

Identification of Enterprise Architecture Challenges in the Banking Industry (Case Study: Post Bank of Iran)

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Abstract

The implementation of enterprise architecture (EA) is one of the most effective strategies for aligning information technology (IT) development plans with organizational goals and strategies and for designing targeted plans for utilizing IT resources. As one of the most important economic organizations, banks need this alignment to succeed in today's competitive market. EA projects are significantly important for banks; however, due to certain challenges, most of these projects have not been completed in the banking industry on time and within budget. This research investigated and identified EA challenges in the banking industry. This was a descriptive-applied study. Following the literature review, the Fuzzy Delphi Method was used and the opinions of 15 IT experts working in the Post Bank of Iran were analyzed to identify 19 challenges impeding the EA implementation in this industry.

Keywords: Enterprise architecture, Identifying challenges, Banking industry, Delphi fuzzy.



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1. Introduction

As one of the most important economic organizations, banks need to use new technologies as well as information technology tools to succeed in today's competitive market. Due to their engagement with serious challenges and constant competitions, IT operational models have undergone various unpredictable developments in organizations. Therefore, in today's organizations, the IT operational environments are highly unstable and complicated and thus, alignment with the business has become more difficult and yet more important. Thousands of years of human experience show that "architecture" is the only way to simultaneously address complexity and change.

EA is rooted in the discussions of "Information Systems Architecture". EA is an approach used for describing various aspects and layers of an organization and can utilize standard models and techniques to describe an organization's status quo (AS-IS) as well as its desired state (TO-BE). EA also contains a special plan, called the transition plan, which guides the transformation of an organization from the status quo state to a target state. EA development provides banks with the opportunity to adopt a proper long-term approach in order to identify, categorize and prioritize their present and future IT needs and to define specific projects and to take the necessary steps in order to address these needs and to achieve desired objectives.

The importance of EA projects in providing a clear image of an organization's IT system, on the one hand, and the complexity of managerial and executive issues of such projects in the banking industry, on the other hand, prompted the author to investigate the specific problems of these projects in this industry. Unfortunately, there is no detailed statistics on the number of projects conducted in this area and their success and failure rates; however, obviously, managers and experts face various challenges in achieving desired goals and expected outcomes of EA projects.

Therefore, this study aimed to identify and investigate the problems and issues threatening the EA implementation as one of the major IT projects in the banking system. In this regard, after conducting a systematic review on research literature, major EA problems were identified, categorized and summarized to achieve a comprehensive view of the subject and finally, appropriate solutions were provided to reduce the risk of such projects. This study also identified and categorized the views and approaches of the banking industry professionals and experts towards EA

projects in order to achieve a deeper and more local understanding of the realities of these projects in Iran. In addition, the Fuzzy Delphi Method was used to analyze the criteria derived from the systematic review as well as the expert opinions.

2. Theoretical Background

EA is also known as IT Master Plan or Informatics Master Plan in Iran. This plan mobilizes the ICT resources of organizations such as: infrastructures, information systems, financial resources, human resources, etc. in order to achieve organizations' goals and to support their strategies and programs. In other words, EA is a framework for explaining, coordinating and aligning all activities and elements of the organization in achieving the strategic goals of the organization. In other words, EA provides a framework for explaining, coordinating and aligning all the organizational activities and elements to achieve strategic goals. In fact, in EA the entire IT sector of an organization is re-engineered to improve business processes through utilizing IT tools [13].

Many definitions have been presented for EA. The International EA Institute defines Architecture as follows: EA involves analyzing and documenting an enterprise in its current and future states from an integrated strategy, business and technology perspective [8]. The MIT Center for Information Systems Research has provided a formal definition of EA as follows: EA includes organizing logics for business process and IT capabilities reflecting the integration and standardization requirements of the firm's operating model [12]. The EA Research Forum defines architecture as follows: EA involves the continuous practice of describing essential elements of a socio-technical organization, their interrelationships with each other and with the environment, in order to understand the complexity and management of changes [4]. The Institute For EA Developments (IFEAD) provides a full definition of EA: it is a complete expression of an enterprise; a master plan that facilitates collaboration between aspects of business planning such as goals, perspectives, strategies and management principles; aspects of business operations such as business functions and processes, organizational structures and data; aspects of automation such as information systems and databases and IT business infrastructures, such as computers, operating systems and networks [7]. The Chief Information Officers Council (CIOC) is an intergovernmental organization responsible for improving the design, modernization, application, sharing and efficiency of information resources. It has developed the FEAF framework in 1999 and defines EA as a strategic

information asset base, which defines the mission, business activities supporting the mission, the information and the technologies necessary to perform the mission and the transitional processes needed for implementing new technologies in response to the changing business requirements [3].

EA plans usually provide a road map for the next 3-5 years on IT development. These plans contain a portfolio of various plans, projects and activities developed and discussed in relevant areas and from different perspectives [20, 21].

Different frameworks and methodologies have been presented for EA. Zachman, TOGAF, FEAF, C4ISR and EAP are the most commonly used EA frameworks in the world. These frameworks are provided by private institutions or government departments during the evolution of EA and can be used as a guide for practical EA implementation.

Following the literature review, the Fuzzy Delphi Method and expert opinions were used to identify and categorize EA challenges in the Iranian banking industry.

3. Empirical Background

Many studies have investigated EA challenges in various aspects. Some of the findings of these studies are presented in Table 1.

As shown in the table above, during 1999 to 2017, some researchers have addressed this issue and have identified and reported a number of effective criteria. This study combines previous studies and uses the Fuzzy Delphi method to summarize and analyze the above criteria with a comprehensive approach in EA projects of the Iranian banking industry.

4. Methodology

The method of the present study is descriptive in terms of purpose and from the perspective of the data collection method. This was a descriptive-applied study and documentary, fuzzy Delphi and survey research methods were used to collect data. The Delphi method is both a research method and a data collection method. Delphi's traditional approach has always suffered from low expert consensus, high implementation costs and the probability of deletion of the opinions of some experts. Thus, Murray, Pipino, and Gigch (1985) integrated the traditional

Delphi method and the fuzzy theory in order to eliminate the ambiguity and inconsistency of the Delphi method. The fuzzy Delphi method uses geometric mean to develop a group decision model; this will eliminate undesirable criteria and will remove the outlier values [9]. In the fuzzy Delphi method, written data are obtained from the experts and they are analyzed using fuzzy method [22].

In the present study, the following criteria were considered for selecting experts:

- Relevant knowledge and experience (At least a bachelor's degree and five years of experience in the area of Information Technology);
- Willingness to participate in the study as well as an open schedule;
- Effective communication skills.

Figure 1 displays an algorithm for the implementation of fuzzy Delphi method.

Figure 1: The algorithm of the implementation of fuzzy Delphi method

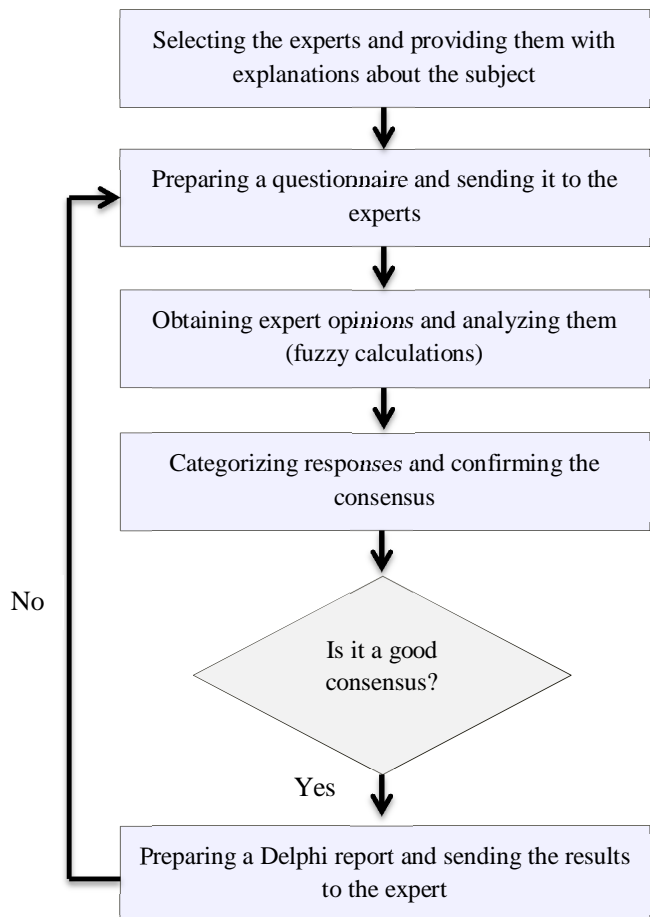


Table 1: Previous studies

No	Title	Author	Findings	Year
1	Enterprise architecture management challenges	Olsen	Unclear roles, unsuccessful communication, low EA maturity and commitment, and complicated EA tools	2017
2	Enterprise architecture adoption challenges	Olsen and Trelsgard,	Lack of support from high organizational levels, Lack of a strategic EA council, lack of scientific competence at the top management level	2016
3	Architecting the system of systems enterprise: enabling constructs and methods from the field of engineering Systems	Rhodes et al.	Lack of management commitment, multiplicity of stakeholders, not sharing findings, complexity, incorrect definition of architecture domain and poor EA framework	2009
4	Key issues in enterprise architecture implementation	Seppanen, Heikkila and Liimatainen	Lack of management commitment, lack of supervision, multiplicity of stakeholders, lack of proper coordination, poor communication, poor knowledge of requirements, not sharing findings, inexperienced executive and poor EA framework	2009
5	Coordination and governance in geographically distributed enterprise architecting: an empirical research design	Espinosa and Boh	Lack of management commitment, lack of supervision, multiplicity of stakeholders, lack of proper coordination, poor communication, complexity, the size of EA projects and unreliable contractors and business partners	2009
6	Using axiomatic design in the process of enterprise architecting	Sharifi, Moghaddam and Merati	Poor EA framework, the risk of outsourcing EA projects, poor laws and procedures for selecting contractors, conflicts and poor cooperation of other organizational units	2008
7	Frameworks for enterprise architecture	Shah and Kourdi	Lack of management commitment, poor supervision, multiplicity of stakeholders, poor communication, complex and changing conditions, Poor EA framework, poor knowledge management and proper support for tools	2007
8	System of systems engineering and architecture challenges	Meilich	Complex and changing conditions, incorrect definition of architecture domain and poor knowledge management	2006
9	Technical risk management on enterprise integration projects	Lam	Lack of management commitment, poor supervision, multiplicity of stakeholders, lack of proper coordination, poor communication, poor knowledge of requirements, not sharing findings, inexperienced executive, complex and changing conditions, poor knowledge management, organizational instability, environmental changes	2004
10	Enterprise architecting: critical problems	Kaisler, Armour and Valivullah	Lack of management commitment, multiplicity of stakeholders, not sharing findings, complex and changing conditions, incorrect definition of architecture domain, improper support for tools and prolonged EA projects	2004
11	A big picture look at enterprise architecture	Armour, Kaisler and Liu	Poor supervision, lack of proper coordination, poor understanding of requirements, not sharing findings,, inexperienced executive, complex and changing conditions, incorrect definition of architecture domain, poor EA framework, lack of highly skilled workforce	1999

This research aimed to identify and categorize the views and opinions of banking professionals and experts on the major EA projects challenges to achieve a deeper and more local understanding of the realities of these projects in the Iranian banking industry. In this regard, the opinions of 15 IT experts working in the Post Bank of Iran were collected using a questionnaire as well as a 5-point Likert scale. Most of the previous studies conducted in the area of EA problems have utilized qualitative methods; therefore, the Fuzzy Delphi method was used to obtain a comprehensive integration of the subject based on a translation of the performed qualitative studies. Previous studies were reviewed and 68 challenges were identified and finally, based on the existing overlaps, 23 challenges were identified. In this questionnaire, each expert expressed his/her opinion on the importance and intensity of each of the challenges using verbal comments (very low, low, moderate, high and very high). As shown in Table 2, the comments are defined in the form of triangular fuzzy numbers[6].

Meanwhile, the face and content validity as well as the reliability of the questionnaire have been confirmed.

Table 2: The triangular and discrete fuzzy numbers in the 5-point Likert scale

Verbal Comments	Triangular Fuzzy Numbers	Discrete Fuzzy Numbers
Very high	(0.75, 1, 1)	0.75
High	(0.5, 0.75, 1)	0.5625
Moderate	(0.25, 0.5, 0.75)	0.3125
Low	(0, 0.25, 0.5)	0.0625
Very low	(0, 0, 0.25)	0.0625

In Table 2, the discrete fuzzy numbers have been calculated using equation 1 as follows:

$$\chi = m + \frac{\beta - \alpha}{4} \tag{1}$$

5. Findings

Different steps of fuzzy Delphi method used in this study are described below.

5.1. The first survey

At this stage, a questionnaire containing 23 EA challenges was provided to the expert group members and they were asked to express their opinions on the importance and intensity of each of the challenges using verbal comments. The fuzzy mean of each component is calculated based on the data obtained from the first questionnaire and by

using equations 2 and 3. These figures are presented in Table 3.

$$(a_1^i, a_2^i, a_3^i) \quad i = 1, 2, 3, \dots, n = A_i \tag{2}$$

In the above equation, “n” represents the number of experts, and represents the opinion of the i-th expert.

$$A_{ave} = (m_1, m_2, m_3) \\ = \left(\frac{1}{n} \sum_{i=1}^n a_1^i, \frac{1}{n} \sum_{i=1}^n a_2^i, \frac{1}{n} \sum_{i=1}^n a_3^i \right) \tag{3}$$

In the above equation, represents the mean of expert opinions.

Table 3: The mean of expert opinions in the first survey

No.	Components	Triangular fuzzy numbers (m, α, β)	Discrete fuzzy numbers (χ)
1	Unclear roles	(0.08, 0.25, 0.50)	0.14
2	Lack of support from high organizational levels	(0.63, 0.88, 0.98)	0.65
3	Low EA maturity and commitment	(0.45, 0.70, 0.90)	0.50
4	Complex tools	(0.05, 0.30, 0.55)	0.11
5	Poor communication	(0.29, 0.15, 0.40)	0.35
6	Lack of a strategic EA council	(0.10, 0.18, 0.43)	0.16
7	lack of scientific competence at the top management level	(0.48, 0.73, 0.88)	0.51
8	Multiplicity of stakeholders	(0.58, 0.83, 0.95)	0.61
9	The size of EA projects	(0.63, 0.93, 0.98)	0.69
10	Poor EA framework	(0.55, 0.80, 0.98)	0.59
11	Poor supervision	(0.55, 0.80, 0.95)	0.59
12	Lack of proper coordination	(0.50, 0.75, 0.90)	0.54
13	Poor knowledge of requirements	(0.55, 0.80, 0.95)	0.59
14	conflicts and poor cooperation of other organizational units	(0.53, 0.78, 0.95)	0.57
15	Unreliable contractors and business partners	(0.53, 0.78, 0.95)	0.57
16	Environmental	(0.13, 0.18, 0.43)	0.19

	changes	0.43)	
17	Poor laws and procedures for selecting contractors	(0.60, 0.85, 0.95)	0.63
18	Incorrect definition of architecture domain	(0.58, 0.83, 0.95)	0.61
19	Prolonged EA projects	(0.60, 0.85, 0.95)	0.63
20	Organizational instability	(0.38, 0.63, 0.88)	0.44
21	The risk of outsourcing EA projects	(0.45, 0.40, 0.65)	0.51
22	Poor knowledge management	(0.29, 0.70, 0.85)	0.33
23	Lack of highly skilled workforce	(0.38, 0.63, 0.88)	0.44

In Table 3, the mean triangular fuzzy numbers and the mean discrete fuzzy numbers are calculated using equations 3 and 1, respectively.

5.2. The second survey

According to Cheng and Lin (2002), if the difference between the two surveys is less than the lower threshold (0.1) then the survey will be stopped [2]. Therefore, in the second survey, the previous opinions of each expert and their differences with the views of other experts, along with a questionnaire were again sent to the expert group members. The results of the second survey were again analyzed using equations 1 and 3. The results are shown in Table 4. Table 4 also shows the difference between the first and second surveys.

Table 4: The mean of expert opinions in the second survey

No.	Components	Triangular fuzzy numbers (m, α, β)	Discrete fuzzy numbers (x)	Difference with the first survey
1	Unclear roles	(0.13, 0.18, 0.43)	0.19	0.05
2	Lack of support from high organizational levels	(0.70, 0.78, 0.93)	0.74	0.09
3	Low EA maturity and commitment	(0.53, 0.70, 0.95)	0.59	0.09
4	Complex tools	(0.10, 0.18, 0.43)	0.16	0.05
5	Poor communication	(0.15, 0.18, 0.38)	0.30	0.05
6	Lack of a strategic EA council	(0.12, 0.18, 0.38)	0.18	0.02
7	lack of scientific	(0.50, 0.60, 0.78)	0.54	0.03

	competence at the top management level			
8	Multiplicity of stakeholders	(0.65, 0.75, 0.93)	0.70	0.09
9	The size of EA projects	(0.75, 0.78, 0.88)	0.78	0.09
10	Poor EA framework	(0.63, 0.73, 0.92)	0.67	0.08
11	Poor supervision	(0.63, 0.70, 0.90)	0.68	0.09
12	Lack of proper coordination	(0.69, 0.78, 0.93)	0.73	0.19
13	Poor knowledge of requirements	(0.63, 0.70, 0.90)	0.68	0.09
14	conflicts and poor cooperation of other organizational units	(0.60, 0.73, 0.95)	0.71	0.09
15	Unreliable contractors and business partners	(0.65, 0.73, 0.95)	0.71	0.14
16	Environmental changes	(0.15, 0.21, 0.44)	0.21	0.02
17	Poor laws and procedures for selecting contractors	(0.78, 0.83, 0.95)	0.81	0.18
18	Incorrect definition of architecture domain	(0.65, 0.73, 0.88)	0.69	0.08
19	Prolonged EA projects	(0.65, 0.73, 0.88)	0.69	0.08
20	Organizational instability	(0.43, 0.60, 0.85)	0.49	0.05
21	The risk of outsourcing EA projects	(0.53, 0.65, 0.85)	0.58	0.07
22	Poor knowledge management	(0.83, 0.88, 1.0)	0.86	0.53
23	Lack of highly skilled workforce	(0.43, 0.65, 0.85)	0.49	0.05

As Table 4 shows, the experts have reached consensus on most of the studied criteria and the differences between the first and second surveys are less than the lower threshold (0.1) in these criteria. Therefore, these criteria are selected as effective criteria and the survey will continue only for criteria 12, 15, 17 and 22. In addition, in the first and second surveys, the scores of criteria 1, 4, 6 and 16 were

below the moderate range (low and very low); thus, they were removed from the survey.

5.3. The third survey

In the third survey, a questionnaire containing criteria 12, 15, 17 and 22 was designed and it was again sent to the expert group members, along with the previous opinions of each expert and their differences with the views of other experts. The fuzzy analysis of the results of this step is presented in Table 5.

Table 5: The mean of expert opinions in the third survey

No.	Components	Triangular fuzzy numbers (m, α, β)	Discrete fuzzy numbers (X)	Difference with the first survey
12	Lack of proper coordination	(0.63, 0.88, 1.08)	0.68	0.06
15	Unreliable contractors and business partners	(0.55, 0.80, 1.08)	0.62	0.09
17	Poor laws and procedures for selecting contractors	(0.69, 0.95, 1.10)	0.73	0.07
22	Poor knowledge management	(0.73, 0.98, 1.10)	0.77	0.09

As Table 5 shows, the differences between the second and third surveys are less than the lower threshold (0.1) in these criteria; therefore, the survey process is stopped at this stage. Finally, among all the 23 EA challenges, criteria 1, 4, 6 and 16 were eliminated and 19 challenges were identified as the major EA challenges in the Iranian banking industry.

6. Conclusion

This study aimed to identify EA challenges in the banking industry. Following the literature review, the Fuzzy Delphi Method was used and the opinions of 15 IT experts working in the Post Bank of Iran were analyzed to identify 19 challenges impeding the EA implementation in this industry. The findings showed that “lack of support from high organizational levels”, “the size of EA projects” and “poor knowledge management” were the major EA challenges in the banking industry. Reviewing the research literature shows that this research has been the most serious scientific effort made for

identification of EA challenges in the banking industry. This research can pave the ground for future studies and can help researchers develop specific frameworks for the successful implementation of EA projects in the banking industry. It can also help banks identify these challenges and take effective actions for the implementation of EA projects, aligning IT plans with organizational strategies and for designing targeted plans for utilizing information technology resources.

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