 42, 43]. The present research employs the technology variables of ICT infrastructure (ICT) and EA complexity (CPX) as suggested by [5, 6, 17, 29, 36, 71] as these variables are most commonly found as the descriptive measures. The organisational context refers to the characteristics and resources of the firm, including top management support (TMS), organisational readiness (OR), clear communications (COMM), normative pressure (NP), expected benefits (EB), good governance (GVR), and organisation size (OS) which are among the most accepted predictors of innovation [39, 40, 72]. However, the extent to which these organisational variables influence EA adoption has not been examined. The environmental context here refers to the factors within which the organisation operates, the external pressures, and the opportunities that may influence the EA adoption. Concerns are given to three critical environmental factors in the public sectors: external IS support (EXT), coercive pressure (CP), and mimetic pressure (MP). Organisation type refers to federal and state government in MPS to measure the moderating effects and may enhance the relationship between TOE factors and EA adoption. The relationship between the federal and the states differ based on the distribution of legislative powers, executive powers, grants, and financial burdens [73]. This significant distribution was enacted in Malaysian Federal Constitution through Articles in Part V and was delegated to the state level with Articles in Part VI. Since there are inconsistencies in findings about expected benefits, top management support, complexity, and intention to adopt new ideas, moderating variables could be introduced. Previous studies demonstrated that influences of expected benefits, top management support, and complexity on adoption are significant [39, 45, 50, 74] while others are insignificant [42, 50, 61, 75, 76].

Therefore the organisation type has been chosen as a moderating effect as it may boost the relationships differently. Technology adoption and EA establishment studies have found that diffusion occurs unevenly across countries with different environments [25, 41]. The theory

supports that the extent of diffusion depends on a variety of economic, social, and political factors, including income, education, technology policies, cultural norms, and access to formal and informal communication networks [66, 77]. In the context of present research, the adoption of EA may occur asymmetrically in federal and state governments. Keeping in view these findings, the past literature did not show the buffering effect of organisation type as an important variable in the relationship between TOE factors and EA adoption in the organisation. Therefore, a conceptual model for EA adoption that proposes and organises the potential adoption factors within TOE context was developed and depicted in Fig.1. This research proposes that organisation type moderated the relationship between TOE factors and EA adoption in the organisation.

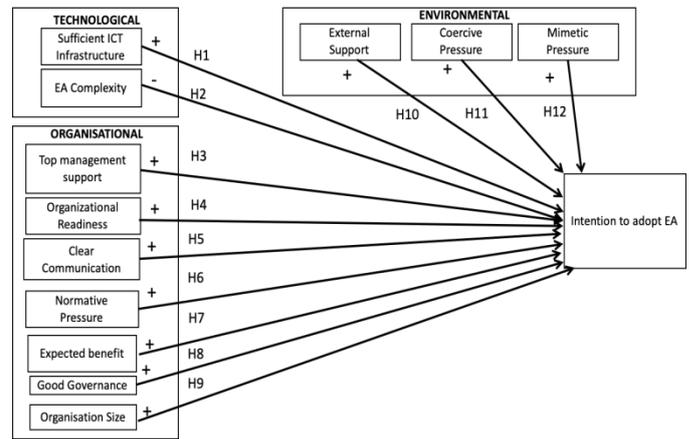


Fig.1 The proposed research EA adoption model

V.METHOD

An instrument is a tool of quantitative data collection for measuring, observing, or documenting numerical data [78]. The instrument used in the present research is questionnaire. The items to be measured were adapted from the previous research that are relevant to this research. Instruments that are widely cited and frequently used by other research are good candidates for research instrument [78]. Therefore, the content of the validity has been fulfilled [79]. The coefficient alpha is used to test the internal consistency for reliability and accuracy of scores from instruments [78, 80]. The pilot survey is required to evaluate the questionnaire with actual population in small sample and determine statistically the quality of questionnaire [81, 82]. Thus, the questionnaire of the present research was conducted through pilot survey to the key participants from MPS organisations. MPS organisation consists of five types of organisation which are federal, federal statutory body, state, state statutory body, and local authority. A seven-point Likert-type scale was suggested to be used in this research to represent the answers of the respondents [83]. The Likert-type scale is popular as it illustrates theoretically identical intervals among responses Creswell [78] and to measure attitude or opinions.

Single-item questions are not suggested and inappropriate in measuring the factors, therefore this research used multi-item questions pertaining to the factors or constructs for reliability [84, 85]. The technique of content validity ratio (CVR) was used in the assessment process for elimination or retention of particular items [86]. This technique invited experts from academic and industrial sectors to validate the measurement items. Hence, the measurement items had been assessed adequately and gave high confidence level of clarity and appropriateness of the items from the experts' opinions and viewpoints. The pilot survey was divided into two parts: demographic profile (part A) and constructs (part B). The self-administered online survey was conducted using Google form and disseminated via e-mail to the respondents. The unit of analysis of this research is organisation, therefore the respondents were decision makers, middle management officers, or senior officers as they would have knowledge of the organisation's nature and practices of adopting and



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implementing new ideas such as EA. The respondents' answers should reflect the organisation's viewpoints and not the individuals. A total of 23 respondents from different type of organisations in MPS had answered the survey and their responses were further analysed using SPSS. The number of 23 responses for the pilot survey of this study is sufficient as recommended by [87, 88].

VI.RESULTS AND FINDINGS

Statistical analysis was used to validate and verify the pilot test responses using SPSS version 2. There were five analyses that had been deployed which are frequency, normality, reliability, Pearson correlation, and ANOVA. The results obtained from the frequency analysis of the demographic profile show that half of them worked in federal government with the percentage of 52.2%, followed by state government with 26.1%, and 21.7% from local authority. The average age of 36 until 45 was the majority in this pilot test with 30.4%. As for education level, more than three quartile of the respondents were degree holders and the rest held Master's degrees and diplomas. The position grade group of 48 responded more compared to other groups and more than half of the respondents had more than 10 years of working experience. The responses from organisation size of more than 1000 employees formed the highest percentage of 34.8%, followed by organisation size of less than 100 employees with 30.4%. Specifically, the size of organisation with more than 50 IT employees contributed to the highest responses. Linear graph in Fig.2 shows that the cumulative probability of the dependent variable has normal P-P plot of regression. Table.3 provides the results obtained from the reliability test of the variables. The Cronbach's alpha value represents the reliability of the variables. The cut-off point for the minimum value of Cronbach's alpha for this research was 0.7 [85, 89, 90]. Thus, no item was dropped for this research. Table.3 depicts Cronbach's alpha values of each construct. The Cronbach's alpha value for the questionnaire was 0.976.

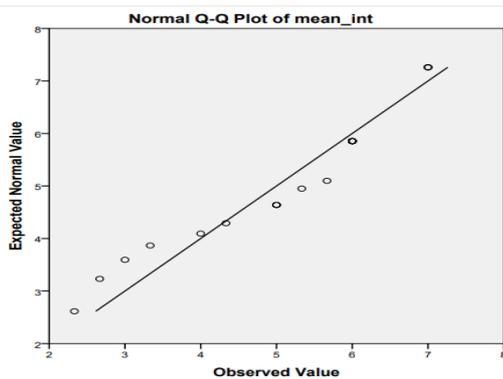


Fig.2 Normality test

Most of the variables were excellent where values of 0.8 and less than 0.9 indicate good value while 0.9 and above indicate excellence [91, 92]. Hence, all the variables were accepted where 'Expected Benefits' was the highest followed by 'Intent to Adopt', 'Clear Communication', and 'Mimetic Pressure'.

Table.3 Reliability Analysis (Cronbach's Alpha Value)

Variable	Items	Alpha	Interpretation
ICT	3	0.931	Excellent
CPX	4	0.938	Excellent
TMS	4	0.932	Excellent
OR	4	0.785	Good
COMM	6	0.962	Excellent
NP	3	0.913	Excellent
EB	5	0.991	Excellent
GVR	6	0.958	Excellent
EXT	5	0.899	Very Good
CP	3	0.936	Excellent
MP	3	0.961	Excellent
INT	3	0.987	Excellent

All the variables significant correlations where 'Coercive Pressure' was the first independent variable showing high correlation compared to the other independent variables. Nevertheless, following the rule of thumb of Hinkle, et al. [93], the size of a correlation coefficient can be interpreted and presented through negligible or little correlation (0.0 to 0.3), low positive or negative correlation (0.3 to 0.5), moderate positive or negative correlation (0.5 to 0.7), high positive or negative correlation (0.7 to 0.9), and very high positive or negative correlation (0.9 and more). The variable of 'EA Complexity' showed low correlation to the dependent variable. The relationships between independent and dependent variables are illustrated in Table.4. The strength of relationship denoted by two asterisks (**) revealed that there was a significant correlation at 0.01 level, demonstrated by relationship among the independent variables [24]. The data in Error! Reference source not found., shows that the strength of relationship in 'Coercive Pressure' had the highest value, followed by 'Mimetic Pressure'. Meanwhile, 'Organisational Readiness', 'Normative Pressure', 'Top Management Support', and 'External Support' demonstrated moderate relationship with 'Intention to Adopt EA'. On the other hand, the relationship between 'EA Complexity' and 'Intention to Adopt EA' was negligible and indicated that 'Intention to Adopt EA' appeared to be unaffected by 'EA Complexity', while other independent variables showed relationship significance at 0.01 level (two-tailed).

Table.4 Relationships Between Independent Variables And Dependent Variable

Variable	Pearson value	Interpretation
ICT -> INT	.785**	High
CPX -> INT	.040	Low
TMS -> INT	.593**	Moderate
OR -> INT	.662**	Moderate
COMM -> INT	.577**	Moderate
NP -> INT	.741**	High
EB -> INT	.657**	Moderate
GVR -> INT	.796**	High
EXT -> INT	.561**	Moderate
CP -> INT	.880**	High



Variable	Pearson value	Interpretation
MP -> INT	.817**	High

As shown in Table.5, the results states the strength (R square = 0.916), the value (F = 109.3017), degrees of freedom (2, 20) and significant level (< 0.001) of the regression. More than 90% of the technological, organisational, and environmental factors influencing the intention to adopt EA were explained significantly by 91.60% (R-square) of the variance of the dependent variable (Intention to adopt EA). Furthermore, the proposed model was deemed suitable as shown in Table.5 with the significance value < 0.001. In conclusion, the proposed model of EA adoption has been validated, with a very good model fit and quality indices.

Table.5 Model Summary And Anova

Model Summary					
Model	R	R ²	Adjusted R ²	Std. Error	
Model 2	.957	.916	.908	.41420	
ANOVA					
Model	Sum Square	Df	Mean Square	F-test	Sig.
Regression	37.506	2	18.753	109.307	.000 ^b
Residual	3.431	20	.172		
Total	40.937	22			

Ascertaining significant factors are crucial for a successful EA adoption. The present research identifies a multidimensional model for adopting EA. Previous studies gave much attention on post-adoption process and EA implementation phase which are limited to factors from fragmented contexts, either environment, organisation, or technology [7, 10]. Furthermore, the models were developed and applied in the post-adoption phase and the EA implementation process. In addition, they were analysed and formulated through different research designs such as case

studies and interviews to obtain influential factors of EA adoption [1, 26, 31].

The generalisability of EA adoption research is an issue. The main feature of this research is the consideration of the factors that affect all aspects of EA adoption. In this regard, 'Sufficient ICT Infrastructure', 'EA Complexity', 'Top Management Support', 'Organisational Readiness', 'Clear Communication', 'Normative Pressure', 'Expected Benefits', 'Good Governance', 'External IS Support', 'Coercive Pressure', and 'Mimetic Pressure' were the factors evaluated in this research, which are related to the technological, organisational, and environmental aspects of EA adoption. Coercive pressure is the factor with the highest influence on the successful intention to adopt EA. Coercive pressure has been suggested from previous studies on EA adoption where regulations could influence project results both negatively and positively [31]. According to Syyrimaa [94], the force of mandate can give pressure and

great influence during adoption phase [94]. This is consistent with the study of Pudjianto, et al. [41] where lack of supportive regulatory environment on e-government will result in negative effects on adoption and assimilation. Previous studies by Dang and Pekkola [95] and Korhonen and Halen [29] supported this finding where a positive EA adoption is highly influenced by expected benefits as they are wisely evaluated before deciding to adopt EA due to concerns of returns on investments and values for the organisation[52]. Mimetic, normative, and coercive pressures present in this model have been widely used in IS research to understand the mechanisms of innovation adoption in the organisation. Such pressures have been shown to significantly affect adoption in IS studies [8, 96, 97] and they are of relevance when examining assimilation processes and technology adoption [42, 44]. The present research opens a new avenue for empirical study and increases the generalisability of EA adoption research as previous studies employed qualitative approach. There are still no research that apply prevalent models or theories, huge population, and generalisation of the perception.

VII.CONCLUSION

In this research, the aim is to assess significant factors influencing the intention to adopt EA. The present research has identified the technological, organisational, and environmental factors affecting the intention to adopt EA in MPS organisations. Pressures namely coercive and mimetic as well as knowledge and attitude are the best factors in boosting the adoption level of EA among MPS organisations. The evidences from this research suggest that further investigation to conduct an actual sampling size and widen the sampling size to state level is needed to increase the generalisability of research findings. A Structural Equation Model (SEM) will be used for data analysis for each context of the TOE and concurrently investigate all the relationships. This research contributes to the TOE literature by demonstrating the multidimensional perspectives with the inclusion of institutional theory and its relation to EA adoption in the public sector, a rarely studied topic. This research provides insight into the adoption of EA among MPS organisations. The government (federal and state), decision makers, and academicians may use the findings to expand the adoption of EA activities. Consequently, the integrative adoption model acts as a guideline that may lead to an understanding of the contributing factors and the underlying relationships of EA adoption. As a result, an effective adoption of EA can be facilitated in the organisations.

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