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Knowledge transfer, translation and transformation in the work of information technology architects

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ABSTRACT

Context: Information Technology (IT) architects are the professionals responsible for designing the information systems for an organization. In order to do that, they take into account many aspects and stakeholders, including customers, software developers, the organization's business, and its current IT infrastructure. Therefore, different aspects influence their work.
Objective: This paper presents results of research into how IT architects perform their work in practice and how different aspects are taken into account when an information system is developed. An understanding of IT architects' activities allows us to better support their work. This paper extends our own previous work (Figueiredo et al., 2012) [30] by discussing aspects of knowledge management and tool support.
Method: A qualitative study was conducted using semi-structured interviews for data collection and grounded theory methods (Strauss and Corbin, 1998) [5] for data analysis. Twenty-seven interviews were conducted with twenty-two interviewees from nine different companies through four cycles of data collection and analysis.
Results: Companies divide IT architecture activities among different roles. Although these roles receive different names in different organizations, all organizations follow a similar pattern based on 3 roles: enterprise, solutions and software architects. These architects perform both the technical activities related to the IT architecture and the social activities regarding the communication and coordination with other stakeholders and among themselves. Furthermore, current tools used by IT architects lack adequate support for all these aspects.
Conclusion: The activities of the different IT architects are highly interconnected and have a huge influence in the way the requirements are handled in every phase of the development of an information system. The activities of IT architects are also important for knowledge transfer, translation and transformation, since they receive from and spread information to different groups of stakeholders. We also conclude that they lack appropriate tool support, especially regarding support for their collaborative work.

1. Introduction

The main goal of any information system is to attend to client and user requirements. However, clients and users are not always sure or do not even know what they want [27]. That is why requirement analysts are essential to the development of an information system. Nevertheless, there is still a considerable gap to be covered between requirements and a working system. In other words, during the construction of any information system, requirements need to evolve from client and user desires expressed in natural language into technical aspects and constraints developed by developers. In this process, aspects such as current and potential customers, organization's business, existing IT infrastructure, and others also influence the information system and need to be reflected in the working system. In fact, in large-scale companies software is seldom built from nothing; instead, it is embedded in

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a large ecosystem that includes other information systems, organizational patterns and standards to be followed, costs and businesses goals it needs to achieve, among other factors [28]. While requirement analysts are responsible for understanding and eliciting client and user desires and software developers are responsible for the development of a particular software, *information technology (IT) architects* are the professionals in between these two groups. They take all the aforementioned aspects, and also the work of analysts and developers into account when designing an information system: they define the components that make up the information system of the entire organization instead of the components of a single system, and establish how products acquired and already developed systems are going to be integrated to compose the overall information system of the organization [7].

Given the importance of IT architects' work some companies and organizations have looked into ways to support it. For instance, customized modeling languages have been proposed [14]. There are also associations that seek to study and improve the career of IT architects (e.g., IASA [1] and The Open Group [2]). These associations created certifications trying to better regulate and create a common knowledge base to this career. According to them, IT architects occupy a broader role, while enterprise architects, software architects and other roles involved with architecture work are specializations of the first one. For this reason, we adopt this nomenclature (IT architects), given that it encompasses the other architecture-related roles.

Despite their importance, to the best of our knowledge, there are no studies focusing on the work performed by IT architects. Therefore, this paper goes a step beyond previous research by describing a qualitative study conducted with IT architects. As is usual in qualitative studies, our research question is very broad: *How do IT architects perform their activities in industry?* In order to answer this question we conducted 27 semi-structured interviews [24] with 22 different architects from 9 different system-developing companies. We used grounded theory methods [5] for data analysis. Consistent with results from the literature, our results suggest that there are 3 different types of IT architects who all perform similar roles in the organizational ecosystem at different "points" in the organizational hierarchy. More importantly, our results extend the literature by suggesting that those architects work as "bridges" between the customers (and analysts) and the developers, transforming [29] the business requirements and the organizational constraints into technical aspects that can ultimately be implemented by software developers. To be more specific, each architect is a "bridge" between different set of actors in such a way that the activities of the different IT architects are highly interconnected. Based on data from the interviews and an analysis of tools, frameworks, and modeling languages suited for IT architects, we also suggest that IT architects lack tool support, especially regarding collaborative aspects that can help them better coordinate their work given their interdependencies [27]. The work reported in this paper is an extension of our earlier work described in [30].

The remainder of the paper is organized as follows. Section 2 presents background information about IT architecture and the different types of IT architects. Sections 3 and 4 describe the setting of the study and the research methods used respectively. Section 5 presents the findings followed by their implications in Section 6, while Section 7 discusses tool support for IT architects. Finally, Section 8 presents our conclusions and suggestions for future work.

2. IT architecture

2.1. Architect roles

IT architecture is defined by IASA as "the art or science of designing and delivering valuable technology strategies" [6]. This definition emphasizes that IT architecture is not focused on delivering solutions or projects in a particular timeframe. Instead, it focuses on delivering technology *strategies*, of which solutions and projects are only a part. More specifically, IT architecture defines the components that make up the overall information system of an organization. It generates a plan that defines how acquired products and developed systems will be integrated to compose the overall information system strategy of the organization. It also enables the management of IT investment in a way that more clearly meets business needs [7].

The professional responsible for developing the IT architecture is the *IT architect*, who defines strategies for solving customer business problems or needs through the use of information technology. Those strategies include systems, applications, processes, hardware and software components, and the integration of many kinds of products, technologies, and services [8].

Based on the aspects discussed above, it is no surprise to find out that there are many different aspects that an IT architect needs to be able to handle. In fact, some authors [9–11] argue that this role is considered "ambiguous and murky" because it interacts with many different types of stakeholders and each of them expects the architect to work in a different way. According to these authors, an IT architect needs to be, at the same time, (i) a generalist, when she/he interacts with managers for example; and (ii) a specialist, when she/he interacts with software developers or other technical personnel. In order to reduce this ambiguity many companies establish different types of architects, also called IT architect roles [11]. However, these different roles are not standardized, i.e., each company establishes the roles it considers most adequate.

In a first step towards standardization, IASA and The Open Group discuss disciplines or specializations of the IT architect role [6,8]. The idea is very simple: every IT architect should have the same basic knowledge and then acquire a higher level of proficiency in one IT architecture discipline or specialization. Examples of disciplines include: software architecture, information architecture, business architecture, technological infrastructure architecture, network architecture, etc.

In this paper, we will use the definition presented by the IASA, which suggests four different architect roles [9] (described below). It is important to highlight that this definition was used to describe our results, but did *not* guide our research as a preconceived theory or view. This will be described in detail in Section 4.

- *Enterprise architect*: this architect works to support the organization's business strategy with IT solutions and information. He/she is responsible for the overall IT strategy and ensures that the IT architecture is cost effective, i.e., that the IT investments are aligned to the organization's business strategies. He/she is responsible for strategies at many different levels, such as global standards and strategies related to security and overall infrastructure. This requires a deep knowledge of business, IT, enterprise architecture, business modeling, governance, project management and economy experience; in addition to leadership and negotiation skills. Akenine [9] argues that this role is similar to a city planner who, using strategy, planning, and regulations, is responsible for different functions in a city that must work together effectively.
- *Business architect*: this role also focuses on IT solutions for the entire organization. The business architect focuses on the organizational business needs and understands in details how the organization works. He/she is usually involved in business related areas and also in process improvement efforts. This architect suggests improvements in the organization IT department together with enterprise architects, once they understand how information systems support the organization's business.