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International Journal of Information Management

journal homepage: www.elsevier.com/locate/ijinfomgt



Examining the potential of language technologies in public organizations by means of a business and IT architecture model

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ARTICLE INFO

Article history:

Received 6 February 2016
Received in revised form 3 April 2016
Accepted 23 April 2016
Available online xxx

Keywords:

Language technology
Business architecture
IT architecture
Business cases
E-government
Business intelligence

ABSTRACT

New technologies have the potential to improve the quality and efficiency of public organizations. However, it is not always clear what new technologies exist, why they should be introduced, how they can be applied, and how they fit within existing business and IT architectures. In this paper, we examine the potential use of new technologies in the form of language technologies and tools, such as text mining, information extraction, and question and answering systems. We do this examination by introducing a business and IT architecture model. The model contains an overview of IT systems and information traditionally used by public organizations in their interaction with citizens. The model also includes a set of problems facing public organization using traditional IT solutions. More importantly, the paper presents an extension to the model showing how language technologies can be used for supporting operational and strategic processes in public organizations, and addressing the identified problems. The model, its extension and the identified problems are based on and exemplified by cases from Swedish public organizations.

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1. Introduction

Public organizations need to be efficient, provide high quality services, manage formal cases in a fair way, be accessible via different channels, and be responsive to new ideas and demands. Therefore, public organizations employ a wide range of means, not at least IT systems. Examples of IT systems used in public organizations are case handling systems for managing formal applications from citizens, workflow systems for efficient routing of documents, web applications and e-services for interaction with citizens, and business intelligence solutions for supporting strategic and operational decisions.

The use of IT systems in public organizations is, however, not optimal. For example, citizens may need to wait for weeks and months for receiving certain services; may need to wait for hours in telephone queues for asking basic questions; and may receive confusing and inconsistent answers from different public officers. Moreover, public organization may need to spend a large amount of resources to manage unstructured information, and, on a strategic level, may need to be reactive instead of proactive.

By properly introducing new technologies in public organization the described problems can be addressed. A promising group of technologies addressing these problems are language technologies. In this paper we define language technology as a technique for processing human language, including semantic techniques (e.g. natural language processing and information extraction), statistical techniques (e.g. text retrieval and text mining), or a combination of these. These technologies are now mature enough to have a significant impact on an organization's business processes and services as well as on their strategies. They can be applied as a new form of IT systems or as part of existing ones, such as a case handling system. Different types of language technologies can also, as mentioned above, be combined in order to provide a more beneficial solution for an organization.

The large number of existing language technologies and solutions – stand-alone, combined, and integrated with other IT systems – makes it hard for both business and IT managers in public organization to understand what language technologies exist; why they should be introduced in public organizations; how they can be applied to support operational and strategic processes; and how they fit within an existing business and IT architecture. In this paper, we present a business and IT architecture model supporting business and IT managers to choose an appropriate mix of language technologies in a public organization. The contributions of the paper are:

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- A number of business cases showing what language technologies exists.
- A list of current problems facing public organizations when they deal with citizen requests given existing IT systems, specifying why language technologies should be used in public organizations.
- A high-level graphical business and IT architecture model of public organizations showing roles, main information flows and IT systems. The model's focus is on describing the interaction with citizens in form of customer services and case handling.
- An extension of the model showing how language technologies fit into the model, and how language technologies can be used to address current problems.

The model and its extension is based on an analysis of customer services and case handling processes in Swedish public organizations. The analysis has been carried out as part of a research project, called IMAN2. The project's goal was to develop innovative e-government solutions for customer service and case handling processes by the use of language technologies, with the aim to simplify and improve the interaction between public organizations and the actors they serve, such as citizens and organizations, both private and public. The project was a collaboration between researchers in language technology at Stockholm university, Sweden, Royal Institute of Technology, Sweden, the business intelligence company Gavagai, the process improvement company Visuera, and the IT consultant company Cybercom. Moreover, the project includes a number of Swedish public organizations on national as well as local level: the Swedish Transport Administration, the Swedish Pension Agency, and a number of local governmental organizations: the municipalities of Klippan, Kungälv, Nacka, and Söderhamn. These public organizations need a well-structured way of managing citizen services and case handling processes. They have all seen language technologies as promising solutions. The role of these public organizations in the IMAN2 project was, first, to provide the project with practical challenges within public organizations based on analysis of their citizen services and case handling processes; second, to participate in design of solutions based on language technologies; and, third, to act as test beds for the designed solutions, i.e., implement software prototypes that was develop as part of the project. In this paper, we also include some experiences from a previous research project, IMAIL, in which the Swedish Social Security Agency participated (Cerratto-Pargman, Knutsson, Celikten, Sneiders, & Dalianis, 2011).

The paper is an extension of an initial work presented in (Henkel, Perjons, & Sneiders, 2016). Compared to the initial work, we have in this paper provided descriptions of the problems that public organizations face; included a more detailed view of the business and IT architecture; and presented a more thorough description of the research approach used. Note that a full description of language technologies is not included in this paper, instead a full description of the state-of-art of language technologies was presented in a previous paper, see (Henkel et al., 2014).

The paper is structured as follows: Section 2 and 3 describes the research methodology used and related research. Section 4 presents the business and IT architecture model. Section 5 presents problems that language technology solutions can address. Section 6 and 7 present operational and strategic use of language technology. Finally, Section 8 concludes the paper.

2. Research approach

The research methodology used in the research presented in this paper was design science, which aims to create innovative artifacts for solving practical problems (Hevner et al., 2014). Example of

artifacts are models, methods and IT systems. A design science process has been presented by Peffers, Tuunanen, Rothenberger, and Chatterjee, 2007 describing how an artefact are designed and developed in a research context. The activities in this process, as well as their applications in the IMAN2 project, are described below:

2.1. Identify problems and motivate

The first activity in the design science process presented by Peffers et al. (2007) is to identify a practical problem that needs to be addressed and that motivate why the artifact, in our case the business and IT architecture model and its extension, needs to be designed and developed. In our case the business problem was identified as part of the IMAN2 project. While working in the IMAN 2 project it was evident that the potential of using language technologies in public organizations is high, but that it was difficult for business and IT managers in public organizations to understand what language technologies exist; what problems language technologies address; how they can be applied supporting operational and strategic processes; and, and how they fit within existing business and IT architectures.

2.2. Define objectives of a solution

The second activity defines the objectives of the artefact. In this paper the activity is interpreted as defining the requirements on the artifact in focus. These requirements are based on the identified problem, but specify more precisely in which way the artifact addresses the problem. These requirements guide the design and development of the artifact and form the basis for a future evaluation. For the work presented in this paper, we focus on two requirements presented and motivated below:

- *Applicability*, i.e., the degree to which the business and IT architecture model and its extension (i.e. the artifact) support the organization that use the model to select appropriate language technologies and solutions
- *Understandability*, i.e., the degree to which the model and its extension are understood or comprehended by the users. The model is an instrument that should support business and IT managers to get a better overview of what language technologies exist; why they should be introduced; how they can be applied; and how they fit within the business and IT architecture of an organization. Therefore, the business and IT architecture model needs to be understood by these managers

The reason for introducing a limited set of requirements on an artifact is that an artifact cannot normally manage all kinds of requirements when addressing a problem. Instead, it needs to focus on a certain number of requirements, which need to be clearly stated.

2.3. Design and develop

The third activity describes how the artifact was designed and developed as well as its final construction and functionality. The artifact presented in this paper is mainly based on actions and discussions carried out within the IMAN2 project, including all participants: researchers, system developers, business and IT consultants and managers within public organizations. An important step in the IMAN2 project was to perform process analysis in the participating public organizations. This uncovered a number of concrete problems in the public organizations case handling processes and customer service. This was an important input to a number of problems that language technology solutions can address. These problems are presented in this paper and related to the business

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