Practical EA Model Development: A Case Study of An Educational Institution in Bahrain

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Abstract: Organizations strive to meet their business goals in preserving a desired harmony and collaboration between its business environment and integrated ICT. At the same time, Enterprise architecture (EA), as a high ontological analysis tool, claims that organizations could directly benefit from EA efforts in enhancing knowledge and improved decision making about the organization’s people, business processes, information, and ICT applications. Massive number of EA methodologies and frameworks assist organizations in achieving their aforementioned benefits. This paper addresses the development of an EA (baseline and a target architectural effort) analysis that enables the management of a Bahraini educational department; Information Systems Department (IS-Dep) assess its readiness for investing in a new Dashboard application. Respectively, Zachman Framework (ZFW), an Architecture Development Process (ADP), and ArchiMate modeling language were employed as an analysis tool, project methodology and a rigorous architecture description provider for the business and IT stakeholders. Results reveal that 1) The whole university is facing communication and information sharing difficulties, at which more advanced application systems, should be adopted to correct this problem. 2) Every type of data and information in the university is centralized implying that lengthy and time-consuming procedures are to be tackled. In order for the IS-Dep to meet the needs of both students and academics, the system needs to be decentralized. 3) Many services are not fully utilized, so the IS-Dep should utilize them.

Keywords: Enterprise Architecture, Zachman FW, Architecture Development Process, ArchiMate, EA Case Study.

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1. Introduction

Enterprise architecture (EA) is an ontological analysis tool that provides a high level description of an organization's baseline (as-is) business processes and ICT applications, their interrelationships, along with the organization's stakeholders. EA also, supports an organization reaching its desired goals by providing a transition plan for moving towards its target (to-be) vision. In this regard, EA captures a wide variety of organization’s information and links it together, so that managers can then see relationships and ask questions to identify problems and/or to make decisions about changes they are considering. In this paper, we are trying to achieve the following objectives. First, developing an EA baseline for an educational department (IS-Dep) by utilizing ZFW and following a distinguished ADP. Second, developing a target EA for the IS-Dep to demonstrate the new requirements. Third, modeling unified architectural artifacts for the IS-Dep by utilizing ArchiMate modeling language. Consequently, we present a case study for an educational department (IS-Dep) in Bahrain. The Data collection procedure includes 1) semi-structured with open-ended questions interviews with different stakeholders and 2) document analysis of available sources of information that relate to our study case. Apparently, the IS-Dep is one amongst three departments of the college of IT at an actual educational institution in Bahrain. Neither the university nor the
college and the department have a baseline EA. The aim was to develop a ‘Dashboard System’ that integrates all applications in the IS-Dep and by the College of IT’s dean to integrate this system with the rest of the university’s systems. The rational is that developing the system helps accessing of all software applications from one single portal (i.e., reduces the redundancy in the functionalities), and the integration allows accessing other departments' repositories for the shared information they need. Subsequently, we acquired a mandate to develop a baseline “as-is” architecture for the IS-Dep and then develop a target “to-be” and a transition plan that all assist in achieving those requirements. A trustworthy framework and methodology were selected for this task. Unfortunately, due to financial limitations, EA development project at the IS-Dep discontinued, thus our contribution in this paper was limited at step 3 of the ADP.

2. Enterprise Architecture (EA)

The ISO/IEC 42010 standard defines EA as “the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution”[8]. [23] defines EA as a set of relevant descriptive representations (i.e artifacts) to describe an object, while [7] defines it as the blueprints of an organization's People, Business processes, Technology, and Software applications. Furthermore, EA is composed of views, viewpoints, and frameworks (EAF). [13] describe a view as a way to represent what you see in the forms of drawings, blueprints, or level of details, while a viewpoint refers to where you are looking from which is expressed from different perspectives. EAF is a set of integrated layers of abstraction including Business Layer, Application Layer, and IT Infrastructure [14] that all guide the development of an organization’s architecture from a baseline state to a target state, through a transition plan and an architectural roadmap [19]. EA literature provides massive number of EAFs including ZACHMAN, GERAM, ARIS, TOGAF, etc, each of which best services different domains.

3. Previous work

Most of EA related research articles including development, adoption, and implementation of EA, were conducted qualitatively adopting a Case Study approach. Furthermore, Armour, Kaisler and Liu proposed an EA development using UML for the U.S. Capitol Police’s information system [3]. Moreover, [11] analyzed, designed, and implemented an EA for a small manufacturing SME firm in Mexico aiming to measure its goals and objectives. Also, [5] presented a case study for a small defense contractor aiming to develop efficient systems engineering tools for war purposes. Moreover, [9] proposed a SMEAG model to enhance the SMEs’ growth stage models in South Africa. [18] employed EA to develop an e-participation reference model. Furthermore, [4] proposed a roadmap for EA implementation for the higher education institutions of Ecuador. Moreover, [6] studied Enterprise modeling based on ontology and presented a case study for a software producing firm in Iran. Finally, [15] employed an interpretive case study approach to explore the interoperability challenges resulting from EA implementation for a hospital in Denmark.

3.1 Zachman Framework (ZFW)

[12] describe ZFW as a comprehensive matrix that is composed of six rows, representing the “Perspectives” of different stakeholders and include: Planner, Owner, Designer, Builder, Implementer, and Actual system, and six columns, representing the “Aspects/Abstractions” which identify different types of information (textual/drawings) and are characterized by questions What, How, Where, Who, When, and Why. As a result, each cell of the 36 cells matrix portrays a certain aspect of EA from a distinctive viewpoint. Table 1 and Table 2, consecutively explain ZFW’s perspectives and aspects. In 2012, the name of “ZFW” was converted to Zachman ontology of organizations at which the Business, Application, and Technology layers could be identified [21].

3.2 ArchiMate modeling language

ArchiMate is proven to be the most modeling language complying with the IEEE 1471–2000 standard [16] as it satisfies four goals, first, focusing on the between domains and inter domain relations, second, allowing for modeling any global structure within each domain, third, ensuring that the depicted models can be described correctly, and fourth, permitting the visualization of the same model in different ways [20]. Figure 1 demonstrates three Layers, three Aspects and eight viewpoints across the layers and aspects of ArchiMate. Layers include 1) Business Layer which refers to business processes realized by actors, 2) Application Layer which supports the business layer with software services, and 3) Technology Layer which offers required infrastructure H/W services to run applications [10]. The three Aspects include 1) active structure which represents the structural concepts (the business actors, application components, and devices that display actual behavior), 2) behavior aspect which represents the behavior (i.e. processes, functions, events, and services) performed by the actors and behavioral concepts which are assigned to structural concepts, to show who or what displays the behavior, and 3) passive structure aspect which represents the objects on which behavior is performed (i.e. information objects in
business layer and data objects in application layer, but they may also be used to represent physical objects[10].

To define the drawings of the baseline and target states for an organization, Figure 2 depicts a dashed rectangle of the allowed ArchiMate notations overlapping with ZF’s perspectives/rows (2-4) and aspects/columns (1-4). Excluded ZF cells are expressed in natural language.

### 4. Research Methodology

In this paper, we employed a case study approach for the utilization/adoption of EA for a single case (i.e. the IS-Dep) as a holistic single unit of analysis. Single case is selected when it is a typical choice or when it allows observing and analyzing a phenomenon in depth at which few have considered previously [17][22]. Data collection procedure included Semi-structured with open-ended questions interviews and document Analysis. Data analysis results were performed based on ZFW’s viewpoints and views.

### 5. EA development of the Case study

#### 5.1 Architecture Development Process (ADP)

This section illustrates the EA development methodology for the case (IS-Dep). Figure 3 conceptually depicts the Architecture Development Process (ADP) which is an EA methodology that was originally developed by [1],[2] is partially employed here to work with ZF in order to develop the baseline and target EA for our business case (IS-Dep). Notice that during the EA development, steps (1- 4) are concerned with the Architecting process and that step 0 is performed just once, either for baseline/target development, while Step 5 is continuous. Table 3 elaborates more details on the ADP activities.

#### 5.2 Step 0-Initiate ADP

Step 0 is concerned with the preparation efforts prior to the architecting task. A snapshot of some key work out is demonstrated in Table 4. Further results will be reflected in the following steps.

#### 5.3 Step 1-Baseline Architecture Development

The baseline architecture (as-is) encompasses the existing objects of an organization based on the aforementioned layers and serves as a starting point for
identifying relationships between those objects [19].
This step characterizes and develops the baseline architecture (as-is) for the IS-Dep using textual representation for non-model based cells (1.1-1.6).
To mitigate data collection complexity, a mapping technique was introduced to model the artifacts of the 36 cells of ZF. As expressed in Table 5, each of cells (1.1 - 4.6) represents a unique generated model (s).
Since the implementation is out of the scope of this paper, we excluded viewpoints 5 and 6 (Perspectives (5 - 6) and Aspects (5.1 - 6.6)).

**Planner Perspective:** The planner’s perspective defines all the organization’s scope in a highly abstracted description and is expressed in natural language (textual). A snapshot of the viewpoint’s objects is demonstrated in Table 6.
Note that this is a highly abstracted level of details. Further levels of details will be generated in the following perspectives. An important point to emphasize is that business, application, and technology objects evolving from this perspective may change or get updated or cancelled during the following perspectives.

**Owner Perspective (Business layer):** The owner’s perspective is the viewpoint of the IS-Dep’s Chairperson and the College of IT’s Dean across Aspects. Depicted models of cell (2.2) - Cell (2.6) are available in Appendix A. Table 7 demonstrates the ArchiMate notation used to generate the content of Cell 2.2. It is important to mention that the number of

| Step | Activities | Description | Deliverables |
|------|------------|-------------|--------------|
| 0    | 0.1 Define Scope and Objectives | - Define a clear charter including boundaries of the EA agreement with senior Management. | ADP Project Plan |
|      | 0.2 Assemble Arch Team | - Assign a project leader and project members. |  |
|      | 0.3 Tailor Arch Principles | - Set Architectural Principles to guide the development of target architecture. |  |
|      | 0.4 Select Standards | - Develop an ADP Plan that defines WBS, Schedule, Resource Allocations and Products. |  |
|      | 0.5 Develop ADP Plan |  |  |
|      | 0.6 Obtain Management Approval |  |  |
| 1    | 1.1 Characterize Business View | Analyze the current architecture including:  
• Business  
• Application software  
• Technology | Baseline Architecture Document |
|      | 1.2 Characterize Baseline EA Views | Reflect on “as-is” arc to show the impact on “to-be”, w.r.t:  
• Business  
• Application software  
• Technology |  |
|      | 1.3 Characterize Baseline Infrastructure |  |  |
|      | 1.4 Create & Update Baseline Arch |  |  |
| 2    | 2.1 Define/Update Business require(s) | Identifies differences in three architectural views  
 Enumerate components that need to be changed  
 Assess the status of legacy systems  
 Assess the maturity of available technology  
 Identify Design Constraints  
 Determine which requirements can be satisfied  
 ATP includes: milestones and activities | Architecture Transition Document |
|      | 2.2 Define/Update Tgt Business View |  |  |
|      | 2.3 Define/Update Target EA Views |  |  |
|      | 2.4 Define/Update Target Infrastructure |  |  |
|      | 2.5 Create Target Arch Document |  |  |
| 3    | 3.1 Perform Gap Analysis |  |  |
|      | 3.2 Assess Technology maturity |  |  |
|      | 3.3 Identify design Constraints |  |  |
|      | 3.4 Select Transition opportunities |  |  |
|      | 3.5 Create Architecture Transition Plan |  |  |

**Figure 3.** The ADP (Adopted: [1] [2])
functions compared to the previous perspective is reduced to six at which Registration, Human resources, and Scientific publishing are loosely coupled with the IS-Dep boundary. This proves the differences in viewpoints which imply the certain levels of concerns. For Cell (2.3), seven locations are identified to support the IS-Dep. This includes 1) Block S40 where IT college including 2) IS-Dep resides, 3) Classrooms (20 rooms) at which each one has a single desktop and one data show device, 4) Open area lab which is shared with other college’s departments including around 50 desktop Pcs, 5) S50 Hall room (Hall of 2 halls) next to Block 40 and allows for conferences, seminars and workshops to occur, 6) Offices for staff including desktop PCs, and 7) Labs where students are assigned practical sessions. All seven locations have internet and intranet facilities.

Notice that “Blackboard website” and “ADS” are networks that grant a required communication to the IS-Dep.

However, since they are shared networks, they are depicted outside the IS-Dep’s boundary. Cell (2.5) is the time at which IS-Dep has to function and this starts in the beginning of each Fall/Spring (Sep/January) semesters to their ends (June) of each academic year. Cell (2.6) expresses the strategic plans. Notice that the IS-Dep at this time hasn’t established one yet.

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**Table 4. Development of Step 0**

| Perspective | Aspects/Abstraction |
|-------------|---------------------|
| Planner     | 1. What 2. How 3. Where 4. Who 5. When 6. Why |
| Owner       | 1.1 2.1 3.1 4.1 5.1 6.1 |
| Designer    | 1.2 2.2 3.2 4.2 5.2 6.2 |
| Builder     | 1.3 2.3 3.3 4.3 5.3 6.3 |
| Implementer | 1.4 2.4 3.4 4.4 5.4 6.4 |
| User        | 1.5 2.5 3.5 4.5 5.5 6.5 |

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**Table 5. Mapping technique for models representation**

| Perspective | Aspects/Abstraction |
|-------------|---------------------|
| Planner     | 1. Business objects: Students (UG,PG), Staff (Academic, Administrative, Demonstrator), Curriculum, Courses, Course_ Material, Classrooms, Online Learning, Assessment, Senior Projects, Research, Employers, Training, Conferences & Seminars, Budget & Finance, Applications, Network Access, Classrooms, Committees. |
|             | ICT objects: 1) Email application (Ms Exchange) 2) SharePoint intranet 3) Helpdesk application 4) Graduation requirements application 5) QA (AIMS) application 6) Learning management application (Blackboard) 7) Students Grading application. |
|             | Activities: 1) Teaching 2) Studying 3) Community Engagement 4) Research and Development |
|             | Core Functions: Teaching, Research and Development, Community Engagement, Technical Support, HR Management, QA, Strategic Planning, PR, Resource Planning. |
|             | Supporting functions (functions of the university and/or college of IT): Finance and Budgeting, Human Resource Management, Public Relations, Technical Support, Inventory Management, "Student Admission, Registration, and Grading", Resource Planning, "Quality Assurance and Accreditation Auditing", Online Learning Management. |
|             | Location: Building-40 (Classrooms Open Area Lab, S50 Hall Room, Offices) |
|             | People: IS-Dep’s supportive internal departments, Students, Staff, Employers and Supporters & External Entities |
|             | Time: First semester, Second semester |
|             | College of IT Vision: Provide quality higher education IT programs, and conduct quality research. |
|             | College of IT Mission: Conduct research, and disseminate knowledge through international programs. |
|             | IS-DepVision: Provide quality education and research in IS and meet the community’s needs. |
|             | IS-DepMission: Excel in teaching, research and development, industrial collaboration, and community services. |
Designer Perspective (Application layer): Persons acting as designers design the required application systems logically to interact with the Business (upper layer) and Technology (Lower layer).

Since most of the databases and application systems are centralized, there is a lack of local full permission granted to access the databases and applications in IS-Dep. This means that IS-Dep is granted a “read only” access. Noticeably, some technology constraints are considered in this perspective and that most of the IS-Dep’s functions aren’t digitized (paper-based operations). In regard of Cell (3.2), the installed Application systems in the IS-Dep, along with actors and functions are described in Table 8. Also, a descriptive model depicting the application systems and their corresponding Business ones is demonstrated in Appendix B along with the content of Cell (3.3) and Cell (3.4).

Builder Perspective (Technology layer): From the builders’ perspective, the generated models depict the physical design of the information systems and databases of the organization. The physical design of the system considers all technological constraints being set by the available technology in the organization. In this perspective, we depict what the organization currently has built or implemented. Appendix C represents Cell (4.1), Cell (4.2), Cell (4.3) and Cell (4.4). Cell (4.1) and (4.2) both represent the required data and functions of the information system. Cell (4.3) represents the location where the software (systems and applications) is installed and where the hardware (servers and PCs) are located, while Cell (4.4) represents the ones involved with the existing information systems.

5.4 Step 2-Target Architecture Development

The target architecture “to be” identifies the new organization’s objects including the IT resources and technological infrastructure based on the aforementioned layers by integrating the organization structure, business processes, data, and technical resources [19]. Therefore, in this step, we explain what the IS-Dep likes to achieve based on their future vision and then identify how target architecture will change and impact the existing information in the existing (as-is) models. Table 9 lists the management’s requirements, while Table 10 demonstrates the impacted cells resulting in the Target Architecture.

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**Table 7. ArchiMate’s objects and notation**

| Objects              | Notation       | Description                                                                 |
|----------------------|----------------|------------------------------------------------------------------------------|
| IS-Dep               | Actor          | IS-Department carries three main functions.                                  |
| Student              | Actor          | Student was depicted as an actor because they represent a real life person.  |
| Staff                | Actor          | Staff was considered as external entity because they belong to the whole university. |
| QAAC                 | Actor          | QAAC (Quality Assurance and Accreditation Center) is a QA regulator to IS-Dep. |
| ABET                 | Actor          | Accreditation h is an external entity belonging to the entire university.    |
| Education Seeker     | Role           | UG students and PG students.                                                 |
| BB Ser Provider      | Role           | Blackboard service is an external entity (Zain E-Learning Center) for IS-Dep to access. |
| Stu Aff Regulator    | Role           | Student affairs regulator is an external entity for IS-Dep to access events for students. |
| QA Regulator         | Role           | QA regulator is exercised by regulators to the quality & accreditation of IS-Dep. |
| Registration         | Function       | This is students’ registration to courses, courses provision, and student’s grades. |
| Teaching             | Function       | Teaching includes teaching students and administrative works.               |
| Research             | Function       | This is the research of IS-Dep staff and deals with the scientific publishing center. |
| Comm Engt            | Function       | Community engagement provides services to the community of Bahrain and any others. |
| HR Management        | Function       | This is external to IS-Dep and they manage all processes related to the staff. |
| Sci Pub Center       | Function       | The scientific publishing center is deals with IS-Dep research publishing process. |

**Table 8. Applications, actors, and functions relationships**

| Application                     | Primary actor | Function(s)     | Description                             |
|---------------------------------|---------------|-----------------|-----------------------------------------|
| E-mail system                   | Staff         | Research& Develop | Staff members communication             |
| Graduation requirement system   | Staff, Student| Teaching        | Students ask for graduation status      |
| Help Desk System                | Staff         | External        | Complaints sent to tech support        |
| Learning mgt System (LMS/Blackboard) | Staff, Student| Teaching        | Staff communicates with students        |
| Letter grade System             | Staff         | Teaching        | Staff enters grades                     |
| Sharepoint Intranet             | Staff         | Research& Develop | Staff share info with other staff        |

5.5 Step 3- Architecture TP development

This step refers to the long-term plan that helps an organization to advance from its baseline architecture "as-is" of to its intended target architecture "to-be" state. This is achieved by highlighting on the main activities that must be carried out, by showing what an organization lacks, and by providing solutions to fulfill these gaps. According to Table 3 and as depicted in Figure 4, the Architecture Transition Planning deliverable is resulting from step 3 and is composed of five activities (3.1 - 3.5). Activities (3.1-3.4) are concerned with Architecture Transition Plan development while activity (3.5) prepares the documentation. Hence, performing an analysis to find
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The difference between the baseline and the target (Gap Analysis) is carried out along with measuring technology maturity, as a supplementary method to determine whether the IS-Dep is capable of adopting new software applications. Demonstrated in Table 11, we were complied with the maturity levels developed by the US Department of Energy (DOE) at which nine levels of technology maturity are determined.

**Gap Analysis:** Target Architecture aims to develop a comprehensive "Dashboard System" to integrate all currently existing systems in the IS-Dep. After creating such a "Dashboard System", another target architecture will then be created with the goal of integrating the IS-Dep’s "Dashboard System" with all other supporting departments’ databases. The first Gap is that in the baseline architecture all the systems are separated and have to be run individually by the users and accessed individually so they can carry out their functions, however, in the Target architecture all of those systems will be integrated into one. "Dashboard System" will encapsulate all the other systems’ functions, and each of these functions will have their own sub-functions.

**Technology Maturity:** Technology maturity-Level 3 was found to be most suitable to the technology maturity/readiness level resulting after assessing the IS-Dep for several reasons:

1. The technical support has paper based documentation of the current technology and opportunities of technology to implement.
2. The technical support studied all the technology implemented in the IS-Dep, conducted studies on how to improve it, and created plans of buying new technology and infrastructure such as unified desktop computers.
3. Technical support has paper based documentation of all the existing technology and their basic properties.
4. In the IS-Dep, some applications were developed by the university and some were developed by the technical support. The technical support’s applications were presented in the baseline architecture because they were not fully implemented and were not used by IS-Dep.

| Table 9. Requirements of IS-Dep’s management board |
|--------------------------------------------------|
| Requirement | Request by | The Rationale |
|-----------------|-------------|----------------|
| Develop a ‘Dashboard System’ to integrates all applications in IS-Dep | IS-Dep’s Chairperson | Accessing all the applications from one portal will reduce the redundancy in functionalities |
| Integrate the ‘Dashboard System’ with the rest of the university. | College of IT’s Dean | Access other departments' repositories to get the shared information they need. |

| Table 10. The resulting Target Architecture |
|---------------------------------------------|
| **What** | **How** | **Where** | **Who** | **When** | **Why** |
| Addition of a new ‘Dashboard System’. | Automation of processes by using the ‘Dashboard System’. | No change. | No change. | No change. | No change. |
| Addition of a new ‘Dashboard system’. | No change | No change | No change | No change | No change |
| -Normalizing logical design of the database. | The integration of all systems. | New Access point to the system and where the system will be installed. | Setting the new logical constraints on the new system to allow people to use the system | No change. | Providing a better and more stable integrated system |
| Development of a new system and database tables to support the new system | Development of new programming language | Adding new access point of the new system and where this system will be installed and maintained | The physical restriction set on the new system to maintain the old constraint | No change | Provide more stable infrastructure to support the ‘Dashboard System’ and communication between the systems |
| Solving technical issues with the new system. | No change. | No change. | No change. | No change. | Support the development of new systems. |

**Figure 4. Architecture Transition planning activities**
However, other applications including the E-Mail System were fully installed and exploited.

5. The developed applications are not yet implemented. This is due to inaccurate information attributed to the fact that IS-Dep or the technical support isn’t authorized to access other department’s databases.

6. The applications in the IS-Dep are not yet integrated.

7. Some applications such as the SharePoint Intranet are tested on small scale in the IS-Dep, but not on the university as a whole.

Thus, based on the above mentioned reasons, we consider that IS-Dep has reached the 3rd level of maturity. The first two (1&2) reasons ensure that IS-Dep has reached the first level. The second two (3&4) reasons ensure that the organization has moved to level 2. And the last two reasons (5&6) show that IS-Dep has partially met the 3rd level maturity.

**Design and Development Constraints:** Design constraints in the baseline architecture were observed to include the following points:

1. All applications have to be compatible with Microsoft Windows Operating System.
2. Current database is an Oracle server, so commands must be compatible with the Oracle server.
3. Any working application must satisfy design constraints including:
   - Easy to use – so that the system users will be encouraged to and find it comfortable to use.
   - Fast performance – the performance in terms of speed must be extremely good by the system as the demand capacity on the system will be huge due to the large number of system users.
   - Data integrity – the data maintained in the database should be accurate and not easily changeable by unauthorized users of the system. This also includes that any data input field should be easy to use and very specific as to collect the right and required information from the user.
   - Standardized – the system should be standardized or comply with the standards of the organization or department it is implemented in. It should be standardized in the way it communicates with other systems and with other system users.

4. A non-technical (business development) constraint was observed including that every technological development carried out by the technical support or by IS-Dep must be monitored and supervised by several entities in the university as a whole, such as the IT Center. The constraint here is that any future developed technology must go through several approvals within the university before actual implementation.

**Transition Opportunities:** The opportunities and strategies that could be implemented with the available technology to help IS-Dep reach its target were identified. For the objective of developing the "Dashboard System" and based on the data collected from the interviews, we predict that the technology is not yet available. The technology we are referring to here is the development technologies that will help IS-Dep develop the system. This deduction came from observing the technical support personnel using simple tools such as excel sheets. In the IS-Dep, the highly skilled staff uses visual basic development tools which are not advanced enough to create a comprehensive "Dashboard System" that can integrate several systems seamlessly. In the interview, the technical support personnel also stated that applications being developed by the university were developed by the IT Center of the university implying that the technology is still out of the reach of IS-Dep. Hence, we conclude that one of the opportunities available to help reach our target is that a development tool must be bought by IS-Dep to meet with the design constraints (existing technology and infrastructure) to help them develop the "Dashboard System".

6 Conclusion and future work

In this paper, the concept of EA was introduced at which various definitions, aims, and frameworks, particularly ZF of EA were introduced and discussed. Moreover, Modeling and ArchiMate modeling language were investigated. This paper addressed the development of an EA (baseline and a target architectural effort) analysis to enable the management of a real Bahraini educational department and assess its readiness for investing in a new Dashboard application. Results of this work show several shortcomings: 1) The whole university is facing communication and information sharing difficulties, at which more advanced application systems, should be adopted to correct this problem. 2) Every type of data and information in the university is centralized implying that lengthy time-consuming procedures are to be tackled. In order for the department to be more organized and efficient in meeting the needs of both students and academics, the system needs to be decentralized. 3) Many services are not fully utilized, so the IS-Dep should utilize them.
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Appendix A

A1- Cell 2.1 (Owner X Data)

A2- Cell 2.2 (Owner X Function)
A3- Cell 2.3 (Owner X Network)

A4- Cell 2.4 (Owner X People)

A6- Cell 2.6 (Owner X Motivation)
Mission
The mission of the department of information systems (IS) is to excel in teaching, research and development, industrial collaboration, and community services related to the development, implementation, management, and impact of information systems.

Objective
Excel in teaching
Excel in research and development
Excel in community services related to IS

Education
Career Opportunity
Knowledge Empowerment
Research Solutions & Recommendations
Innovation
Development Opportunities
Educational Events
Interactive Events

IS Department
Teaching
Research & Development
Community Engagement
Appendix B

B1- Cell 3.1/Cell 3.2 (Designer x Data & Function)

B2- Cell 3.3 (Designer x Network)
Appendix C

C1- Cell 4.1/Cell 4.2 (Builder x Data & Function)

C2- Cell 4.3 (Builder x Network)

C3- Cell 4.3 (Builder x People)