Stakeholder Oriented Enterprise Architecture Modelling

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Abstract: The enterprise architecture (EA) is defined as a coherent and consistent set of principles and rules that guides system design. In the EA modelling methods, an enterprise is identified with institution, business or administrative unit, a firm or an industrialized region. Beyond that, EA can be considered as a set of organizational attributes or activities. In this paper, the human roles' approach for EA development is emphasized. The paper is to answer the question of who is the stakeholder of EA, who is competent and responsible for the EA planning and development, and what activities must be realized to achieve the EA goals. At first, the paper presents the EA as a product and a process, next the EA evaluation characteristics are discussed. Finally, the EA modelling tool, i.e., ArchiMate is applied for stakeholder role visualizaton.

1 INTRODUCTION

Generally, the enterprise architecture (EA) is a discipline of designing enterprises guided with principles, frameworks, methodologies, requirements, tools, reference models, and standards. The primary need for developing an enterprise architecture is to support the business by providing the fundamental technology and process structure for an IT strategy.

The EA should be widely accessible for all the organization members to receive their acceptance as responsive to user needs. In the ICT domain, architecture will always specify and follow incremental and iterative implementations of information systems. For the purpose of this paper, the enterprise architecture is a venture that seeks to explain why organizations do what they do and how they can be changed to achieve a certain demanded purpose.

The main goal of the paper is to emphasize the role of stakeholders in an enterprise architecture modelling process and product. The paper consists of three parts. At first, the enterprise architecture is presented as a product and a process. Next part covers literature review on the stakeholder theory and the discussion on the stakeholder roles in the enterprise architecture theoretical frameworks. The last part is to present the specification of stakeholders for the e-healthcare prosumption architecture model development.

2 ENTERPRISE ARCHITECTURE AS PRODUCT AND PROCESS

ISO/IEC/IEEE 42010 -2011 standard architecture is the fundamental organization of a system embodied in its components, their relationships to each other and to the environment, as well as the principles guiding its design and evolution. The EA as a product serves to guide managers in designing business processes and system developers in building applications in a way that is in line with business objectives and policies (Minoli, 2008).

The EA as a process is to translate business vision and strategy into effective ICT components. It should be noted that enterprise models are applied as a computational representation of the structure, activities, processes, information, people, goals, and constraints of a business. The EA goals are to promote business-IT alignment, standardization, reusability of existing ICT assets and to share a common model for project management and software development across the organization. The EA is to ensure a holistic view of the business processes, systems, information, and technology of the enterprise. The results of work of enterprise architect cover the derived information technology (IT) strategies, a new and modified EA, the new and modified set of EA standards, and a roadmap describing the ICT projects for the implementation of the new architecture and achieving the target state, and a development plan (Minoli, 2008).

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There are many well developed enterprise architecture frameworks (Bernus et al., 2003; Zachman 2007; Holt and Perry, 2010). The EA frameworks emphasize the modelling part of EA development and they do not consider any methods which strictly belong to economics. The EA frameworks' developers separate EA evaluation from EA implementation. They prefer to analyse architecture models, languages, modelling techniques and propose methods for the evaluation of the created artefacts. They perceive the necessity to ensure coherence among different models, they analyse the convergence of proposed models, their scalability, openness, agility, sustainability and ability to ensure security. However, the real value in the enterprise architecture is revealed in the EA implementation, supported by strong involvement of its stakeholders.

3 COPYRIGHT FORM

The term "enterprise" can be interpreted as an overall concept to identify a company business organization or governmental institution. The EA provides a holistic expression of the enterprise's strategies and their impact on business functions and processes, taking the firm's sourcing goals into explicit consideration. The EA helps the business organization to establish technical guidelines of how the service delivery function needs to operate to deliver cost-effective, flexible, and reliable business services. The EA gives user an opportunity of faster delivery of new functionalities and modifications, as well as an easier access to higher quality, more consistent and more reliable information. Well architected systems can more quickly link with external business partners. The EA is to ensure the comprehensive understanding of the current state or the desired state, as well as the interrelationships of processes, people and technology affected by IT projects. The organization has got a bigger consistency of business processes and information across business units. The EA identifies opportunities for integration and reuse of IT resources and prevents the development of inconsistent processes and information. The ISO/IEC 42010-2011 standard emphasizes the stakeholder object in the architecture description. According to this standard, Stakeholder has an interest in the system, which exhibits an Architecture. Architecture Description identifies stakeholders and system of interests, as well as expresses the Architecture. The following stakeholders can be considered and identified in the architecture description: system users, operators, acquirers, owners, suppliers, developers, builders and maintainers. Therefore, it should be noticed that stakeholders are included in the information system development processes, but the consortium of users of the system should be further discussed in details within a particular EA development project, because it is a group of people highly differentiated, and having different interests, risk awareness and impact on the system.

Considerations on stakeholder theory need to begin from the point of view of the stake. A stake can be presented as an interest or share in a project undertaken to achieve business, technical and social goals. Widely, there are stakeholder's interests, concerns, and perceptions of rights, expectations, or even ownership. The organization’s interests are in maximizing local budget profits, satisfaction, environmental protection, benefits from external funds, protecting intellectual and material properties, balancing resources and demand, keeping the citizens happy.

Stakeholder theory is about value creation and how to manage a business effectively. Generally, the theory should focus on the stakeholder relationships and on the jointers of stakeholder interests rather than solely on the trade-off that sometimes has to be made. Stakeholder analysis asks to consider all the parties who will be affected by or who affect an important decision.

Wiring (2014) defines a stakeholder goal as a desire for which the stakeholder has committed resources in a certain process of value creation. Value is created in a context, with the help of other stakeholders. They jointly satisfy their needs and desires by making voluntary agreements with each other. Recognition of the roles of a multitude of stakeholders in the value creation process diminishes the problem of the dominant group. Stakeholders are conscious that they are engaged in creating multiple win-win situations, as well as they accept the responsibility for the consequences of their actions. The value creation process is determined by stakeholders' attributes, i.e., legitimacy, power, and urgency (Archie et al., 2014). Legitimacy refers to the perceived validity or appropriateness of a stakeholder's claim to a stake. Therefore, owners, employees, and customers represent a high degree of legitimacy due to their explicit, formal relationships with a company. Stakeholders who are more distant from the organization might be considered to have less legitimacy. Power refers to the ability or capacity to produce an effect. Urgency means the

degree to which the stakeholder claim on the business calls for the business's immediate attention or response.

Nowadays, the EA is considered as the discipline of designing enterprises guided with principles, frameworks, methodologies, requirements, tools, reference models and standards. There are many frameworks that support the EA modelling and development, e.g., the Zachman Framework (ZF), the Open Groups Architecture Framework (TOGAF), the Generic Enterprise Reference Architecture and Methodology (GERAM), the Purdue Enterprise Reference Architecture (PERA), the Computer Integrated Manufacturing Open System Architecture (CIMOSA), the Lightweight Enterprise Architecture (LEA), the Nolan Norton Framework (NNF), the Extended Enterprise Architecture Framework (E2AF), the Enterprise Architecture Planning (EAP), the Federal Enterprise Architecture Framework (FEAF), the Treasury Enterprise Architecture Framework (TEAF) (Bernus et al., 2003; Lankhorst, 2005; Minoli, 2008; Theuerkorn, 2005). Mostly, the mentioned above frameworks are product-oriented, and only some of them, i.e., ZF, TOGAF, FEAF, CIMOSA and MODAF emphasize the role of stakeholders in the EA development processes. The ZF provides a basic structure for organizing a business architecture through dimensions such as data, function, network, people, time and motivation (Zachman, 2010). Zachman describes the ontology for the creation of EA through negotiations among several actors. The ZF presents various views and aspects of the enterprise architecture in a highly structured and clear form. He differentiates between the levels: Scope (contextual, planner view), Enterprise Model (conceptual, owner view), System Model (logical, designer view), Technology Model (physical, builder model), Detailed Representation (out-of-context, subcontractor), and Functioning Enterprise (user view). Each of these views is presented as a row in the Zachman matrix. The lower the row, the greater the degree of detail of the level represented. The model works with six aspects of the enterprise architecture: Data (what), Function (how), Network (where), People (who), Time (when), Motivation (why). Each view (i.e., column) interrogates the architecture from a particular perspective. Taken together, all the views create a complete picture of the enterprise (Minoli, 2008). Since 1999, the FEAF has promoted a shared development of US federal processes, interoperability and sharing of information among US federal agencies and other governmental entities. The FEAF components of an enterprise architecture cover architecture drivers, strategic direction, current architecture, target architectures, transitional processes, architectural components, architectural models, and standards. The architect is responsible for ensuring the completeness of the architecture, in terms of adequately addressing all the concerns of all the various views, satisfactory reconciling the conflicts among different stakeholders. The framework emphasizes the role of planner, owner, designer, builder and subcontractor in the EA development process (see Table 1).

Table 1: The Federal Enterprise Architecture Framework, (FEAF, 1999).

	Data Architecture	Application Architecture	Technology Architecture
Planner Perspective	Business Objects' List	Business Processes' List	Business Locations' List
Owner Perspective	Semantic Model	Business Process Model	Business Logistics System
Designer Perspective	Logical Data Model	Application Architecture	System Geographic Deployment Architecture
Sub-contractor Perspective	Data Dictionary	Programs	Network Architecture

The FEAF is derived from the Zachman Framework, however, the user of realized architecture is not included in the development team. Planning of enterprise architecture according to the ZF meets some unclear situations (e.g., question When? is difficult), therefore the FEAF seems to be the simplified and more intensive version of the ZF.

The Ministry of Defence Architectural Framework (MODAF) is the UK Government specification for architectural frameworks for the defence industry (Perks and Beveridge, 2003). The MODAF covers seven viewpoints, i.e, All View, Acquisition, Strategic, Operational, System, Service, Technical. The All View viewpoint is created to define the generic, high-level information that applies to all the other viewpoints. In this approach, the architect role is hidden in the particular viewpoints. The Acquisition viewpoint is used to identify programmes and projects that are relevant to the framework and that will be executed to deliver the capabilities that have been identified in the strategy views. The Strategic viewpoint defines views that support the analysis and the optimisation of a domain capability. The intention is to capture long-term missions, goals and visions, and to define

what capabilities are required to realise them. The Operational viewpoint contains views that describe the operational elements required to meet the capabilities defined in the strategic views. This is achieved by considering a number of high-level scenarios, and then defining what sort of elements exist in these scenarios. The operational views are solution-independent and do not describe an actual solution. These views are used primarily as a part of tendering where they will be made available to supplier organizations and form the basis of evaluating the system views that are provided as the supplier's proposed solution.

The System viewpoint contains views that relate directly to the solution that is being offered to meet the required capabilities that have been identified in the strategic views and expanded upon in the operational views. There is a strong relationship between the system viewpoint and the operational viewpoint. The system views describe the actual systems, their interconnections and their use. This will also include performance characteristics and may even specify protocols that must be used for particular communication. The Service-oriented viewpoint contains views that allow the solution to be described in terms of its services. This allows a solution to be specified as a complete service-oriented architecture where desirable. The Technical viewpoint contains two views that allow all the relevant standards to be defined. This is split into two categories: current standards and predicted future standards. Standards are an essential part of any architecture and it should be noted that any number of standards may be applied to any element in the architecture (Perks and Beveridge, 2003).

The CIMOSA framework is based on four abstract views (function, information, resource and organization views) and three modelling levels (i.e., requirements definition, design specification and implementation description) (Spadoni and Abdmouleh, 2007).

The four modelling views are provided to manage the integrated enterprise model (covering the design, manipulation and access). For the management of views, CIMOSA assumes a hierarchy of business units that are grouped into divisions and plants. The TOGAF standard takes a holistic approach to the enterprise architecture. TOGAF is a registered trademark of the Open Group in the US and other countries. TOGAF divides an EA into four categories:

- Business architecture: describing the processes that the business uses to meet its goals,
- Application architecture: describing how specific applications are designed and how they interact with each other,
- Data architecture: describing how the enterprise data stores are organised and accessed,
- Technology architecture: describing the hardware and software infrastructure that supports applications and their interactions.

In TOGAF, the architecture of a system is the system's fundamental organization embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution. Similarly to the ISO/IEC 42010-2011 standard, in TOGAF the minimum set of stakeholders for a system covers users, system and software engineers, operators, administrators, managers and acquirers.

Beyond that, stakeholders are as follows: the executive management, who defines strategic goals, the client, who is responsible for the allocated budget, with regard to the expected goals, the provider, who delivers the component elements of the architecture, the sponsors, who drive and guide the work, and the enterprise architects, who turn business goals into reality within the structure of their system. Stakeholders have key roles in or concerns about the business information systems. Concerns may pertain to any aspect of the system's functioning, development or operation, including considerations such as performance, reliability, security, distribution, and evolvability. In TOGAF, the Business Architecture Views address the concerns of users, planners, and business managers, and focus on the functional aspects of the system from the perspective of the users of the system - that is, on what the new system is intended to do, including performance, functionality and usability. The People view focuses on the human resource aspects of the system. Beyond that, the Data Architecture Views and Application Architecture Views address the concerns of the database designers and administrators, and the system and software engineers of the system. The Technology Architecture Views address the concerns of the acquirers, operators, communication engineers, administrators and managers of the system (Minoli, 2008). Desfray and Raymond (2014) argue that in TOGAF, stakeholders, actors and roles are differentiated. Stakeholders are individuals, teams, or organizations that have interests in or are affected by the result of architectural change. An Actor is an active enterprise participant (person, system, organization) who takes part in the activities of the enterprise. An actor is never a physical person. It

designates a category of function that participants can carry out, as well as a type of skill required. The role represents one of an actor's usual or expected functions. It corresponds to a certain set of skills, knowledge, experience and capabilities.

The Open Group ArchiMate 2.4 (2012) language defines three main layers, based on specializations of the core concepts. The business layer offers products and services to external customers. The application layer supports the business layer with application services which are realized by software applications. The technology layer offers infrastructure services (e.g., processing, storage and communication services) needed to run the applications, realized by computer and communication hardware and software system.

What is extremely important from the point of view of stakeholder orientation is that in ArchiMate modelling approach the motivational aspects correspond to the "why" column in the Zachman framework. The motivation extension of ArchiMate adds the motivational concepts such as goal, principle and requirement. The motivational element is defined as an element that provides the context or reason lying behind the architecture of an enterprise.

The motivation extension recognizes the concepts of stakeholders, drivers, and assessments. Stakeholders represent groups of persons or organizations that influence, guide, or constrain the enterprise. Drivers represent internal or external factors which influence the plans and aims of an enterprise. An understanding of business organization strengths, weaknesses, opportunities will help the formation of plans and aims to appropriately address these issues. However, it is necessary to understand the factors, often referred to as drivers, which influence the motivational elements. They can originate from either inside or outside the enterprise. Internal drivers, also called concerns, are associated with stakeholders, which can be some individual human being or some group of human beings, such as a project team, enterprise, or society. Examples of such internal drivers are customer satisfaction, compliance to legislation, or profitability (The Open Group Archimate 2.4, 2012).

4 MODEL OF E-HEALTHCARE PROSUMPTION ARCHITECTURE

Although the user centred design process focuses on computer end user tasks, as well as on understanding the user's cognitive, behavioural and attitudinal characteristics, there is a lack of procedures, which strictly depict the role of a user in the information system exploitation process. Generally, the user experience methodologies allow for gaining a very comprehensive understanding of user experiences within information systems as well as domain knowledge. However, for information system customised development, not only user experience is important, but also user creativity and opportunities to implement their creative ideas in the business environment. The framework for end user involvement is a system development and exploitation should be supported by system architecture modelling. The proposed in this paper, e-healthcare prosumption support system model is based on the idea of prosument-patron relationship (PPR) development and management. In this approach a patron is understood as human (library custodian, knowledge broker) or computerized agent, which supports users in the process of exploitation of the knowledge-based e-healthcare information system. The knowledge broker also ought to be engaged in IT system and e-healthcare services development as well as in user learning processes (see Figure 1).

In many developed countries, citizens have access to official governmental e-healthcare information systems. However, beyond that, the prosument-patron relationship system development seems to be necessary to support e-healthcare prosumption, in order to support self-diagnosis, self-testing, self-monitoring and even self-treatment in case of disease. In this case study, prosument is understood as a patient, their family member or friend looking in Internet or any other global system for a remedy for a particular disease. The patron is to be responsible for gathering user requests and providing the competent knowledge to prosuments.

Generally, the patron receives three types of information from prosuments, i.e., patients, their family members or care takers:

- information about incentives, diseases. These problems must be solved and professional knowledge advice is required,
- questions, which answers are delivered by the patron or end user with the help of patrons. The answers could be received, otherwise the user further browses the Internet to find the solution,
- suggestions provided by users as the result of their own experiences and practices. Suggestions should be further surveyed, carefully analysed and presented in the form of case studies.

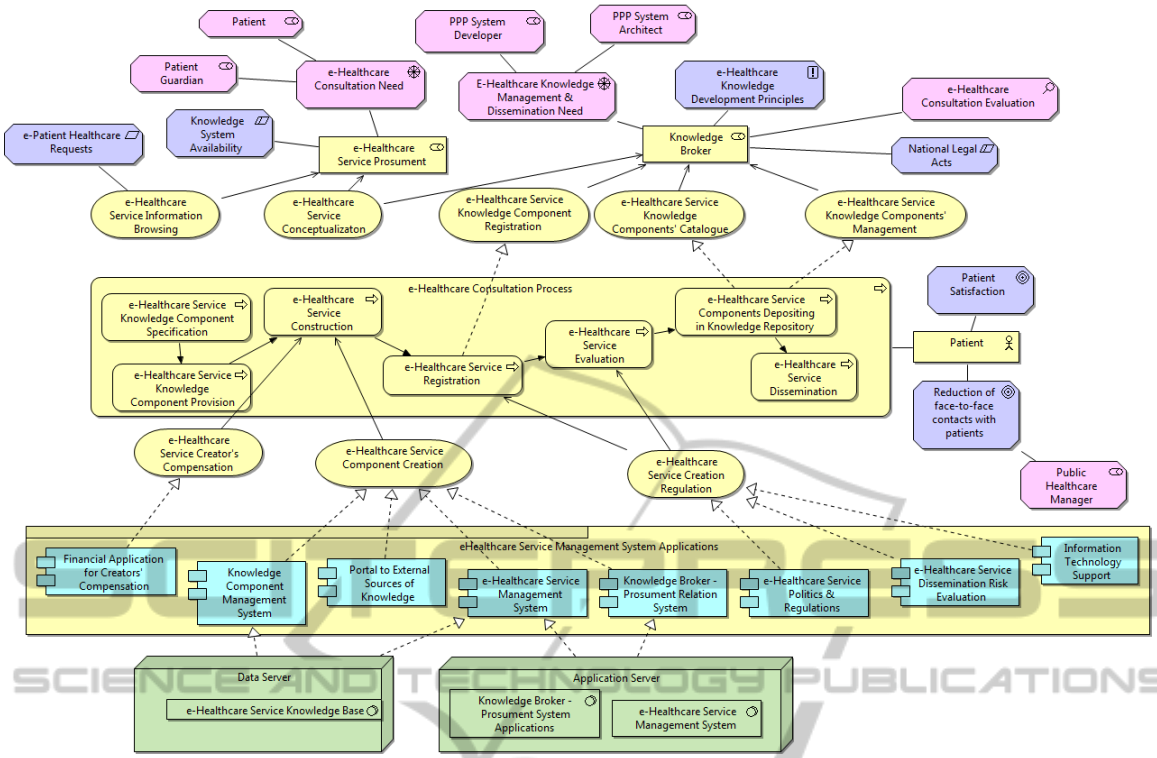

Figure 1: e-Healthcare Prosumption Architecture Model.

The knowledge brokers have access to the following sources of knowledge:

- scientific libraries including articles from scientific journals, articles from professional research reports, books or book chapters, repositories of peer-reviewed electronic articles, i.e., ProQuest, Sciencedirect, Cochrane, Medline,
- secondary documents. i.e., documents from websites, minutes from seminars and symposia, documents from other online knowledge brokers, government reports, and reports from international organizations, e.g., World Health Organization, OECD.

The proposed architecture model (Figure 2) allows for the development of a system which is characterised by widening boundaries, a multiparadigmatic profiling, and methodological innovativeness. The approach allows to utilize user's experience, practices and perceptions.

The knowledge-based PPR system development relies not only on system developer research aims and epistemological stance, but also on organizational, historical, cultural, evidential and personal factors, which are not problems to be solved, but factors that must be included in practical research design. The approach should also include the context and healthcare creativity of users. A system architecture model in ArchMate is organized into some basic layers:

- BUSINESS containing elements such as actors (i.e., Patient), roles (i.e., Prosument, Broker), processes (i.e., e-Health Consultation Process), services (i.e., Browsing, Conceptualization) etc.
- APPLICATION covering elements such as Financial Application, Portal, Management System, Risk Evaluation, IT Support, etc.
- TECHNOLOYGY including elements such as Data Server, Application Server,
- MOTIVATION containing elements: drivers (i.e. Consultation Need), principles (i.e. e-Healthcare Knowledge Development Principles), assessments (i.e. Consultation Evaluation), goals (i.e. Patient Satisfaction), requirements (i.e. Healthcare Requests), constraints (i.e., National Legal Acts, Knowledge System Availability), stakeholders (i.e. Patient, Patient Guardian, PPP System Developer, PPP System Architect) (Figure 1).

When designing services within e-healthcare system, appropriate knowledge components should be assigned to them. According to Karlovcec et al. (2012), a knowledge component is a description of a

mental structure or process that is used alone or in combination with other knowledge components, to accomplish steps in a task or to solve a problem.

User-oriented e-healthcare applications include websites, chat sessions, newsgroups, e-mail exchanges with medical experts, wireless and digital broadcasts, and other compilations of online resources. Developing such a self-care system requires close cooperation between IT and clinical staff. Self-care brings many benefits, i.e., ongoing costs and waiting time reduction, early avoidance of problems by self-diagnosis, networking of cancer survivors peer interaction, reaching more widely geographically dispersed groups. However, the tailoring of the website content requires heavy involvement of medical experts. There is also the risk of losing contact with people who might be vulnerable but will not ask for help as well as the need to legally regulate the roles of knowledge brokers and access to knowledge bases by users (Moody et al., 2013).

A knowledge broker (i.e., a patron) is to ensure a mutual understanding of goals and cultures, while collaborating with users to identify issues and problems for which solutions are requested. Knowledge brokers should facilitate the identification, access, assessment, interpretation, and translation of medical research evidence into local policy and practice. They ought to assist users in translating medical evidence into locally relevant recommendations for self-practice. They develop a trusting and positive relationship with end users, while at the same time they are promoting exchange of knowledge.

5 CONCLUSIONS

The paper is concerned with the enterprise architecture stakeholders as active and passive partners who are involved in the process of the EA products development. The reviewed in the paper enterprise architecture frameworks focus mostly on the enterprise methodology and stakeholder aspects are omitted. Therefore, the development of stakeholder oriented architecture frameworks is still a challenge. Some good works have been done by the Open Group, therefore the e-healthcare prosumption architecture model was done in ArchiMate language.

The presented in the last part of the paper architecture model is developed to emphasize the stakeholder position as well as an important proposal that could be further realized. It should be noticed that since the beginning of human life the first medical diagnosis was the auto-diagnosis (or diagnosis done by the nearest family) and the first therapy is usually auto-therapy. The presented in academic studies and in real life healthcare practices emphasize the passive role of the patient. However, the high cost of medical treatment and open access to Internet enable to look for new ways of the development of the medical auto-diagnosis, self-monitoring, self-testing and going further - self-care. Nowadays, almost all diseases are described online, and virtual communities are developed to support patients and their relatives. Therefore the e-healthcare system based on knowledge brokering could support knowledge management.

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