On the Notion of Context for Business Process Use

Ivonne Kröschel

Institut für Wirtschaftsinformatik
Philipps-Universität Marburg
Universitätsstraße 24, D-35037 Marburg, Germany
kroeschel@wiwi.uni-marburg.de

Abstract: In today's distributed and dynamic business environment companies and their business processes are frequently subject to changes, requiring the ability to continuously evolve business processes in a flexible and dynamic way according to changing external conditions. Taking flexibility as the ability to react to changes by adaptation, it appears appropriate to take the environment, where a change occurs, into account when designing business processes. We propose that the notion of context is key for achieving this objective. Based on a multiperspective analysis we derive a conceptualization of context for business process use that may help to improve the understanding of the notion of context for its integration in BPM.

1 Introduction

In today's distributed and dynamic business environment companies and their business processes are frequently subject to changes. As a result of global and networked markets, individual demands, new distribution channels, etc., organizations increasingly have to face unforeseen developments and a higher complexity of their business processes at the same time, which makes it difficult to constantly align the company´s processes with changing external conditions. The ability to continuously evolve the specification and implementation of a business process in a flexible and dynamic way therefore often constitutes a highly competitive factor [BK03; KB05].

While there is consensus on this apparent need for flexibility in the literature, there is no common agreement on how to achieve this objective of flexible or adaptive business processes[1], which has led to a high amount of research in recent years [cf. e.g. So05; GP00; RSS06; KB05; Aa06]. At the implementation level, the service-oriented architectures (SOA) paradigm appears to be a promising approach as it "provides a flexible architecture that unifies business processes by modularizing large applications into services" [PH07]. Services are platform-independent, standardized pieces of software enabling their easy integration and use in multiple environments.

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[1] In the literature, the terms flexibility and adaptability (among other terms) are typically used synonymously.

At the levels of business process (re-)design and monitoring, however, there is still a lack of appropriate methods for modeling and governing business processes in a more flexible way in accordance to their environment. It has been frequently proposed to make use of technologies and concepts taken from the Semantic Web approach to improve flexibility [BHL01]. These – often referred to as *semantic* – technologies are used to enable the provision of previously implicit knowledge about the meaning of domain-specific concepts in an explicit form which is usually achieved through (ontological) metadata annotations. In case of business process management (BPM), this approach has similarly been proposed by some authors arguing in favor of a Semantic BPM (SBPM). SBPM combines Semantic Web Services (SWS) and BPM with the objective to increase the degree of automation of business processes and to bridge the business/IT gap [cf. e.g. He05; HR07].

However, taking a closer look at the understanding of flexibility, this appears not sufficient. In general, flexibility is described as the ability to react to changes by adaptation [So05]. More specifically, business process flexibility can be defined as "the capability to implement changes in the business process type and instances by changing only those parts that need to be changed and keeping other parts stable" [RSS06].[2] This understanding implies that business processes are *aware* of the environment they are designed for, i.e. it has to be known what parts of the process have to be changed and which parts are to be kept stable, and it has to be noticed when a change is necessary. This in turn suggests taking the environment, where a change occurs, into account when designing business processes. The notion of awareness of an entity`s environment, in turn, can be closely related to the notion of context. *Context-awareness* refers to discovering and deploying context information, where context – in its most generic definition – is understood as "the interrelated conditions in which something exists or occurs" [MW10; CK00]. Information on a particular context therefore refers to information that is relevant to a particular entity in a particular situation.[3] Adding context to business processes thus may help to not only explicitly specify the *meaning* of process elements, but their *relevant meaning* in view of certain surrounding conditions.

Context, though, is a polymorphous term that has been explicitly used in various fields and disciplines, such as psychology, philosophy, linguistics, artificial intelligence, etc. [BB05]. Initially, context is a concept referring to language use and thus has been intensively studied in linguistics. In IS research, the notion of context gained particular attention in the fields of mobile and ubiquitous/pervasive computing. As regards BPM, the use of contextual information constitutes a new but promising approach [cf. e.g. RR06; Ro06; RRF08; Pl09; SN07]. The basic supposition underlying the use of context in all these fields of research is – as pointedly summarized by Davies and Thompson – "the acknowledgement, explicit or implicit, that organisms, objects and events are integral parts of the environment and cannot be understood in isolation of that environment" [DT88]. As business processes highly interact with their surroundings and usually involve a great amount of collaboration, it seems appropriate to also consider contextual values of meaning to improve business process flexibility.

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[2] For a detailed analysis and discussion of the definition of flexibility cf. e.g. [GP00; So05].
[3] The notion of context will be discussed in more detail in section 2.

For integrating contextual information in BPM it is crucial to understand what context is, which contextual factors play a role, and how these can be used to improve process flexibility. For contributing to this issue, the purpose of this paper is first to assess the notion of context for business process use based on a multiperspective analysis of the term, focusing on the use of context in language and mobile and ubiquitous computing research respectively (section 2). Second, based on this analysis we provide a conceptualization of context by identifying six types of context relevant to BPM which may help to improve the understanding of the notion of context in this field (section 3). Section 4 concludes with a short summary and an outlook on future research.

2 The Notion of Context

The notion of context has been explored in many disciplines, increasing both the number of definitions and conceptualizations as well as the term`s ambivalence and vagueness at the same time. In the following subsection we analyze the notion of context from the perspectives of context in language use and in mobile computing scenarios. These two fields are seen as key areas for deriving a business process related understanding of context as the notion is rooted in natural language use and has been primarily used in mobile computing as regards IS research. Context is of a fundamental importance in these fields, resulting in a high amount of research and a solid foundation for assessing the notion of context as regards business process use. Based on this analysis, we derive an appropriate understanding of context for business process use based on related work.

2.1 Context from Language to Systems Use

From a linguistic perspective, context constitutes a fundamental aspect of the determination of meaning in language use that has been a topic of research since the 1920s.[4] Starting from Morris' semiotic theory as the theory of signs, linguistics can be divided into the three branches of *syntax*, which is understood as the study of "the formal relation of signs to one another", *semantics*, referring to the study of "the relations of signs to the objects to which the signs are applicable", and *pragmatics* as the study of "the relations of signs to interpreters" [Le83]. More precisely, syntax deals with the properties or structure of words and expressions, semantics with their meaning or content whereas pragmatics refers to *meaning in context* [Le83].

Hence, context can be primarily attributed to the field of pragmatics. Despite a long tradition of research and its importance for the derivation of meaning, there is however no common language-based definition of the term.[5] Often context is seen as the set of attributes or features relevant to the production and interpretation of utterances [Le83].

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[4] As a precursor Malinowski (1923) is often cited: "a statement, spoken in real life, is never detached from the situation in which it has been uttered. […] the utterance has no meaning except in the context of situation." cited in [Wi04]. For an historical overview of context research in linguistics see e.g. [DG92; Wi04].
[5] This is pointedly illustrated by a quote taken from Asher (1994): "Context is one of those linguistics terms which is constantly used in all kinds of context but never explained", cited in [Fe04].

These attributes are relevant as the meaning of a sentence or utterance can vary depending on the situation in which it is analyzed. Accordingly, Duranti and Goodwin conceive context to be a frame surrounding the object of interest, called *focal event*, that describes a field of action in which this object is embedded [DG92]. Thus, context provides additional background (non-focal) information contributing to the understanding of situations. However, the contextual attributes of the respective field of action are mostly not or ill-defined. It is common to include implicit and explicit information about roles, the involved people`s assumptions and beliefs about temporal, spatial, and social settings, their state of knowledge and all verbal and non-verbal actions related to the respective situation [Le83; Au09]. Different classifications exist, separating contexts into objective, subjective, and social aspects [Fe04] or into linguistic contexts, physical surroundings, the social situation, common background knowledge, and the channel of communication [Au09]. It is important to note that the features of context are determined from the perspective of the entities under consideration and in a specific situation involving certain activities, thus making context a subjective and interactive concept that depends on the respective actors and activities involved [DG92; Fe04]. Moreover, context always refers to an activity or event under consideration, making it a relative concept that depends on its use [DG92; BB05].

In IS research, the notion of context has been investigated in various fields, receiving particular attention in mobile and ubiquitous/pervasive computing and leading to a plethora of definitions and understandings. The most widely used definition by Dey and Abowd describes context as "any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves" [DA99]. Although this definition is very generic, it again highlights context as a notion of interaction providing additional information on a particular situation or activity. A more specific definition is provided by Schmidt et al. who perceive context as the "knowledge about the user's and IT device's state, including surroundings, situation, and to a less extent, location" [Sc99]. As Dey notes, these definitions are typical for the field of context-aware computing where context is either paraphrased by means of synonyms, such as *environment* or *situation*, or by enumerations of examples of possible context factors [De01]. The term context-awareness was initially coined by Schilit and Theimer to describe the ability of applications to "discover and react to changes in the environment they are situated in" [ST94]. Hence, an application is context-aware if it is able to take advantage of contextual information that is of interest to a particular entity. This context information typically includes information on (i) the computing context, such as network characteristics, applications, etc.; (ii) the user context, such as roles, beliefs, etc.; (iii) the physical environment, such as lighting, nearby objects, etc.; and (iv) the time context, such as day of the week, time of day, etc. [SAW94; CK00]. Schilit et al. summarize the important aspects of context by *where you are*, *who you are with*, and *what resources are nearby* [SAW94].

2.2 Context for Business Process Use

The field of context-aware BPM is still in its infancy [RRF08]. Whereas common definitions and categorizations from related fields serve as a theoretical basis, they cannot be identically applied to business process use. In the following, we highlight two early works in that field which are considered relevant for this paper. Rosemann et al. introduce a context framework for process modeling to enable a more flexible and context-oriented design of business processes [Ro06; RRF08]. Their conceptualization of context consists of an onion model including four layers of context: (i) immediate context, referring to all aspects that are essential for the execution of a process, such as required data, applications used, etc.; (ii) internal context, including the immediate organizational system in which the process is embedded; (iii) external context, comprising all external elements relevant to the process, such as competitors, suppliers, customers, etc.; and (iv) environmental context, constituting the outermost layer of the model including factors that are still relevant but outside of the organization's direct network, such as socio-cultural or political-legal issues. Their work constitutes a seminal contribution towards contextualizing business processes. Also, Saidani and Nurcan argue in favor of context-aware process modeling [SN07]. Their work illustrates the relevance of context-related knowledge for process design and includes a four-step model for integrating context knowledge comprising (1) context elicitation, (2) categorization, (3) adaptation and measurement, and (4) business process instantiation. The authors propose a categorization of context knowledge into (i) time-related context, (ii) location-related context, (iii) resource-related context, and (iv) organization-related context. Their work is based on their earlier research on role-based process modeling and thus mainly emphasizes the actors involved in and relevant to a business process.

In consideration of the above mentioned views, we conclude the following general characteristics of the notion of context. (1) C*ontext describes a set of states*; it does not represent an individual concept but denotes a set of several conditions framing an object of interest. It refers to the whole set of interactions and relations of entities and activities in a particular domain. (2) *Context is subjective* as it highly depends on the activities and objects under consideration and the entity perceiving it. Therefore, its understanding also highly depends on the respective domain of interest in which it is used. (3) *Context is relative*, i.e. context is not autonomous but always related to some activity or event. This means that contextual information highly depends on its relevance for the intended use. Hence, context-awareness of business processes can be understood as the detection of and appropriate reaction to events that are relevant to and might affect the execution of a process. A business process is context-aware if contextual factors – factors that might cause such an event – are made explicit for their use in BPM in order to take advantage of this explicit context information for dealing with changes. Context might be crucial for achieving a higher degree of process flexibility as context accounts for the environment of the process and changes often cannot be anticipated in advance, particularly in frequently changing business environments. Based on the generic definition of context by Dey and Abowd, the following understanding of context for business process related tasks can be derived: Context is any information that is relevant to and might affect the

execution of a business process. This information includes aspects of the process itself, the business environment in which it is embedded as well as any other entities that interact with the process.

3 Conceptualizing Context for Business Process Use

In the following we present a possible conceptualization of context for business process use that may serve as a basis for the understanding of context in that field and the identification of contextual aspects affecting business processes. Different to Rosemann et al. [RRF08] we think that an onion model is not appropriate in this regard due to the following reasons. First, as the authors already indicate the onion model suggests relevancy based on proximity, i.e. the elements of the outer layers are considered less relevant than the inner layers. This may seem true in case of immediate context which is certainly most relevant to the process itself. However, we consider environmental issues, such as social or political factors as relevant as, e.g., the organization's competitors. This is highly dependent on the process under consideration. In this regard it may also be argued that the inclusive structure is also based on impact, i.e. the outer layers influence all elements of the inner layers. Again, this appears too restrictive as context relations may also be bilateral, e.g. internal context factors may also influence external ones. Instead of this layered, concentric architecture we conceive these aspects rather to be highly intertwined and affecting each other in mutual relationships. Second, context is a highly subjective and user-centered notion as proposed in a similar way by Saidani and Nurcan [SN07]. However, the user only plays a minor role in their model. We assume that the people involved in the entire life cycle of BPM as well as their behavior and characteristics play a major role in the organization as a *living system*. Third, the onion model is not eligible to represent relations and interactions between the context factors. Based on the analysis above, however, we take context as a notion of interaction describing the relations between objects and the entire set of contextual variables forming an event.

Based on these observations and the analysis of context in section two, we propose a relation-based conceptualization of context that is applicable for the use in BPM. This understanding is based on six context categories as described in the following and illustrated in figure 1.

Domain Context refers to the superordinate domain in which the focal event or object is embedded. In our case, this refers to the business environment in very general terms which is required to set the outer realm restricting relevancy. This is crucial as we have seen that the requirements for contextual information vary between different fields of application.

Business Process Context denotes the elements directly related to the business process. Beside the process itself, this may include several contextual properties, such as e.g. process characteristics, the control flow, specified goals, required resources, organizational units involved, etc., and is directly related to each of the following context types.

Internal Organizational Context includes information about the organization which the business process is designed for. This information predominately comprises characteristics of the organization, such as strategy, number of employees, business area, organizational structure, etc. For the case of interorganizational processes, this may also include the whole network of organizations involved in the execution of the process under consideration.

External Organizational Context has to be delineated from the former type as it refers to information about all external conditions of the organization, i.e. those aspects that are out of the organization's immediate control but are relevant to and affect the business process. This predominantly refers to the market environment, including elements such as competitors, customers, suppliers, market conditions, etc., as well as e.g. political, cultural, or location-based aspects.

Information System Context refers to the entire IS infrastructure in which the applications implementing the process are embedded. This may include all related pieces of software and hardware enabling the implementation of the process as well as all other applications for user support involved in the execution of the process.

User Context includes all actors involved in (re-)design, execution or monitoring of the business process under consideration. This type of context may include profile information, such as qualifications or the social background of the user, but may also refer to roles, tasks, and responsibilities of the actors involved in achieving the process goals.
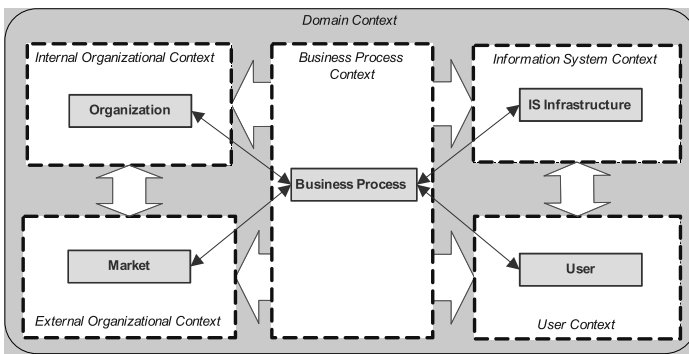

Figure 1: Context types and their interaction

As indicated in figure 1, these individual categories are highly intertwined and interact by means of the relationships among the single entities in a business domain. As pointed out in section two, context can be understood as a frame surrounding the relevant object of interest. Correspondingly, each category centers on a *focal element* (in light blue) that is related to the other core elements within the respective category. For instance, the *user* is seen as core element for the *user context*, whereas *external organizational context* is centered on the term *market* here, denoting all external participants in the environment of the organization. This conceptualization is based on a relation-oriented understanding of context as the elements forming the context relevant to a business processes are perceived to stand in direct or indirect relations to each other.

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4   Conclusion and Outlook

„[C]ontext knowledge will enable future PMS [Process Management System] architectures to discover, use and learn from process changes in an intelligent manner, and will thus make them adaptive to flexible processes." [Aa06]

To make this vision come true a lot of research work still has to be done. Although the notion of context has been explored in a variety of disciplines and from a number of different viewpoints, a common understanding of the notion of context for business process use is still lacking. We present a conceptualization of context comprising six key context categories which appear relevant for contextualizing business processes. These categories are based on the interaction between a business process and its environment. Following up on the issue of process flexibility as addressed in the introduction of this paper, the proposed conceptualization may be seen as a preliminary step for indentifying and classifying possible context factors as well as their representation to allow for better dealing with changes in the process environment. By attaching explicit context information to the process, changes can be seen in a *higher context* enabling the more flexible adaptation of relevant and affected processes to these changes.

In order to prove the benefit of the proposed conceptualization, a validation based on example cases and the application of the model is further required. Moreover, future works should focus on how contextual factors can be identified in particular business environments and how context can be explicitly modeled for business process use. Again, existing literature in related fields of research may assist in achieving this objective [cf. e.g. SL04]. In addition, it must be investigated how context information can be retrieved, stored, and provided for its use in BPM. It should be analyzed how context models may be integrated into existing process modeling techniques and how context information may be effectively used to increase the flexibility of business processes. Besides process design, context-awareness appears to be a promising paradigm for all aspects of BPM enabling future business processes to better *interact* with their environments.

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