Measuring enterprise architecture readiness at higher education institutions.

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ABSTRACT

This paper discusses the Enterprise Architecture (EA) implementation readiness measurement model. One of the definitions of EA is a framework or blueprint that an organization uses to achieve business goals by identifying important strategies, namely business, information, applications, and technology and their impact on business functions. Measuring the readiness of EA implementation in an institution is useful to reduce the potential losses due to failure of EA implementation. By identifying the supporting factors for the success of EA implementation, a measurement model for EA implementation readiness can be formulated and can be used as a reference to determine the readiness of an institution in EA implementation. The application of the model was carried out at two high education institutions with a different academic domain.

I. Introduction

The definition of Enterprise Architecture (EA) is a blueprint that an organization uses to achieve business goals using IT. EA identifies important strategies namely business processes, information, applications, and technology and their impact on business functions [1].

EA was developed to optimize investment in the organization's IT field and translate it into technological solutions to reach competitive business levels. Thus, the implementation of EA in organizations is one strategy that promises to improve business performance. EA implementation provides several business benefits such as reliable IT-based operations, operational risk reduction, faster business innovation processes, and bridging the gap between business and IT [2].

Implementation of EA in an institution has several definitions. One of the definitions is an EA transformation mechanism in an organization to align business strategy and IT as its supporters. The final result of this transformation process is a detailed and structured implementation and documentation of all the IT components of the organization [1], [3], [4].

Although EA has been widely used by various organizations, EA practice in the real world scenario is still immature and encounters various obstacles. By following all the stages and producing various artifacts according to the EA planning and implementation framework, for example, TOGAF and EAP, the basic question is whether the EA can function well, sustainably, and can be applied to any organization?

EA implementation is an ongoing activity and involves interaction with various dimensions of the organization. Some organizations that have used EA turned out to face obstacles at the time of its implementation. Implementation of EA requires a high cost, so, a poor implementation may result in a lot of harm to the organization. Therefore, to reduce the losses that might be caused, the definition

of Critical Success Factor (CSF) in the implementation of EA can play a significant role to find out the level of success of EA implementation in an institution [3], [5].

The EA implementation success chance will increase if CSF is taken into account in the implementation process. CSFs are things that must go well to ensure the overall success of the project, cause the results of a process to meet expectations, and ensure competitive performance for each individual, department, or company [1], [4], [6], [7].

This paper offers a model of measuring the readiness of an organization in implementing EA. This model aims to reduce the potential losses from the failure of EA implementation. By identifying the CSF implementation of the EA, the organization can measure whether the implementation of the EA will succeed or not and then anticipate the factors that have not met the readiness of the implementation of the EA, it is expected that the success rate of the implementation of the EA will increase.

II. Related Research

Some research on CSF and its influence on the implementation of EA has been conducted in several organizations with different business fields. Kamogawa conducted at a banking institution in Japan showed several important factors that influence the successful implementation of EA, including (1) awareness of EA, (2) effectiveness of IT governance, and (3) institutional management capabilities [8].

Another study conducted by Aier took six institutions with diverse business fields as the object of research. The areas of business are financial service providers, global pharmaceutical companies, global telecommunications service providers, financial information system developers, transportation and logistics service providers, and insurance companies. The results of the study formulated several important factors supporting the successful implementation and application of EA including (1) training and education about EA, (2) improvement of communication skills, (3) intensive representation of EA, (4) governance, and (4) equipment EA supporters [3].

Research on measuring the readiness of EA implementation using CSF has been conducted by Jahani at a non-governmental organization [5]. This research formulates several CSFs identified as the main factors of an organization's readiness in the process of implementing EA. CSF formulation uses the EAP (Enterprise Architecture Planning) framework and several EA maturity models (EAMM, E2AMM). Furthermore, the CSF proposal was submitted to EA academics, experts and practitioners whose end result was CSF to measure the readiness index of EA implementation in an organization. However, CSF in this study does not include other factors discussed in previous CSF EA studies, eg: Governance [3], [7]–[10] and Communication [7], [9], [10].

Research on EA in Indonesia covers several topics, including the design and development of EA for an institution [11]–[14]. The topic on EA design discusses how to make a blueprint for the use of IT institutions using a variety of EA frameworks including TOGAF, Zachmann, and EAP. Another topic raised was an analysis after making a blueprint for the utilization of IT institutions, namely how to design and prototype a system that is in accordance with the blueprint [15], [16]. So far there has been no research that discusses the readiness of an organization in implementing EA.

III. Research Methodology

EA implementation readiness modeling is done by studying in-depth of the factors and indicators of the six CSF models namely Jahani CSF, Kamogawa CSF, Schmidt CSF, Aier CSF, Van der Raadt CSF, and Ylimaki CSF which form the basis of literature. The factors and indicators are grouped into components of the measurement model in accordance with the scope and domain of discussion of each factor and indicator.

The EA implementation readiness scale consists of the readiness scale of each component and the average scale of all components. Determination of the scale of EA implementation readiness using a scale of 1 to 5. An organization is said to be ready if all components of EA implementation readiness are more than 3. Measurement of EA implementation readiness uses previously formulated factors and indicators and then summarized into a research questionnaire. This questionnaire uses 1 to 5 Likert scale [5].

IV. Enterprise Architecture Readiness Model

The EA readiness model uses CSF from previous studies by considering various factors and indicators of these factors based on the topic and subject. Indicators of each factor in the CSF research model were previously grouped according to specific topics so that the end result was components and its indicators. The results are as follows [17].

A. Governance.

This component includes all the series of processes, habits, policies, rules, and institutions that provide direction, management and control in an organization in relation to EA [3], [7]–[10].

B. Cognition.

This component includes the understanding of all members of the organization about the functions and benefits of EA in general [3], [5], [8], [9].

C. Management.

This component covers all processes carried out in an organization that aims to achieve business objectives through a variety of structured arrangements and task delegations [5], [7]–[10].

D. Planning.

This component covers the planning stage in implementing EA which includes change management and documentation plans [3], [5], [7], [10].

E. Documentation.

This component includes all documentation activities, both organizational structure, business processes, and IT artifacts, which are then stored in the form of documents [7], [10].

F. Communication.

This component covers the level and quality of communication within an organization, between departments and within the department itself [3], [5], [7], [9], [10].

G. Participation and Commitment.

This component includes the participation and commitment of all stakeholders involved in an organization [3], [5], [7], [9], [10].

H. Organization Culture.

This component includes the ability of an organization to embrace a change in the organization [3], [5], [9], [10].

I. Information Technology.

These components include the organizational perception of IT and the capabilities of IT assets within an organization [5], [10].

J. Resource.

This component includes the ability to exist resources and steps to improve their competence and functionality [3], [5], [10].

The ten components above are calculated to show the readiness of EA implementation in an organization, as shown in Figure 1.

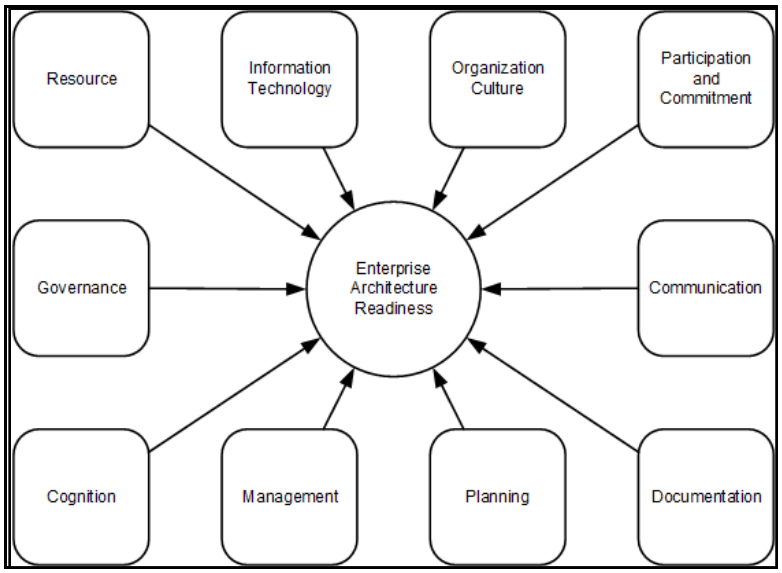

Fig. 1. Enterprise Architecture Readiness Model

These ten components of measuring EA implementation readiness can be used to measure the readiness of EA implementation within an organization by creating a questionnaire. Questionnaire data will be processed using a scale of 1 to 5 so that the final result is a scale of readiness for implementation of each component, and also the average of all components of the measurement model as a readiness index.

V. Research Model Implementation

The application of the measurement model for EA readiness at the institution where the case study was conducted through a questionnaire method and followed by interviews with several respondents to confirm the results of the measurement of the readiness index and all of its components. The case study took place in two high education institution which has a different academic domain. Respondents were directors, deputy directors, study program heads, field chairs, and field coordinators at the institution where they worked, a total of 15 people in each institution. Short interviews were conducted in the form of questions and answers related to the statements on the questionnaire to clarify the purpose of the statement and the suitability of the facts at the case study site. Data from the questionnaire were then processed using statistical software to test the validity and reliability of the questionnaire instruments, and the final results were in the form of an index of each research component. Further interviews were conducted to confirm the results of statistical data processing to the representative representatives of each case study site. Data from the interviews are then used as additional information in the discussion of each component of the measurement of EA implementation readiness.

Questionnaire data was then calculated and an EA implementation readiness index and its components were obtained. The EA implementation readiness index can be calculated both for each component and as a whole, and then compared to the predetermined scale of readiness. The readiness index value is the average value of each component of the EA implementation readiness. The results of data processing in the form of an EA implementation readiness index in the institutions "A" and "B" can be seen in Figure 2.

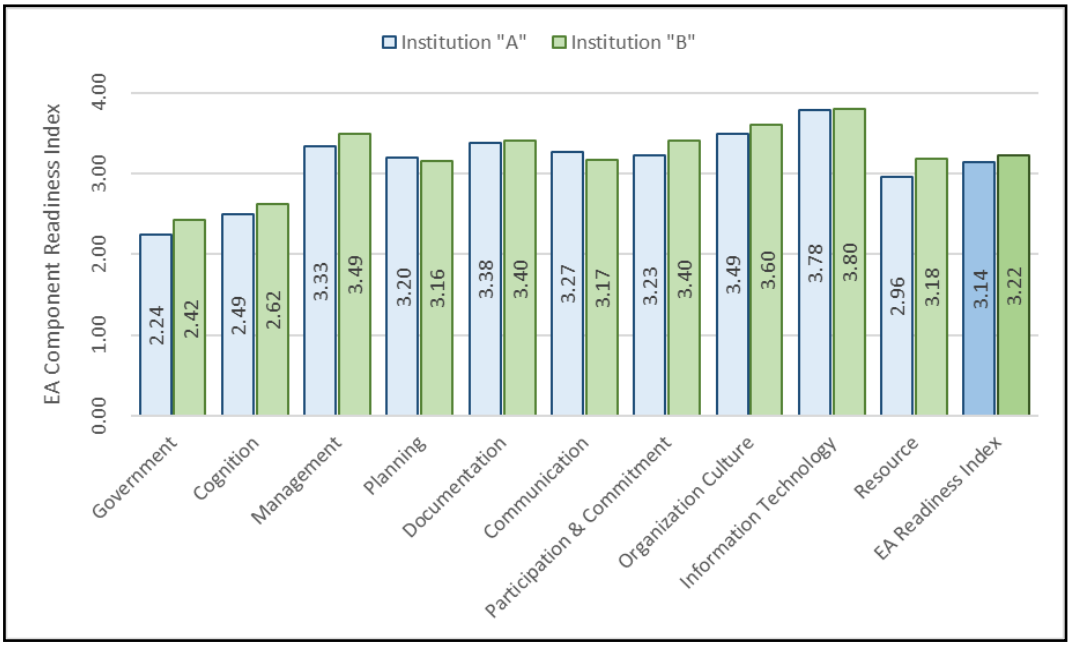

Fig. 2. EA Readiness Index of Institution A & B.

Based on the results of the EA readiness score above, further interviews to the institutions "A" and "B" has been conducted to confirm the results of the study with the conditions in the field. The results of the interview are used as information to broaden the discussion on each component of the EA implementation readiness.

The readiness index at the institution "A" is 3.14, indicates that this institution was ready if an EA would be implemented. There are 3 components that have not met the readiness target, namely: Governance, Cognition, and the Resource component. While the readiness index at institution "B" of 3.22 shows that this institution was also ready if EA would be implemented. There are 2 components that have not met the readiness target, namely: Governance and Cognition component.

From Figure 2, it can be seen that the institution "B" has an EA implementation readiness index higher than the institution "A" in almost every component except for the two components, namely Planning and Communication, although not very significant. This is more due to the relatively small size of the institution, with less than 100 employees and workplaces that are close together, making it easier to communicate between employees and ultimately facilitate operational activities and business processes that run on daily basis. The high index of the Information Technology component shows that IT in these two institutions has become an important part of the organization's operational activities. While the low index of Governance and Cognition components is due to lack of information and knowledge of EA, moreover this topic is relatively new even for the IT realm. The low resource component index is due to the very minimal allocation of IT personnel in these two institutions, only 1 or 2 employees who are truly competent in the use of IT facilities and artifacts, and the lack of employee training processes related to information systems and IT applications.

IT utilization and existing resources in Institution "A" is already optimal, but the demands of students for IT-related services are higher than existing IT facilities and personnel, thus raises the perception that IT and its resources are lacking. Broadly speaking, the problem faced by the Institution "A" is the leadership model of this institution. The business model of this Institution is a family business in the field of education. With this kind of leadership model, managerial competence in the field of education is not a top priority, causing various kinds of problems in taking strategic decisions, for example, developing an AIS, promotion strategy, lecturer recruitment, purchasing IT facilities, etc.

On the other hand in the Institution "B", the leadership factor has been good, namely by considering the competency factor and the process of democratically electing the chair and involving all the teaching staff in this Institution. Thus the aims of this institution remain focused on education and the development of student competencies in its field. IT support in the form of various information systems at the "B" institution is actually already good because it was built by the application developer who is experienced in the field of education. But the operation is still not optimal because both operators and users are still reluctant and feel they do not need to use an existing application. Another influential factor is the director and coordinator of the department which although the change of positions has been very democratic and open, the educational domain in the non-IT sector and the lack of awareness of the role of IT in advancing institutions tends to make the use of IT infrastructure less optimal.

VI. Conclusion

Various obstacles encountered in the implementation of EA in organizations can cause great harm to the organization. CSF formulation that supports the successful implementation of EA in organizations is needed to reduce the potential loss. The measurement model of EA readiness can be used as a reference to determine the readiness of an institution in implementing EA. By knowing the level of readiness of an institution, the institution can reduce losses due to failure of EA implementation, by first improving components that have not yet reached a certain level of readiness.

The measurement model of EA implementation readiness that has been made by collaborating with previous CSF can indicate the level of institutional readiness in terms of EA implementation. The components of the EA implementation readiness measurement model are governance, cognition, management, planning, documentation, communication, stakeholder participation, organizational culture, information technology, and resources.

The measurement model was then applied to two high education institutions namely Institution "A" and Institution "B" with different academic domains. The results of the measurement show the readiness index for EA in Institution "A" is 3.14 with three components that do not meet the scale of readiness, namely Governance, Cognition, and Resources. While in Institution "B" the EA readiness index is 3.22 with two components that meet the readiness scale namely Governance and Cognition

Supplementary Material

Supplementary material that may be helpful in the review process should be prepared and provided as a separate electronic file. That file can then be transformed into PDF format and submitted along with the manuscript and graphic files to the appropriate editorial office.

References

[1] C. M. Pereira and P. Sousa, “A method to define an Enterprise Architecture using the Zachman Framework,” in *Proceedings of the 2004 ACM symposium on Applied computing - SAC ’04*, 2004, p. 1366.

[2] M. Meyer, M. Helfert, and C. O’Brien, “An analysis of enterprise architecture maturity frameworks,” in *Lecture Notes in Business Information Processing*, 2011.

[3] S. Aier and J. Schelp, “A reassessment of enterprise architecture implementation,” in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 2010, vol. 6275 LNCS, pp. 35–47.

[4] S. S. Hussein, M. N. Mahrin, and Z. Ismail, “Towards Readiness in Enterprise Architecture Establishment : A Critical Success Factors,” in *Postgraduate Annual Research on Informatics Seminar*, 2016.

[5] B. Jahani, S. Reza Seyyed Javadein, and H. Abedi Jafari, “Measurement of enterprise architecture readiness within organizations,” *Bus. Strateg. Ser.*, vol. 11, no. 3, pp. 177–191, 2010.

[6] F. Nikpay, H. Selamat, B. D. Rouhani, and P. Nikfard, "A review of critical success factors of enterprise architecture implementation," in *Proceedings - 2013 International Conference on Informatics and Creative Multimedia, ICICM 2013*, 2013.

[7] C. Schmidt and P. Buxmann, "Outcomes and success factors of enterprise IT architecture management: Empirical insight from the international financial services industry," *Eur. J. Inf. Syst.*, 2011.

[8] T. Kamogawa and H. Okada, "Enterprise Architecture and Information Systems: In Japanese Banking Industry," in *2008 International Symposium on Applications and the Internet*, 2008, pp. 433–436.

[9] B. Van Der Raadt, M. Bonnet, S. Schouten, and H. Van Vliet, "The relation between EA effectiveness and stakeholder satisfaction," *J. Syst. Softw.*, vol. 83, pp. 1954–1969, 2010.

[10] T. Ylimäki, "Potential Critical Success Factors for Enterprise Architecture," 2006.

[11] D. Marisa Khairina and A. Khaerani Aziz, "Perancangan e-Government Kelurahan Sempaja Timur Menggunakan Enterprise Architecture Planning," *Pros. Semin. Ilmu Komput. dan Teknol. Inf.*, vol. 2, no. 1, 2017.

[12] R. Trisminingsih and S. N. Putra, "Perancangan Arsitektur Enterprise untuk Koperasi Pertanian Menggunakan Enterprise Architecture Planning," *J. Sist. Infomasi*, vol. 9, no. 1, 2017.

[13] A. Wibowo and E. Rijanto, "Perancangan Enterprise Architecture untuk Menerapkan Innovation Managemet System di LPIK-ITB Menggunakan Kerangka Kerja Zachman," *J. Tata Kelola*, 2017.

[14] B. Widodo and D. Suharjito, "Pengembangan Blueprint It Dengan Zachman Framework Di STP Trisakti," *J. Sist. Inf.*, vol. 1, no. 13, pp. 49–66, 2017.

[15] Y. Liu, M. Basri, and M. Fauzi, "Analisa Tata Kelola Arsitektur Enterprise untuk Mendukung Sistem Informasi Akademik Menggunakan Togaf (Studi Kasus STMIK Indonesia Jakarta)," *J. Inform. dan Komputasi*, 2017.

[16] A. A. Slameto, E. Utami, and A. A. Pangera, "Analisis dan Desain Arsitektur Enterprise Sistem Informasi Pelaporan Kerusakan Komputer dengan Zachman Framework," *J. Teknol. Inf.*, vol. 8, no. 21, 2012.

[17] A. S. Aji, T. Dirgahayu, and H. P. Putro, "Model Pengukuran Kesiapan Implementasi Arsitektur Enterprise Berbasis Critical Success Factor," *J. Teknol. TECHNOSCIENTIA*, vol. 10, no. 1, 2017.