A Context Modelling Method to Enhance Business Service Flexibility in Organisations

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Abstract. The change of the global business environment implies unforeseen requirements that the enterprises did not take into account during system design. Based on such rapid changes and uncertainties in the future that are not predictable, organizations need to be flexible, not only in terms of their organizational structures but also regarding the Information Technology (IT). One challenge is the adaptation and evolution of software systems in changing situations, which is reflected by the criticism of poor flexibility. This work proposes a context modelling method based on enterprise capabilities and Information System (IS) Design, which is a model-based solution approach and aims to improve the flexibility of digital services provided in changing environments.

Keywords: Context Modelling, Capability Modelling, Method Engineering

1 Introduction

We are living in an economy which is characterised by the rapid change. The technological advances and the increasing globalization of the economy require in many areas high adaptability of enterprises. Based on such rapid changes and uncertainties in the future that are not predictable, organisations need to be flexible, not only in terms of their organizational structures but also regarding the Information Technology (IT). The change of the global business environment implies unforeseen requirements that the enterprises did not take into account during system design. Necessarily, this poses new problems for Information System (IS) Development, such as the adaptation and evolution of software systems in various situations, which is reflected by the criticism of poor flexibility [1], [2] as well as increased operative costs based on the manual configuration of the systems. Since it is not possible to propose a one-size-fits-all solution, the investigation has been limited to the service organisations due to following reasons:

- Changes in the role of operant resources caused a shift from Goods Dominant Logic to Service Dominant Logic (SDL) [3]. The growth of the service economy caused by this paradigm shift impacts the business processes of the organizations and makes it even more important for enterprises to adopt themselves to changes.

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- Organizations face the need to adapt their business services according to various situations. In this regard EU-FP7 research project Capability as a Service (CaaS) aims to facilitate a shift towards a capability delivery paradigm. In order to ascertain cross-industry applicability of the new paradigm, the CaaS project follows a use case driven approach. The use cases analysed in CaaS are related to the enterprises offering (digital) services that needs to be designed flexible [4].

The need for manual configuration of business services can be reduced by model-based design of the service application context. The observations from the industrial use cases in CaaS showed that organizations possess necessary knowledge on application contexts of the digital services influenced by various drivers, yet a methodological support on how to capture and model such application context is missing. Thus, the main research goal followed in the thesis is to improve the flexibility of business services provided in changing environments by developing a context modelling method based on enterprise capabilities. The method uses enterprise models as a starting point for the development processes. The approach aims designing business services adjusted to their application context and aligned with enterprise goals, which we call capability. First, Section 2 describes the research approach followed in the thesis. Then Section 3 addresses the problem investigation phase, gathers evidence from industry and theoretical work, which are then used to derive requirements to the design artefact. Section 4 introduces the context modelling method and finally Section 5 reports the current state of the work.

2 Research Approach

The design process of the developed artefact must be defined rigorously and show relevancy to the motivated problem. Due to its socio-technical structure, IS Development is a wicked problem. Wicked problems do not have a definitive formulation, they are unique and solutions to them are good or bad and not true or false [5]. Therefore we apply the Design Science Research (DSR) approach to tackle the problems, i.e. we follow the DSR guidelines proposed by Hevner [6]. The whole research process is conducted design-science oriented and is based on three cycles. *Relevance cycle* is assured by the use cases taken from three industrial application scenarios. In *rigour cycle* we use the applicable knowledge in the literature by investigating frameworks, models and methods that might help in solving the problem. Both relevant and rigour cycles are presented in Section 3. Finally, in the *design cycle* we develop the artefact (the method) based on the inputs from both cycles, observe how the developed artefact behaves in these scenarios and refine it after the gathered feedback in the evaluation (see Section 4). In line with the relevance and rigour cycles of DSR, two main research questions arise when tackling the flexibility issues in IS Design.

- RQ 1: How can the enterprises be supported from a method perspective in improving flexibility when offering digital services?
  - RQ 1.1 What are the current problems of the organizations offering services in changing environments? (Section 3.1)

- RQ 1.2 Which approaches exist to align business services and IT? (Section 3.3)
- RQ 1.3 What are the current problems in context modelling support for enterprises (Section 3.1)? Which approaches exist to model context (Section 3.3)?
- RQ 1.4 How should a methodological support for increasing flexibility look like? (Section 3.2)

• RQ2: Does the method use lead to an improvement in enterprises offering digital services based on business processes? (Section 5)

3 Problem Investigation

3.1 Theoretical and Practical Relevance

Enterprises offer business services to satisfy customer needs and to support the exchange of business value across a network of enterprises [7]. Business services are perceived as high-level implementation components that operationalize an organization's strategy [8]. Thus the modelling of business services should depend on enterprise goals, business context and not only comprise of technical aspects. This addresses business/IT alignment, which is a serious challenge in today's enterprises due to changes in regulations, time-to-market pressures and technological advances. One way to tackle these challenges is the management and modelling of (IT) capabilities [9] (see Section 3.3).

Due to the achievements in IT, business services are electronic-oriented and can also be offered digitally, which require the infrastructure of an IT-based Internet for service creation, request or delivery [10]. Especially in the domain of e-services, actors exchange information based on IT Systems. We define such business services as "digital services". Although digital services are developed for a specific customer group, they need to be configured in line with the actual application context. The need stems both from external constraints, such as changes in customer requirements, regulations or service deployment environment and internal constraints, such as priorities changes, delay constraints and staff schedule [11]. In summary, digital enterprises need to offer IT-based flexible services to improve their chances of survival [9]. In order to support theoretical observations from the literature, we also analyzed the problem from the practical point of view and investigated two organizations offering digital services within two distinct domains.

• **SIV.AG** is an independent software vendor for the utilities industry with particular focus on Germany. The company owns a BSP that provides services for the customers running kVASy®, SIV's industry specific Enterprise Resource Planning (ERP) platform. The BSP deals with inter-company business processes between partners in the utility market that requires exchange of bulky messages about energy consumption data. Currently, if an exception occurs in validating or processing the message, the BSP acts as a clearing center involving the manual interaction of a human agent, which causes extra costs on the side of the utility as well as operational efforts.

• **everis** is a multinational consulting firm providing business and strategy solutions, application development, and outsourcing services. The everis use case is based on the public sector and the main emphasis is put on electronic services provided to

municipalities, which are then used by citizens and companies. The company provides in a SOA platform a service catalogue with up to 200 services in 250 municipalities. Different factors and actors involved has to be taken into account when offering the services, such as public administration's laws, regulations, multinational corporations, administrative consortia and calendars, as well as various technological tools.

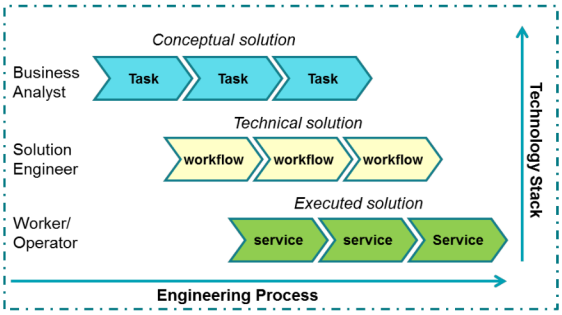

Fig. 1: Roles, Processes and the Technology Stack [12]

The aforementioned enterprises have established development and operating processes, technology stacks, and roles which is shown in **Fig. 1**. The horizontal line represents the *engineering process* encompassing the steps for designing, developing and operating digital services whereas the vertical line, technology stack, addresses all IT-tools, notations, languages, workflow engines, software development environments required in the engineering process. The engineering process consists of three phases. In the *conceptual solution* phase digital services are developed, in the *technical solution* phase the conceptual solution is prepared for execution and finally in the *executed solution* phase the solution is deployed. Different roles participate to the engineering process, i.e. *business analyst* develops solutions expressed in appropriate models, *solution engineer* configures them for deployment in line with the application context and *worker/ operator* monitors the deployment.

Both enterprises offer services that have to be adapted to business requirements of the customer. The requirements are strongly related to the service application context. Currently these organizations envision reducing operative costs required to adjust the business services by increasing the flexibility. One prerequisite is aligning the needs of business and IT as well as reaching a common understanding with participating roles on different levels. This could be achieved by model-based design of the services and their application context, which represents the configurable parts. Although there is enough knowledge about the service application contexts in the enterprises, such knowledge is either hard-coded in the systems or preserved in separate documents. As a result, their configuration is a cost-intensive task, which can be reduced by a methodological support addressing how to capture and model this knowledge.

3.2 Artefact Requirements

The requirements towards the method to be developed were derived from the industrial use cases presented above by conducting workshops and expert interviews with

the industrial partners as well as analysing secondary data. The use case requirements were cross-examined based on industry-wide surveys that illustrated its relevance towards a wider user base rather than just the project's industrial partners (see [4], [13]). First of all, to support different ways of working, the method has to provide an adaptable development methodology and should not be a monolithic block (REQ1). Business services should be designed in an understandable way for the stakeholders, who do not necessarily have a deep IT knowledge. From the flexibility point of view, this requires adopting model-based design of IS. In particular, based on the developed models, the method should enhance the communication between different stakeholders such as business analysts, solution engineers and knowledge workers (see **Fig. 1**) (REQ2). Due to changes in requirements, the standard processes are altered when offering services to the customers and variants of these standard processes are modelled/ implemented. Thus, the method should offer guidelines on how to manage process variability efficiently (REQ3). Last but not least, the method should document the steps to model the application context in detail with certain inputs, objectives and outputs. Moreover, the important concepts that the method user needs to be acquainted with must be described to have an ontological commitment to the terms and related notation to model such concepts should be provided (REQ4).

3.3 Related Work

Relevant areas for this paper are capability management and modelling as well as the approaches in context modelling, which are briefly discussed in this following.

Capability Management. Capability is a widely used term for the alignment of business and IT. In line with CaaS project, the capability is defined as "the ability and capacity to reach a goal in a given context". Capabilities help to design business services and are related to organizational strategies. They are used as fundamental abstraction instruments in business service design. Moreover, they support flexible service design by taking the business context into consideration [4, 13, 14]. Due to their roots in strategic management, capabilities are less technical-oriented concepts and take a business point of view whereas services rather take a technical point of view and are concerned about the implementation aspects. For business stakeholders, capabilities provide an abstraction from technical concepts [9]. Based on such characteristics, the capability concept is central to context modelling method.

Context Modelling. The state of the art analysis conducted in [15] showed that context modelling and context-based systems are a popular topic in contemporary research and exposed different context definitions and application examples. Most of the works focus on the conceptualization of context, i.e. what elements context typically consists of and how to represent context models. An off-the-shelf context modelling method fulfilling the requirements and showing what steps to take as well as how to identify relevant context elements has not been proposed yet. However, the proposed approaches can be used as inspiration based on the six parameters provided by [16], namely *constraint, influence, behaviour, nature, structure,* and *system*.

4 Solution Artefact

Organizations have different ways of working, in a context where the organizations are in a constant seek of balance work methods should be organized flexible and support various application scenarios [11]. To fulfil REQ1, a modular approach to method engineering was applied by dividing the methodology into several method components. In doing so, the method user could focus on those parts of the method that are needed and select the components relevant for a specific tasks. For this purposes, the method conceptualization framework of Goldkuhl is applied, which allows defining the important concepts and supports their representation with a notation (REQ4). Moreover, the framework is extended, i.e. i) the procedures are refined with additional elements such as *steps* with certain *inputs*, *outputs* and *tool support* and ii) the terms *perspective* and *framework* are replaced by *purpose* and *overview to method components* respectively [14]. The method addresses different aspects of IS Design, i.e. the method components (MC) 1, 2 and 3 are concerned with early design phase, where business analysts and knowledge workers are required, whereas the MC 4 and 5 is concerned with the binding and run-time phases, where the solution engineers play a vital role (REQ2). The context modelling method assumes that the causes of the variability in enterprise models can create the basis for the method user to identify the context elements. Thus, the method offers guidelines on how to identify variations and to elicit context elements from them (REQ3). The concepts shared by the MC are based on the slightly updated version of the Capability Meta Model proposed in [17]. To represent such concepts, the method adopts the Business Process Model and Notation (BPMN) as well as the CDT Notation, which has been developed during the CaaS project. The context modelling method is illustrated in **Fig. 2** and the MC are described very briefly in the following. Detailed discussions on the concepts, notation and prerequisites to use the method can be found in [14].

MC1: Preparing to Context Modelling. As mentioned earlier, variations and their causes are used to elicit the context elements influencing the service provision. Therefore the context modelling method proposes to analyse enterprise models from the variation point of view. For the time being, the thesis is limited to the analysis of business process models, i.e. the variations in the goal models, or concept models are not investigated extensively. If no enterprise models are available or they are not up to date, then the method user applies MC1. To exemplify, we encountered one use case where the organisation captured the enterprise knowledge based on the textual descriptions related to specific services. In such cases the method user can perform MC1. However, if the enterprise models are up to date and used extensively in the service provision, then the MC1 can be skipped.

MC2: Find Variations. In this MC, the modeller analyses the structures that will form the context element in the following method components. The MC2 focuses on identifying possible variations in the business process models. The main motivation of this MC is that such variations in the business models arise due to the factors, from which context elements can be extracted.

MC3: Capture Context Element. Focuses on investigating the entities and aspects of the context by eliciting the factors, which cause variations in the processes and

which were identified in MC2. By defining the attributes and measurable properties, the method user defines a context element.

MC4: Design Context. Defines value ranges of the context elements for a certain capability and collects them in a context set. The capability defined in the earlier activities can also be refined in this method component, since the method user now has a better view of the context, goals and business processes.

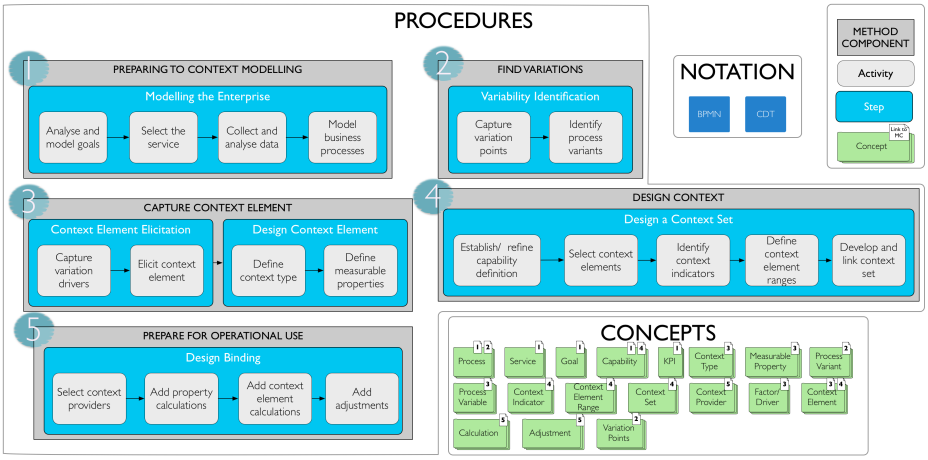

Fig. 2. Context Modelling Method

MC5: Prepare for Operational Use. Describes the way of adding part of the specifications to the context model in order to generate code from the model and make it implementable.

5 Summary and Outlook

The main research goal of the thesis is to improve the flexibility of business services provided in changing environments by explicitly modelling the service application context with a method based on enterprise capabilities. Due to its different entry points, the method can be applied in and adapted to different kinds of situations. The method, which is in the late phases of its development, aims to support various stakeholders in an enterprise on different levels such as business analysts, solution engineers and (knowledge) workers /operators. To date, the method evolved based on the feedback from enterprise modelling experts and application in industrial use cases. Although a systematic evaluation of the method is missing, there are initial thoughts on the type of evaluation approach as well as the available resources. The future work will i) specify the approach to evaluate the method and ii) implement the approach to engineer the final version of the method.

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