

# A Capability-based Context Modelling Method to Enhance Digital Service Flexibility

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**Abstract.** Today's economy is characterized by rapid change and digitalization. For improving their chances of success, enterprises need to cope with the challenges caused by dynamic markets. This requires a constant adaptation and flexible design of service/ product offerings. Due to the strong paradigm shift towards service economy, the thesis tackles the flexibility problem from the perspective of enterprises offering digital services. Digital services follow a process-oriented paradigm, i.e. there exists an underlying business process that is executed during service delivery. The central question tackled throughout the work is "from the methodological perspective, how can the design of digital services adaptable to changing requirements of the environment be supported?". The artefact developed in this thesis is the Digital Enterprise Context Modelling Method (deCOM), which captures the context of a digital service based on the variations in the business processes. The method has been developed following the Design Science Research paradigm and evaluated six times. The results indicate that, although requiring an effort to learn, deCOM is a comprehensible, useful and well-documented method to identify and model the context of a digital service.

**Keywords:** Context Modelling, Context-Awareness, Process Variants, Design Science Research, Service Science, Digital Service, Capability Modelling.

## 1 Introduction: Why Do We Need to Understand the Business Context?

Digital economy is growing worldwide and seen as an important driver of innovation, and competitiveness. This fact is underlined by the digitization of our everyday life or the digital transformation to seize the opportunities provided by the current paradigms, such as Internet of Things (IoT), Sensing Enterprises, Social Media and Industry 4.0. In order to improve their chances of survival, enterprises need to cope with the challenges caused by today's dynamic markets, such as technological advances and increasing globalization. This requires a constant adaptation of business models and processes to current market conditions, which is basically their *business context*.

The change of the global business environment implies unforeseen requirements that the enterprises could not take into account during system design. As there is an intrinsic relationship between an enterprise, its ecosystems, and its Information Technology (IT) systems to the extent that changes in one affect the others [1], organizations need to be flexible, not only in terms of their organizational structures but also regarding the IT supporting their service design and delivery. Yet, solutions in IS field predominantly focus on predictable system designs. In this context the proposals promising service flexibility have a technical focus and do not provide support about documenting drivers of change in the key activities, partners, customer segments etc. Consequently, the missing link between business and IT limits the reaction ability of organizations.

One way to reduce this gap is understanding the business context, in which the digital services are provided. Yet, enterprises require a different conceptualization of context awareness than its usual interpretation in IS, i.e. beyond physical context, they need to be aware of their market, legal and social context. In this respect, the thesis proposes a systematic approach to enhance the design, development and analysis of IS components supporting the digital service provision. By analyzing business process variability and enterprise goals, it engineers Digital Enterprise Context Modelling Method (deCOM), a method to develop "context-aware" digital services.

### **1.1 Why is it a Challenge to Offer Digital Services?**

A digital service represents an activity or benefit that one party can give to another (. . .) through a digital transaction (...) over Internet Protocol [2, pp. 506]. Digital services encompass the IT-based design and provision of usual business services, mainly focusing on the related business processes and enterprise objectives to exchange value. An understanding on different levels is the key for adaptation to changing business scenarios, which is not possible only by analyzing the technical aspects of a service, such as the required technologies, configuration items, supporting applications and infrastructures.

The main characteristic of all types of services is that they are customer centric, i.e. customers are co-producers of services [3]. Although digital services are developed for a specific customer group, they need to be configured before being delivered to the customer in line with the application context. A commonly used approach for composing digital services into business applications is business process modelling [4,5,6]. The business processes constitute the "how" part of the service provision and there is a duality between the business processes and business services [7]. To offer flexible digital services the enterprises usually adapt their business processes to the changing situations and create in turn many variations of business process models, which include contextual information.

The thesis observes the main problems hindering enterprises to offer flexible services based on the two organizations within two distinct domains, Business Process Outsourcing (BPO) and e-Government. Which challenges exist in the practice? First of all, provision of the flexible digital services requires constant updates in the underlying business processes. In addition to that, deviations in such process models and in

the related processes are expected, which requires additional efforts in the modelling and management of processes. Second, a prerequisite for digital service flexibility is the alignment on various levels, e.g. service design and delivery. Yet, reaching a shared understanding among the different roles participating to digital service engineering is difficult. Third, manual configuration of services to different application scenarios is necessary. Since contextual aspects are not taken into account during service design, IS cannot respond to changing demands at service runtime. Fourth and last, enterprises possess enough knowledge about the drivers causing changes in the service provision, whereas they do not know how to capture this type of contextual knowledge systematically. Adjustments are implemented manually on a code level, tacit knowledge applied during the configuration is hard to be explicated. As a result, it is for many organizations a challenge to offer flexible digital services.

## 1.2 State of the Art

Although we did not directly find proposals that concern flexibility enhancement in digital services, it is possible to relate different lines of work in the literature to the investigated problem. Among these lines of work, approaches have been identified in the area of Business Process Management (BPM), particularly in process variant management and context-aware business processes. Literature analysis has shown that the solution approaches document the business context within a process model, leading to overcomplicated business process models. As the models include both the contextual information and the procedural view, it is not quite easy to focus on one aspect by separating concerns.

Which proposals exist on context modelling methods in the literature? To answer this question, an extensive and systematic literature review was performed. Briefly, approaches for context modelling perceive context to be of physical nature, the context of an **enterprise** and its operations lack scholars' attention. Solutions assume in most cases that the contextual information is known. Although having a procedure for context representation, they fail to show how to elicit contextual information in a systematic way, i.e. they lack important elements, such as notation, tools required to model the context, the prerequisites to use the method etc.

## 1.3 Solution Approach: deCOM

The main contribution of the thesis is a method for business context modelling. We define context as *any information characterizing (i.e. changing, influencing) the provision and design of a digital service that fulfils enterprise goals in a changing environment* [8]. Organizations possess necessary knowledge on different application contexts of the digital services influenced by various drivers, such as the changes in type of services offered, Service Level Agreement (SLA)s and regulations. However, a methodological support on how to capture, model and communicate such application context is missing. As stated in [9] "existing work takes a more intuitive approach to context rather than following a systematical and methodologically sound procedure". A way to contribute to the body of knowledge is engineering an artefact, a **method for context modelling**, which can be adopted by the organizations envi-

sioning flexible provision of digital services and derives value from enterprise models to deal with complexity. In order to do so, the method explicates the enterprise goals that have to be reached, identifies the business processes required to implement digital services, and models the delivery context of the digital service. Flexible digital services require alignment of experts on various layers. To subsume all these aspects and represent such alignment, the method proposes the term *capability*.

#### 1.4 Research Method

The work follows the Design Science Research (DSR) guidelines [10]. The research process in any DSR project is mainly based on three cycles. *Relevance cycle* is assured by the application cases taken from two industrial cases (BPO and e-Government). In *rigour cycle* existing frameworks and methods are investigated. Finally, in *design cycle* the artefact is developed in line with the inputs from both cycles. Based on the gathered feedback through evaluation, the artefact is refined.

**Systematic Literature Review (SLR)** is used to develop new ideas by identifying the gaps in the research and justify the uniqueness and relevance of context modelling *method*. **Framework for Evaluation in Design Science Research (FEDS)** is used to assure a rigorous design and evaluation process. Each method version was evaluated by the FEDS approach. The method evolved based on the gathered feedback from a total of six evaluation cycles [11]. **Technical Action Research (TAR)** is used in one of six evaluation episodes to improve the effectiveness and efficiency of the method by helping the problem owner. **Survey** techniques are used i) to gather industrial requirements for the context modelling method and ii) to evaluate whether the method works in a real environment in the final evaluation cycle. **Observation** techniques are used to determine the quality of the resulting models developed by applying the method. **Support** techniques such as focus groups and workshops are used to ensure that the properties of the design artefact fulfil the stakeholder objectives. **Document-centric** techniques are used to analyze secondary data. The data was extracted from the flexibility & context modelling support perspective. **Interview** techniques are used to gather extensive feedback from the method users, who applied the method in the last evaluation cycle.

#### 1.5 Summary

The technological advances and the increasing globalization of the economy require in many areas high adaptability of enterprises. In order to improve their chances of success, enterprises need to cope with the challenges caused by today's dynamic markets. This requires a thorough understanding of change drivers affecting service provision, which is basically their *business context*.

In order to understand their business context and offer flexible digital services, enterprises require a different conceptualization of context awareness than its usual interpretation in IS. There is a fair number of works in the literature proposing context modelling approaches, yet they fail to show how to elicit contextual information in a systematic way. They lack important elements, e.g. notation, tools required to model the context, the prerequisites to use the method etc., which would enhance their prac-

tical applicability. This work closes the gap by introducing deCOM, a method to identify and model the contextual factors influencing the design and delivery of a digital service. By analyzing the variability in business process models, the method documents the business context and aims to improve the flexibility of digital services. The evaluation results indicate that, although requiring an effort to learn, deCOM is a comprehensible, useful and well-documented method to elicit, identify and model the context of a business service.

Further contribution of the thesis is the interpretation and integration of the capability notion to Service Science. The term “capability” is used in this work as an instrument to bridge the gap between the design of digital services and their actual implementation, which necessarily requires a refinement in its traditional understanding.

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