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Completed Research Paper

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Abstract

Enterprise Architecture (EA) is an integrated approach of information systems, processes, organisation and people in aligning business and information technology together. However, there is a discrepancy in public sector EA implementation whereby the developing countries are still grappling with issues in the implementation while those developed countries are already harvesting the EA benefits and value. Hence, this study aims to investigate the capability and priority of public sector of the developing countries in implementing the EA by proposing an assessment model. The assessment model is based on Balanced Scorecard (BSC) and Analytic Hierarchy Process (AHP) approach. There are 27 EAI capability and priority criteria identified and grouped into six categories according to BSC perspectives namely Internal Process, Learning and Growth, Authority Support, Cost, Technology and Talent Management. Followed by AHP pairwise comparison in calculating the rank of each criterion which is presented via three case studies from Malaysian Public Sector agencies.

Keywords: enterprise architecture, public sector, assessment, balanced scorecard

1 Introduction

Enterprise Architecture (EA) is a hierarchical approach used to align business and Information Technology (IT) together. It is achieved by integrating the information systems, processes, organisational units and people in an organisation. The aim is to enhanced various IT systems in the public sector in order to provide better services to the citizens and business (Al-Nasrawi and Ibrahim 2013; Ojo et al. 2012; Shaanika and Iyamu 2015). A robust architecture of IT system will facilitates better communication between the government and citizen (Kaushik and Raman 2015). EA also translates the organisational vision and mission into operational reality by leveraging on the current technology to improve the public sector service delivery system (Saarelainen and Hotti 2011; Tamm et al. 2011; Weerakkody et al. 2007).

However, there is a discrepancy in terms of public sector EA implementation between the developed countries in the North America, Western Europe and East Asia compared to the developing countries in the Middle East, Africa, South America and South East Asia (Borra and Iluzada 2016; Dang and

Pekkola 2016; Lee et al. 2016; Yong 2016). While the public sector of those developed countries are harvesting the EA benefits and value, these developing countries are still grappling with issues in EA implementation (Banaeianjahromi and Smolander 2016; Pekkola 2016). The United States and Canada are among the countries that have a complete EA solutions and implementation (Guijarro 2007). In addition, almost all European countries have implemented EA and reached high maturity level. Meanwhile for Australia and New Zealand, the EA initiative was executed in provincial segment by the local government (Rasti et al. 2015; Saha 2012). Compared to South East Asia countries, such as Malaysia, Indonesia, Philippines and Vietnam, they only recently started their EA initiative in year 2013 (Arifiyanto and Surendro 2009; Borra and Iluzada 2016; Dang and Pekkola 2016; Ghozali and Sucahyo 2013) . In fact Singapore, the most developed country in this region only designed the EA solution for the healthcare sector and not for the whole government (Saha 2009).

Although the implementation of EA has started since year 1990, (Richardson et al. 1990), most of the studies on public sector EA implementation were originated from the United States of America, Europe and Oceania countries (Rasti et al. 2015; Saha 2012). There are limited number of studies found on the EA implementation in the developing countries (Saha 2013). This is due the low EA maturity level and the infancy state of public sector EA in these countries. Therefore, this study aims to assess the capability and priority of the public sector organisation in the developing countries in implementing the EA. This will assist the EA practitioners in this sector to acknowledge and identify their organisation capability and priority in implementation process, hence reduce the failure of EA initiative. Simultaneously EA researchers will gain a better understanding of the EA implementation phenomenon in the developing countries context.

In this paper, we answer the following research question: "What are the capability and priority of public sector in developing countries in implementing the EA? This study uses the Balanced Scorecard (BSC) and Analytic Hierarchy Process (AHP) to assess the level of EA implementation capability and priority from three case studies from Malaysian Public Sector (MPS). Findings indicate that, there are 27 EA implementation capability and priority criteria which are grouped into six categories according to BSC perspectives namely Internal Process, Learning and Growth, Authority Support, Cost, Technology and Talent Management. Next, AHP result is presented in determining each case study capability and priority for EA implementation.

The paper is organised as follows; first, related literature is presented. This section is followed by the research methods and settings. The subsequent sections show the findings and their discussion. The paper ends with a concluding section.

2 Literature Review

This section defines the EA, status of EA implementation in public sector followed by the explanation on models adopted in this study, the Balanced Scorecard (BSC) and Analytical Hierarchy Process (AHP).

2.1 Enterprise Architecture

EA is a blueprint for an organisation to achieve current and future business objectives by using IT. It is a comprehensive framework or taxonomy of systems analysis models for aligning organisational strategy with IT. It describes how the information systems, processes, organisational units and people in an organisation function as a whole (Fernández 2013; Hjort-Madsen 2009; Wan et al. 2013). EA is fundamentally focused on identifying shared assets and relationship of all different elements in enterprise-wide manner(Lapalme et al. 2015). Therefore, EA is typically not limited to IT but also encompasses the relation and support within the business.

Academically, EA was extensively explained in Zachman's IBM Journal article (Zachman 1987) and book on EA by Spewak and Hill (1993). EA then has emerged and gained attention from the industry and they began to aware the potential benefits of EA. The Open Group Architecture Framework (TOGAF) stated that, *"EA is a complete architecture for IT solution comprises of four domains, which are business, data, application, technology" (Zakaria et al. 2012).* EA implementation is described as the recurring methodology of describing the *'as is'* and *'to be'* states of an enterprise and IT developments, interventions and processes to take an organisation from the one state to the next (Winter and Fischer 2006). The first EA was implemented in 1990 when Texaco and Star Enterprise EA adopting the EA in their oil and gas business operation (Richardson et al. 1990). Since then, EA implementation is expanding parallel with the increasing number of EA frameworks introduced by both academic and industry.

2.2 Enterprise Architecture Practices in Public Sector

Due to the incapability of the existing e-Government (e-Gov) approach in solving the issue on IT utilisation, many countries launch EA programs as their new government transformational plan (Dada 2006; Ojo et al. 2012; Yildiz 2007). EA provides a framework to support better services for public sector by introducing efficient IT resource planning as well as effective partnering with the private sector (Azad et al. 2008). The existence of EA public sector reformation agendas successfully breaking down the traditional bureaucracy (Al-Nasrawi and Ibrahim 2013; Hjort-Madsen 2009; Ojo et al. 2012; Shaanika and Iyamu 2015). A robust architecture of IT system will facilitate better communication between government and citizen (Kaushik and Raman 2015). EA also translates the organisational vision and mission into operational reality and leverage on current technology to improve the public sector service delivery system (Saarelainen and Hotti 2011; Weerakkody et al. 2007).

The e-Gov initiatives also being upgraded to EA to comply with United Nations e-Government Development Index assessment. This assessment provides a composite indicator for measuring the willingness and capacity of national administrations in utilising IT for public service delivery. The increasing attention for EA in public sector is also due to the transformational government criteria stated in e-Gov policy reports by United Nations E-Government Survey 2014 (UN 2014) and Waseda University World E-Government Ranking (Waseda 2014). The implementation of EA is important as it contribute to the score that indicates the level of advancement of e-Gov as outlined by these two bodies. Thus, to date 67 percent of countries has undertaken an EA initiative to achieve this standard requirement (Agency 2008 ; Du Lee and Kwon 2013).

Since 2000, large multinational companies in Malaysia started to implement EA followed by a few public sector agencies in 2006 (Abd Razak et al. 2007; Seow 2000). However, findings from the studies show that EA status for both in private and public sector in Malaysia are still at infancy level (Md Dahalin et al. 2011; Zakaria et al. 2012). This is supported by MAMPU EA assessment result by that highlights only 7% of the MPS ministries and agencies implement the EA while almost 80% IT architecture in MPS are in unstructured state (MAMPU 2014).

2.3 EA Assessment

EA assessment is needed to facilitate the EA implementation process. Study by Rodrigues and Amara (2010) stated that EA assessment can increase the EA legitimacy, efficiency, stakeholder satisfaction and value of the organisation. However, the existing EA assessment mechanisms are mostly based on sequence checklist and maturity model approach, which are very generic in nature (Bakar et al. 2015; Sobczak 2013). None of assessment model is tailored to assess the capability and priority of EA implementation in the public sector organisation.

Capability is the ability to perform or achieve certain actions or outcomes through a set of controllable and measurable faculties, features, functions, processes, or services (Paulk 2009; Peppard and Ward 2004). In this study context, EA implementation capability aims to identify what is the strength of the organisation in developing and implementing EA. Therefore, the organisation can start implementing EA based on the existing strength and at the same time, begin to build the capability in other lacking areas.

Whereby priority is defined as something given or meriting attention before competing categories (Lange et al. 2015; van Steenbergen et al. 2010). It refers to something that is more important than other things that need to be done first. In this study context, the priority assessment aims to identify the rank of importance criteria in implementing EA. Therefore, any organisation can execute the EA implementation based on the criteria prioritisation and synchronise it with the existing capability identified earlier on. By doing this, the resources and project efficiency can be increased thus contribute to better project success rate.

BSC is a strategic planning and management system that is widely applicable to organisation in any size or type of business (Kaplan and Norton 1992). It consists of a set of measures to assess how the organisation is progressing toward meeting its strategic goals. BSC has been employed in many IT areas such as public sector IT project, enterprise resource planning, IT project tender evaluation and software project monitoring. This study adopted a BSC model for non-profit organisation that consists of internal process, learning and growth, authority support and cost. Even though the BSC provides assessment perspectives relevant to EA implementation, it does not equip with the quantitative measurement to calculate the score of each perspective either in relative of absolute mode

(Abran and Buglione 2003). Hence, AHP algorithm is added in order to provide a quantitative measurement in this EA implementation assessment.

AHP is introduced by Saaty (1980) for organising and analysing complex decisions based on mathematics and psychology. It provides a pairwise comparison between criteria and equipped with algorithm to check for consistency of the result. AHP provides group decision making by combining the judgements of several individuals into a single judgement for the group (Escobar et al. 2004). This means the individual rating is obtained from own hierarchy and their judgements are based on their priorities (Saaty 2008). Then, group decision score is calculated for geometric mean. This provides accurate collective assessment result rather than averaging the total scores from the reviewers (Dong et al. 2010; Moreno-Jiménez et al. 2008). Therefore, AHP is the most suitable algorithm to assess the capability and priority of EA implementation in public sector organisation.

The combination of AHP and BSC as an assessment model are widely found in various area of studies. This explains that AHP and BSC are well integrated and able to produce reliable assessment model. Study by Arshad, Mohamed and Mansor (2009) described how AHP and BSC is used to develop a Strategic Balanced Scorecard Tool for Malaysian automotive industry. Meanwhile, study by Inworn and Chompu-inwai (2015) show how BSC and AHP are used to assess the performance of lean concept application in hospital outpatient department. Similar study by Huang, Chang, Wu and Liao (2015) explains how BSC and AHP are used to evaluate the performance of the World Expo Taiwan Pavilion.

3 Research Methodology

The research methodology in this study are based on AHP steps (Saaty 2008). There are three main steps and 10 activities defined, starts from scoping, model design and finally assessment calculation.

The first step is Scoping and it starts with Activity 1: Identify and scope the domain, which is EA implementation public sector organisation in developing countries. The second step is Design. The first activity in this step is Activity 2: Set the objective and focus area, which is to assess the capability and priority of the public sector organisation in EA implementation. This is followed by Activity 3: Determine assessment criteria. A total of 21 assessment criteria were identified from the literature and grouped according to four BSC categories namely Internal Process, Learning and Growth, Authority Support and Cost.

Following, three MPS case studies namely case A, B and C were chosen as they have implemented EA for more than two years. Table 1 shows the EA implementation details for case A, B and C. The assessment criteria were enriched with the findings obtained from interviews with EA teams from the case studies. Finally, 27 assessment criteria were identified and two new assessment categories were added which are Technology and Talent Management. The selected assessment criteria are listed in Table 2.

Next is, Activity 4: Present the assessment criteria into a hierarchy. Based on AHP algorithm, the assessment criteria were converted into three levels hierarchy. Top level hierarchy shows the objective of the process which is to assess the EA implementation capability and priority. The second level hierarchy is the assessment categories, which are Internal Process, Learning and Growth, Authority Support, Cost, Technology and Talent Management. Finally, the third level is the assessment criteria. Figure 1 shows the assessment criteria hierarchy.

Key Points	**CASE A**	**CASE B**	**CASE C**
Year Started	2006 & 2016	2013	2010
EA Framework	TOGAF	Based on case B transformational program and EA process defined by the consultant	TOGAF and consultant EA Framework
EA Tools and Repository	1GovEA, TOGAF and Archimate	Consultant Tools (Proprietary)	TOGAF and Archimate
Implementation Approach	In-house implementation by EA Team	Joint venture implementation by consultant and case B EA Team	Initial phase: based on consultant Following phase: own development by internal team
Governance Structure	Equal collaboration between business and IT department Telehealth Division and IT Division	TEAC with BRM and BRL Governance structure in place and involves all management levels and departments	EPU EA Committee Governance structure in place and involves all management levels and departments

Table 1: Details of EA Implementation for Case A, B and C

Category	Criteria	Description	Source	
INTERNAL PROCESS	IP1-Business Driven Approach	EA is driven by business approach	Interview	Foorthuis *et al*., 2015; Larsson, 2011; Saha, 2013; Seppänen, 2014; Schmidt and Buxmann, 2011; Van der Raadt *et al*., 2010; Xueying *et al*., 2008
	IP2-Strategic Planning	EA is aligned with business organisation strategic planning	Interview	Aier and Schelp, 2010; Kamogawa and Okada, 2009; Seppänen, 2014; Schmidt and Buxmann, 2011; Weerakkody *et al*., 2007
	IP3-Implementation Roadmap	Clear roadmap on EA implementation exist	Interview	Aier and Schelp, 2010; Iyamu and Mphahlele, 2014; Kamogawa and Okada, 2008; Schmidt and Buxmann, 2011; Van der Raadt *et al*., 2010; Ylimäki, 2008
	IP4-Governance	Strong and clear EA governance exist	Interview	Aagesen *et al*., 2011; Aier, 2014; Aier and Schelp, 2010; Kamogawa and Okada, 2008; Janssen, 2011; Seppänen, 2014; Schmidt and Buxmann, 2011; Van der Raadt *et al*., 2010; Ylimäki, 2008; Winter and Schelp, 2008, Lee *et al.*, 2016
	IP5-Rules & Process	Standard business rules and process exists	Interview	Aier and Schelp, 2010; Al-Nasrawi and Ibrahim, 2013; Lee *et al.*, 2016, Gilliland et al., 2015; Van der Raadt *et al*., 2010, Lee *et al.*, 2016
	IP6-Organisation Value	EA is linked with business organisation value	Interview	Not stated in literature
LEARNING AND GROWTH	LG1-Assessment	EA implementation assessment and evaluation exist	Interview	Foorthuis *et al.*, 2015; Saha,2009; Rodrigues and Amaral, 2010; Ylimäki, 2008
	LG2-Documentation	EA documentation are complete and available	Interview	Roth, S., Hauder, M., Farwick, M., Breu, R., Matthes, F., 2013; Grunow, S.,2013.; Michel, F., Münch, D. 2013; Buckl *et al.*, 2009
	LG3-Learning Culture	EA is empowered and shared in the organisation learning culture	Interview	Aier, 2014; Donaldson *et al.*, 2015; Faller and De Kinderen, 2014; Foorthuis *et al.*, 2015; Gaver, 2010; Ylimäki, 2008; Shah and El Kourdi, 2007; Seppänen, 2014
	LG4-Skill of Architect	Sufficient and skilful EA architect is in place	Interview	Aier, 2014; Aier and Schelp, 2010; Short and Burke, 2010; Iyamu and Mphahlele, 2014; Van der Raadt *et al*., 2010; Ylimäki, 2008;
	LG5-Training and Certification	Relevant EA training and awareness program is provided throughout the public sector	Interview	Aier & Schelp, 2010; Jick and Peiperl, 2010; Kotnour, 2011; Van der Raadt *et al*., 2010; Ylimäki, 2008
	LG6-Community of Practice	EA communities of practice is created, in order to gain knowledge from employees and share it in the organisation	Interview	Not stated in literature
AUTHORITY SUPPORT	AS1-Stakeholder Support	EA gain continuous support from all stakeholders	Interview	Gilliland *et al*., 2015; Gravesen, 2012; Nikpay *et al*., 2013; Schmidt and Buxmann, 2011; Seppänen, 2014; Hauder *et al*., 2013; Weerakkody *et al*., 2007
	AS2-Stakeholder Benefit	EA benefits are recognised by all EA stakeholders	Interview	Kamogawa and Okada, 2008; Janssen, 2011;
	AS3-EA Recognition	EA importance are recognised by all EA stakeholders	Interview	Seppänen, 2014; Blomqvist *et al*., 2015; Gilliland *et al*,2015;
	AS4-Mandate	EA rules and processes are mandated	Interview	Wan *et al*., 2013; Iyamu and Mphahlele, 2014
	AS5-Political Influence	EA received positive political influence	Interview	Gravesen, 2012; Iyamu and Mphahlele, 2014
	AS6-Stakeholder Understanding	Mutual understanding of all EA stakeholders exist	Interview	Gaver, 2010; Van der Raadt *et al*., 2010
COST	CS1-Financial Resources	Sufficient financial resources are allocated	Interview	Aier and Schelp, 2010; Kamogawa and Okada, 2008; Schmidt and Buxmann, 2011; Van der Raadt *et al*., 2010; Ylimäki, 2008
	CS2-Non-financial Resources	Sufficient supply of other resources is available	Interview	Aier & Schelp, 2010; Kamogawa & Okada, 2008; Schmidt & Buxmann, 2011; Ylimäki, 2008; Iyamu and Mphahlele, 2014
	CS3-Central Funding	Central funding on EA implementation is allocated	Interview	Not stated in literature
TECHNOLOGY	TC1-Practical EA Technology	EA tools, methodology, framework are available, easy to be used and understand	Interview	Gravesen 2012; Iyamu and Mphahlele, 2014; Lee *et al*., 2016; Nikpay *et al*., 2013; Perkins, 2000; Ylimäki, 2008
	TC2-EA Technology Support	Competence and reliable vendor/customer support for EA tools, methodology, framework and repository exists	Interview	Seppanen, 2014; Jonkers *et al*., 2006; Fischer *et al*., 2007

Category	Criteria	Description	Source	
	TC3-EA Repository	EA repository is available for organisational usage	Interview	Not stated in literature
TALENT MANAGEMENT	TM1-Talent Management Plan	Specific plan is created to retain the EA expertise in the organisation	Interview	Not stated in literature
	TM2-Centralised Enterprise Architect	Centralised EA experts team is created and govern by IT public sector central agency	Interview	Not stated in literature
	TM3-Retention Program	EA knowledge retention programs is created to ensure the sustainability of EA initiative	Interview	Not stated in literature

Table 2: EA Implementation Assessment Criteria for Public Sector Organisation

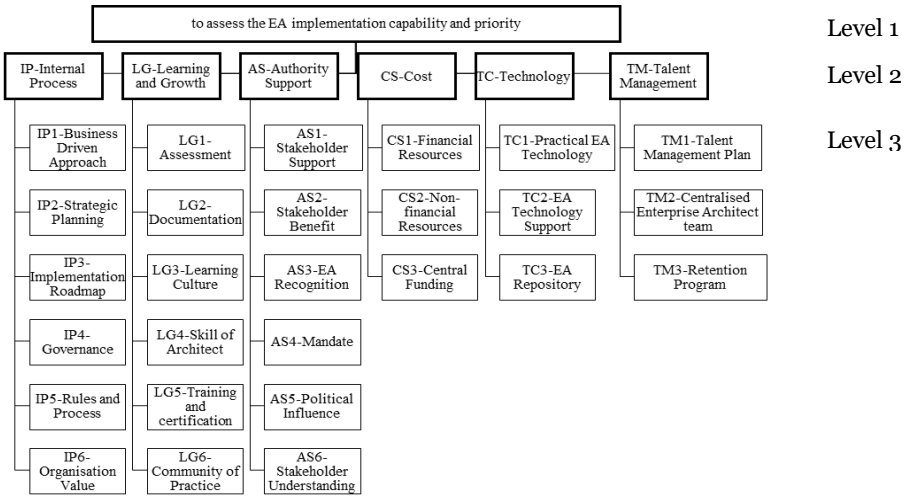


Figure 1: Hierarchy of EA Implementation Assessment Criteria

All criteria are then converted to quantifiable metrics for pairwise comparison analysis. The output of this step is *n (n-1)/2* comparisons, where *n* is the number of elements belongs to each category. This is followed by *Activity 5: Assess the importance of the assessment criteria*. All pairwise comparisons are arranged in a decision matrix table. The importance of the assessment criteria is assessed comparatively via the questionnaire designed by using a scale from 1 to 9 defined by Saaty (1980). The participants from case A, B and C perform the assessment based on pairwise matrices with aim to evaluate the relative importance of each criterion at level two and three against other criteria within the same category. The AHP importance scale is shown in Table 3.

Quantitative importance	Qualitative relative importance	Explanation
1	Equal importance	Two factors contribute equally to the problem
3	Weak importance of one over another	Experience ad judgement slightly favours one over the other (3 times more important)
5	Essential or strong importance	Experience and judgement strongly favour one over the other (5 times more important)
7	Demonstrated importance	Experience and judgement very strongly favour one over the other (7 times more important)
9	Most important	The evidence favouring one over the other is of the highest possible validity (9 times more important)
2,4,6,8	Intermediate values applied between groups	When participants are not sure about choosing among the respective important comparison

Table 3: Saaty's Scale of Relative Importance

Next, is *Activity 6: Calculate weight and prioritise each criterion*. This involves the multiplication of the element priorities in a hierarchical level by the priorities of elements in the next higher level and adding them for each element in a level based on the attributes that it affects. All levels are interrelated and value from the lowest level will affect the upper level and so on until it reached the top level. This is followed by *Activity 7: Consolidate the scores*. Scores obtained from individual participants were then consolidated into one comparative matrix through geometric mean. This study

applies the aggregate individual judgment (AIJ) and not the aggregated individual priority (AIP) because the aim of this study is to get the collective judgment of the group rather than the individual prioritisation (Aragon et al. 2012; Dong et al. 2010). Equation 1 shows how the score is computed.

$$b_{ij} = (a_{1ij}.a_{2ij}...a_{kij})^{1/k} . \quad (1)$$

As a result, the weightage assign is based on consensus decision of the evaluators. Table 4 show the consolidated matrices of priority assessment for Case C EA implementation according to assessment category.

Criteria	Internal Process	Learning and Growth	Authority Support	Cost	Technology	Talent Management
Internal Process	1.00	0.49	0.62	0.43	0.44	0.40
Learning and Growth	2.03	1.00	0.37	0.40	0.42	0.47
Authority Support	1.62	2.67	1.00	0.45	0.45	0.38
Cost	2.32	2.47	2.24	1.00	0.43	0.45
Technology	2.26	2.35	2.25	2.32	1.00	0.38
Talent Management	2.51	2.12	2.62	2.25	2.62	1.00
Total	**11.74**	**11.11**	**9.09**	**6.85**	**5.36**	**3.08**

Table 4: The Geometric Mean of Priority Assessment for Case C EA Implementation

Then, the scores are normalised accordingly. They are calculated by dividing the value in each cell in the consolidated tables by the sum of their columns as shown in Table 5.

Criteria	Internal Process	Learning and Growth	Authority Support	Cost	Technology	Talent Management	Priority Vector
Internal Process	0.09	0.04	0.07	0.06	0.08	0.13	7.87%
Learning and Growth	0.17	0.09	0.04	0.06	0.08	0.15	9.93%
Authority Support	0.14	0.24	0.11	0.07	0.08	0.12	12.69%
Cost	0.20	0.22	0.25	0.15	0.08	0.14	17.28%
Technology	0.19	0.21	0.25	0.34	0.19	0.12	21.67%
Talent Management	0.21	0.19	0.29	0.33	0.49	0.32	30.55%
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**100.00%**

Table 5: The Normalised Consolidated Values of Priority Assessment for Case C EA Implementation

Next is Activity 8: Calculate Eigenvector and Consistency Index (CI). To ensure the judgement consistency and its trustworthiness, Saaty (1980) suggests to use Consistency Ratio (CR) to check if a pairwise input is transitive. This is to measure the consistency of the judgments relative to large samples of purely random judgements. The Eigenvector for each factor is then calculated by averaging its normalised values in each row. Followed by calculating the Consistency Index (CI) based on the given formula shown in Equations 2 and 3,

$$\mathrm{CI} = (\lambda \max - n)/(n-1) \quad (2)$$

where; n = number of compared alternatives, λ max = the maximum Eigenvalue. And

$$\lambda \max = \sum_{i=1}^{n} [(w1.t1) + (w2.t2)...(wi.ti)]/n \quad (3)$$

w is the Eigenvector for alternatives, t is the sum of columns and n is the number of alternatives. The Consistency Ratio (CR) is then calculated by dividing the consistency index by the Random Index (RI) as shown in Equation 4.

$$CR = CI/RI. \quad (4)$$

RI is obtained from the Random Index table of indices generated by Saaty (Saaty 1980) based on the nine values scale as shown in Table 6.

Number of variables	1	2	3	4	5	6	7	8
Random Index (RI)	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41

Table 6: Random Inconsistency Table of Indices

If the CR value exceed 0.1, the judgements are considered untrustworthy because they are too close for randomness and the assessment must be repeated. Table 7 shows the consistency result of priority assessment for Case C EA implementation.

n	**λmax**	**CI**	**RI**	**CR**
6	6.47	0.0934	1.24	0.0753

Table 7: Result of Consistency Calculation of λmax, CI and CR

Next is, *Activity 9: Scores Validation*. AHP scores are validated by using two approaches. Firstly, this assessment is given to selected participants based on their experience and familiarity with the topic. The assessment was done in a group rather than single to ensure it reached a consensus assessment describing the EA implementation of that particular agency. The participants also were given a face-to-face instruction on how to perform the assessment hence this has reduced the impact of individual inconsistencies. Apart of the AHP assessment questionnaire, the EA team members also were interviewed for details information on EA implementation scenario in their organisation to ensure the relevancy and consistency of the assessment result.

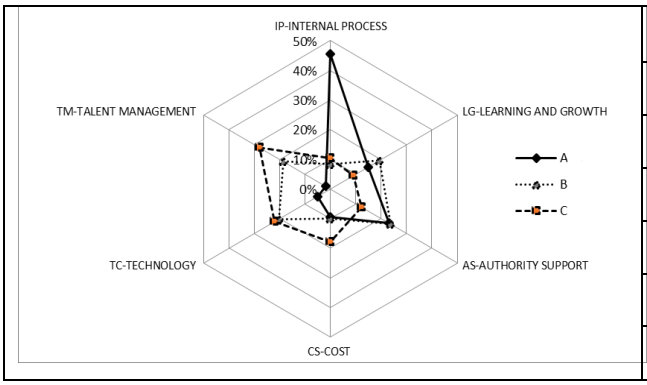
Secondly, the consistency of individual participants was used for inclusion or exclusion of their responses. Following the suggestion by Vargas, the cut-off points for acceptable CI is 0.1 or CR of 10% (Vargas and IPMA-B 2010). The participants were asked to reach a consensus or to re-evaluate their comparison scores if high inconsistency ratios are detected. (Dong et al. 2010; Escobar et al. 2004). The final activity is *Activity 10: Ranking of criteria* whereby the obtained weights of variables at different levels were presented in rank as a final result.

4 Findings

This section explains the findings of EA implementation capability and priority assessment from Case A, B and C.

4.1 EA Implementation Capability Assessment Result

Figure 2 shows the result of EA implementation capability assessment for Case A, B and C



EA Capability Category	**Case A**	**Case B**	**Case C**
Internal Process	45.45%	8.37%	10.48%
Learning and Growth	14.85%	19.22%	9.10%
Authority Support	23.16%	23.66%	12.36%
Cost	9.36%	9.91%	17.97%
Technology	5.24%	20.32%	22.13%
Talent Management	1.94%	18.52%	27.97%

Figure 2: EA Implementation Capability Assessment Result of Case A, B and C

Result shows Case A has extreme score for Internal Process (45.45%). This capability dominated the whole percentage whilst other capabilities only scores from 23.16% to 1.94%. The second highest

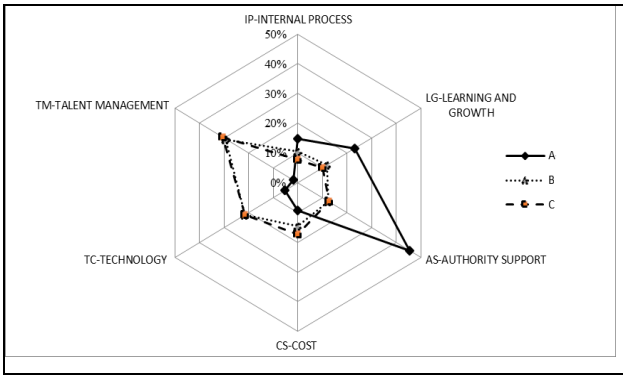
capability is Authority Support with 23.16%, followed by Learning and Growth at 14.85%. The rest of the capabilities have low scores such as Cost (9.36%), Technology (5.25%) and Talent Management (1.94%). This pattern exists due to redevelopment process of EA initiative in Case A which emphasised more on business IT alignment compared to other aspect in EA implementation.

Meanwhile, the level of capability in Case B and C are similar to each other and all criteria are equally distributed. This happened because both cases start the EA initiatives in the same period and has progressed well. Case B highest capability category is Authority Support at 23.66%, followed by Technology at 20:32%, Learning and Growth at 19.22% and 18.52% of Talent Management. There are no huge differences between capabilities thus the four strengths are well balanced. This is followed by two relatively similar capabilities, which are Cost at 9.91% and Internal Process at 8.37%.

On the other hand, Case C, the highest capability is Talent Management at 27.97%. This is probably due to the high number EA team member in Case C with EA certification. There are moderate levels of capability for Technology (22.13%) and Cost (17.97%) and three other capabilities such as Learning and Growth (9.10%), Internal Process (10.48%), and Authority Support (12.36%) are quite low as compared to others.

4.2 EA Implementation Priority Assessment Result

The result of case A, B and C EA implementation priority assessment is depicted in Figure 3.



EA Priority Category	Case A	Case B	Case C
Internal Process	14.85%	10.58%	7.87%
Learning and Growth	23.16%	11.79%	9.93%
Authority Support	45.45%	12.44%	12.69%
Cost	9.36%	14.57%	17.28%
Technology	5.24%	21.40%	21.67%
Talent Management	1.94%	29.22%	30.55%

Figure 3: EA Implementation Priority Assessment Result for Case A, B and C

Case A shows the extreme score in Authority Support of 45.45%. These criteria dominated the percentage whilst other criteria only score from 23.16% to 1.94%. The second highest priority is Learning and Growth (23.16%) followed by Internal Process (14.85%). The rest of the priorities have lower scores of 9.36% (Cost), 5.25% (Technology) and 1.94% (Talent Management).

Meanwhile, Case B and C have almost the same pattern of EA implementation priority scores. As expected, this could be due to the same duration and level of implementation period, hence resulting this similar results. For Case B and C, the highest priority is Talent Management at 29.22% and 30.55%. This is quite prominent from other criteria whereby Technology scores are 21.40% for Case B and 21.67% for Case C while Cost only scores 14.47% for Case B and 17.28% for Case C. Meanwhile forth priority goes for Authority Support, which Case B scores 12.44% and Case C scores 12.69%. The fifth priority is Learning and Growth with score of 11.79% and 9.93% for Case B and Case C. Finally, the last priority is Internal Process, whereby Case B scores 10.58% and Case C scores 7.87%.

5. Discussion

This section discusses on the assessment results in EA implementation capability and priority from three MPS case studies. In addition, series of interview were conducted with the team member of each case which provide detail justification on the result obtained.

For case A, the highest capability is IP-Internal Process, followed by Authority Support, Learning and Growth, Cost, Technology and lastly Talent Management. Different result occurs for EA implementation priority, with the top priority starts with Authority Support, then Learning and Growth, Internal Process, Cost, Technology and Talent Management. Looking at the Case A EA implementation background, this agency has started the EA implementation in 2006. So this means that, over the time they have clearly defined the agency IP-Internal Process and this becomes their main capability. For Case A, the first EA was not successfully implemented due to lack of support

from the stakeholders. Therefore, they set higher priority for Authority Support aspects which is clearly shown in the assessment result.

Result from Case B capability assessment shows that Authority Support scores the highest, followed by Technology, Learning and Growth, Talent Management, Cost and finally Internal Process. Whereby for EA implementation priority, the focus is on Talent Management, followed by Technology, Cost, Authority Support, Learning and Growth and lastly Internal Process. This assessment result corroborates with Case B EA implementation scenario whereby their EA initiative is originated from an agency transformation programme, which means they have full support from the stakeholders. With the establishment of stakeholders' support, clear EA process and governance, Case B is focusing to empower their internal human resource in EA. This explains why Case B scores highest priority is for Talent Management. The second priority and capability for Case B is Technology. This indicates that Case B already has the EA technology implemented, and now they are going to expand the usage of EA technology. Case B is actively conducting series of EA training, campaign and awareness programme and it is depicted in the assessment result with Learning and Growth ranks in third capability aspect. However, Case B is lack of EA trained personnel, and it is clearly reflected in the assessment result whereby Talent Management only at the fourth ranks in the EA implementation capability assessment. Realising this issue, Case B has set the Talent Management to be the highest priority in their EA implementation. The lowest priority and capability of Case B is on the Internal Process aspect. As described by Case B, they are still in the process of aligning the business and IT process, but due to some organisational policy, some of these processes need to be halted. This explains why Case B has the lowest scores in Internal Process for both EA implementation capability and priority.

EA implementation assessment result for Case C shows similarities between its capability and priority. For the time being, both rank Talent Managements as the highest capability and priority. This is followed by Technology, Cost, Authority Support, Internal Process and Learning and Growth. The stakeholders begin to realise the EA benefits and the number of EA related request is increasing. Therefore, Case C is in the process of adding more trained and certified EA team members. With the increasing number of EA talents, this also automatically becoming Case C strongest capability as opposed to the rest of criteria in other categories. Meanwhile Internal Process is at the fifth rank of EA implementation capability and lowest rank of priority, as well as Learning and Growth that scores the lowest rank in capability and fifth rank in priority. According to Case C, Internal Process is not their main priority and capability for now, because those processes are derived from organisation transformation plan. A specific team was assigned by the agency, to streamline all the business process across the organisation. For the time being, all EA trainings, awareness and campaigns are part of Case C organisational transformation programme. This explains why the scores for EA implementation capability and priority are among the lowest.

6. Conclusion

This paper successfully describes how the capability and priority of EA implementation can be assess quantitatively based on BSC and AHP models. Therefore, it is strongly believed that this new EA implementation assessment approach is a novel attempt towards assisting public sector in the developing countries in implementing the EA and has significant contribution in theoretical and practical aspects

For first theoretical contribution, this assessment approach integrates BSC model in defining the EA implementation assessment criteria and AHP algorithm in quantifying the assessment result. Compared to the existing EA assessment, their assessments are based on maturity model and checklist. Thus, the result of the assessments are still subjective and depends solely on the evaluator which can be disputable (Wendler 2012). Those assessments also do not cater for consensus decision as it only designed for individual assessment. Hence, this new assessment approach employs a quantifiable assessment algorithm by using a pairwise comparison analysis. Apart of that, this assessment provides a group decision making in determining the capability and priority of EA implementation in the organisation. In brief, this newly developed assessment offers a systematic and reliable results in EA implementation assessment, thus enhancing the quality of EA assessment.

For second theoretical contribution, this study provided valuable insights on assessment criteria for EA implementation. This study identified 27 assessment criteria from the literature reviews, preliminary study and multiple case studies and categorised according to BSC perspectives for Non-Profit Organisation, which are Internal Process, Learning and Growth, Authority Support and Cost. Two more categories that associated with EA were added, which are Technology and Talent

Management. To date, only one EA assessment model applied the BSC concept in their solution, but there is no enhancement on the existing BSC perspectives (Schelp and Stutz 2007). Hence, this study contributes by introducing two new perspectives to BSC framework, which are Technology and Talent Management which are proven in this study as part of important assessment for EA implementation in organisation.

The result of EA implementation assessment brings a valuable practical contribution of the study. This EA implementation assessment able to assess the capability and priority in EA implementation for MPS and other developing countries that has similar characteristics. Hence it can assist the EA team in EA implementation and expedite the delivery of EA initiative. The assessment results also help EA team to understand the capability and the priority of the organisation thus this will assist them in executing the best approach for EA implementation.

This assessment serves both summative and formative assessment. During the EA project execution this assessment provides a formative assessment, means it specifically checks the status of the EA implementation and suggest immediate corrective or preventive actions. At the end of EA implementation project, this assessment become a summative assessment and is used to quantify the achievement of the project. Depends on the need of the organisation, this assessment is designed to cater all different phases in EA implementation process as long as it is still in a public sector context. Hence, by understanding the organisational capability and the priority in EA implementation, decisions can be made based on time, money, people and resources of the organisation. As a result, the assessment model does not only facilitate better EA and faster organisational decision making, but it also minimises any EA associated risks.

The study findings able to help the EA experts and academia to understand on the issues in EA implementation. This is important since it has recently been noted that EA communities especially those in the developing countries have limited insight into the aspect of EA implementation either from industry or academia. The EA practitioner would also have a wider conceptualisation based on the identified assessment criteria which will lead to a more effective implementation of EA. In the long run, this EA implementation assessment implicitly creating a guideline for organisational decision-makers to follow. Whenever there is a change in business process, the organisation can use the assessment result to redesign the impacted EA accordingly. Hence, promoting the reuse of institutional EA knowledge and technology.

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