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Key Requirements for a Context-aware Service Marketplace: An Expert's Perspective

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Abstract

With the advent of an Internet of Services, requirements arise for new or repurposed channels to offer, sell, moderate, and change services. A possible manifestation of such a channel is an internet-based service marketplace. Due to the complexity of service delivery between arbitrary providers and consumers the effective matching of offering and demand, as well as its delivery, is crucial. To narrow and focus the search and delivery process we consider context-awareness as a key requirement. Context-aware information systems are conscious of their environment, i.e. their relevant execution context and, thus, provide a better targeted application experience. As there is no universally accepted context description model, which explicates relevant context information, we gathered requirements on the basis of expert interviews. The interviews were performed with stakeholders from different organizational units to get a broad understanding of the key issues. The consolidated findings lead to a number of context categories.

Keywords

Requirements engineering, context-aware information system, service marketplace

INTRODUCTION

The Internet of Services enables agile enterprises to reach out to a global market and focus on core competencies but also create global competition. It is extending today's internet to become service-enabled, i.e. facilitating the trade as well as the execution of services. For businesses it is supposed to be the underlying global infrastructure which allows the formation of flexible and agile service networks to provide value-added services (Heuser 2007). It is "a multitude of connected IT services, which are offered, bought, sold, used, repurposed, and composed by a worldwide network of service providers, consumers, aggregators, and brokers resulting in a new way of offering, using, and organizing IT supported functionality" (Villasante 2009).

In order for this to work, an infrastructure is necessary to trade and provide services over the internet. A service marketplace is one possible form of appearance of an internet-based trade platform (Janiesch et al. 2008). "A marketplace lists suppliers offering their products and allows buyers to access the supplier listings" (Bussler 2003). On this platform, a consumer must be able to find services, adapt them, execute them, and eventually be able to uninstall them. A provider must be able to make their services available, improve their services, and eventually retire them. Therefore, a marketplace must be able to act as a broker and moderator in order to facilitate the matching process of consumer and provider as well as the service delivery process including monitoring and billing.

In the case of an electronic service marketplace, this entails that the traded products are services which can be sold and purchased online. In contrast to consumer products or even simple, non-material goods such as videos or music, services are rarely traded online. Reasons are that it is very time-consuming to search for the right service online due to the lack of standardisation. If purchasing complex services, the individual services are often spread over multiple providers. Consequently, service marketplaces have to facilitate transactions in a well governed way in order to be successful (Janiesch et al. 2009).

However, this business environment is subject to frequent and, at times, unpredictable change. This observation results in a need for flexibility for organizations and enterprises and the ability to respond to these changes (Quinn 1992). Due to this fact, in the research field of Business Process Management, the aspect of flexibility has become more and more important in recent years and the notion of flexible process design has evolved.

Although the extrinsic stimulus of change – the *context* – was not taken into consideration until recently (Balabko et al. 2005; Hallerbach et al. 2008; Rosemann et al. 2006), the concept of context-aware business processes, which explicitly incorporate context during the design and execution of the processes emerged. However, there is still no universal understanding of what context is in relation to information systems.

In addition to that, there is an intensive interaction between the customer and the marketplace. Every customer may access the marketplace from external applications. Thus, he or she may have already made a solution scoping or a business configuration inside their application. Based on the pre-existing configuration of these applications, an adaptation of the marketplace to the customer's needs can facilitate the buying process. This context information can also be used to cluster the customer profile with other customer profiles. Based on them, e.g. recommendations for specific services in the marketplace can be given. As a result, the external application with which the user accesses the marketplace can have an impact on the use of the marketplace. The scope of a marketplace may comprise sending the order to the service provider, the provisioning of the delivery status inside the service backbone, and a provider rating after finalizing the order. In the backbone, existing services and content in the repository can be matched with the customer needs. Afterwards, personalised customer solutions can be constructed based on the content and the service repository.

This research belongs to the design science paradigm (Hevner et al. 2004). It strives for developing a practically relevant artefact in form of a context model for service marketplaces in the Internet of Services. We examined existing research that describes the notion of context and based on that we gathered requirements for a context description model. Following a literature review across several sciences, we substantiate the initial findings by eliciting requirements from domain and technology experts through a series of interviews. The paper is structured accordingly. Section 2 presents related work on context. Section 3 introduces the research method. Building on this, Section 4 includes selected transcriptions from the interviews which are analysed and consolidated into a comprehensive context description model. The paper concludes with a summary and outlook.

RELATED WORK ON CONTEXT-AWARENESS

Notion of Context

The notion of context is widely used in different research areas. Examples can be found in the areas of formal logic (Arló-Costa 1999), knowledge representation and reasoning (Brézillon et al. 1998; Sowa 1999), computational and sociological linguistics (Clark and Carlson 1981; Halliday 1978), cognitive psychology (Kokinov 1999), and business process management (Hallerbach et al. 2008). While a linguist considers context as a psychological construct for instance, to a sociologist context is provided by macro-social forms (Berztiss 1999; Leppänen 2005). Thus, it is rather difficult to precisely define context in a unique notion. "Rather the interpretation of the notion itself is context-sensitive" (Leppänen 2005).

A very generic definition of context reads: "the circumstances relevant to an event or fact" (Crozier 2006). In the working definition of Rosemann et al. (2006), context is "the relevant subset of the entire situation of a business process that requires a business process to adapt to potential changes in the context variables". Thus, context is understood as the combination of all implicit and explicit circumstances that might have impact on the situation in which it is embedded (i.e. here: the business process) (Schmidt 2000). Rosemann et al. use context mainly for the purpose of adapting business process models. Leppänen elaborates a more general definition of context composed of two different parts: the teleological part and the structural part. Hereafter, a context is also a conceptual or intellectual construct which facilitates understanding, analysis, and design. It results in more elementary things in the concerned environment or circumstance as a whole which is determined by the focal thing(s) of which making sense is important. Furthermore, it is composed of interrelated things in which each of them represents a specific contextual domain (Duranti and Goodwin 1992; Leppänen 2005).

Although the given definition is much elaborated, an application to the usage of context in the computing field is rather difficult. Dey and Abowd (2000) try to provide this exact solution and attempt to define context for usage in the computing field by using already existing definitions in literature. They also state that for most people it is clear to understand the meaning of context but it is difficult to elucidate and grasp it. They differentiate between definitions of context based on the definition's characteristics: by examples, by synonyms, operational.

Definitions using synonyms and enumerations of examples have one thing in common: they are difficult to apply. If there is only one object missing in the enumeration, one does not know whether it can be defined as a context element or not. Similar to the definitions based on examples, it is problematic to apply the synonyms

dynamically to an arbitrary use case. An operational definition is needed that can be easily adopted in different situations.

Dey and Abowd's argumentation underlines that most operational definitions are too specific. The important aspects of context may change depending on the situation. Therefore, it is fairly impossible to define specific characteristics of context. For this reason, they provide another definition of context: "Context is any information that can be used to characterise 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 application themselves" (Dey 2001; Dey and Abowd 2000). Thus, if a piece of information can be used to characterise the situation of a participant, then it is context. In the following, the term context will be constantly related to the presented definition above.

It is also necessary to unambiguously specify other terms derived from *context*. Thus, *context category* is defined as a set of entities derived from the original context to specialise context in a standard way but nonetheless provide an appropriate abstraction level (Stuhec 2005). The categorization of context helps business analysts and application designers to find relevant context for their IS and structure the context they use (Dey and Abowd 2000). Schilit and Theimer (1994) introduced the term *context-awareness* and referred to context as location, identities of people and objects, and changes to those. Accordingly, a *context instance* is a concrete value of the defined context categories. Also, we refer to the definition that an IS is context-aware "if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's tasks" (Dey and Abowd 2000).

Structuring of Context

Recent research work has focused on providing a contextual infrastructure for context-aware systems. Consequently, a wide variety of structuring models for context were developed. There is the reference frame of Rosemann et al. (2006) trying to facilitate the identification and integration of relevant context into business process models. However, the authors only define rough layers rather than defining specific context categories. Gu et al. (2005) use an ontology-based approach with the help of OWL (Web Ontology Language) to model context. The authors classify context into two main domains: the common upper ontology for all pervasive computing domains and multiple domain-specific ontologies that only apply to specific computing domains. Each ontology type can have individual subclasses, properties, and relationships. Furthermore, they differentiate between *direct context* and *indirect context*: direct context can be directly acquired from a context provider, whereas indirect context is derived by interpreting direct context through context reasoning (Gu et al. 2005). Using also an ontology-based approach, Strang et al. (2003b) introduce their own ontology language for structuring context, named CoOL (Context Ontology Language). However, they do not provide a specification of any categories to classify context. The authors extend their approach and, among other things, define different aspects for categorizing context (Strang et al. 2003a). However, an aspect only represents a criterion for testing and evaluating the introduced concepts of context. Chen et al. (2003) also utilise context in combination with ontologies by defining their own context ontology, CoBrA. Leppänen (2005) makes use of context to evaluate method engineering artefacts that are used for IS development. Using this approach, he explicitly specifies categories to facilitate the evaluation. Dey et al. (2001) apply context to the domain of computing devices and applications. Due to the broad diversity of context information, in their opinion it is useful to categorise context for a better, systematic comprehension of context. For this purpose, they define the four basic context categories *identity*, *location*, *status*, and *time*. Apart from these rather academic approaches, there are also practical categorization models such as the core components and unified context methodology of UN/CEFACT (UN/CEFACT 2008), the delivery context overview for device independence of W3C (Gimson et al. 2006), and the aspects context driver principle of SAP (Stuhec and Yu 2007).

RESEARCH METHOD

As the objective was to gather initial requirements for a context-aware service marketplace the research method of interviewing was chosen. Interviews are one of the most common sources of information in qualitative research. Interviews can be open ended, semi-structured, structured or survey type. This requirements gathering used a semi-structured interview approach. The expectation was that the interviews would help to highlight different perspectives of requirements for a context-aware service marketplace by encouraging the interviewees to think outside the box and extrapolate from their software engineering expertise.

We asked two types of requirements from the participants of the interviews:

a) What areas constitute context for the usage in a service marketplace? The approach is to gather a superset of requirements to cover a vast range of aspects of context. For the specific application in context-aware information systems a subset, a view, can be used.

b) After defining the relevant context, which factors are important to apply it to a service marketplace? The requirements specify technically and functionally what is necessary to use context for the adaptation of the application including e.g. processes, user interface, or business logic. Due to length restrictions we cannot include the findings in the following.

Both types of requirements have been derived on the basis of expert interviews that were conducted from November 2008 to December 2008. The participating experts belong to several departments and different scientific backgrounds. Every expert is either a researcher or professional in an organization or works for an academic institution. After having contacted the experts, an interview date was fixed. Due to the global diversity of the interview partners, not every interview could be conducted face-to-face. Nonetheless, there is evidence in the related literature that telephone interviews are as effective as face-to-face interviews (Rogers 1976). We observed the same and could not find any drawbacks of interviewing the persons via telephone. The interviewees were chosen based on the objective to get as many different perspectives on the problem of setting up context for a service marketplace as possible. Every expert works or does research either in the field of marketplaces, services, or both but has set different foci on the problem. Table 1 lists the interviewees including their background, location, and how the person was interviewed. The duration of every interview was 40 to 60 minutes. While the selection of interviewees and the amount of people interviewed do not suffice to guarantee an unbiased and final result, the qualitative analysis of the interviews unveils a broad range of topics that need to be covered in order to develop a context-aware service marketplace.

Table 1. Interviewee Details

No.	Interview Conduct	Location of Expert	Language	Background of Expert
#1	Face-to-Face	Brisbane, Australia	German	Research – Organization
#2	Face-to-Face	Brisbane, Australia	German	Research – Organization
#3	Telephone	Walldorf, Germany	German	Professional – Organization
#4	Telephone	Karlsruhe, Germany	German	Research – Organization
#5	Face-to-Face	Brisbane, Australia	English	Research – Organization
#6	Telephone	Karlsruhe, Germany	German	Research – Organization
#7	Face-to-Face	Brisbane, Australia	German	Academic
#8	Telephone	Walldorf, Germany	German	Professional – Organization
#9	Telephone	Dublin, Ireland	English	Professional – Organization

The interviews are designed as semi-structured interviews. This entailed drafting some general ideas and guidelines for the interviews, though, no concrete questions were set up in advance. Every interview started with an open question about the two requirement areas that were investigated. Afterwards, if not already mentioned in the response to the open question, the interviewer led from the open question to the concrete issues described in the guideline. The topics we covered with the guideline are introduced in the section below with a colon. They are derived from the categories of other context models which we analysed during our literature review. Due to the semi-structured nature of the interview, the interviewees could think about the topics and the contents mentioned in the interview guideline in a different way and also discuss new ideas and perspectives. Despite that, it is essential that the interviewer can moderate the interview and lead the conversation to a direction that is sensible (Bandara et al. 2007; Kramp 2004).

After every interview was completed we summarised the findings. We transcribed the relevant parts of the interviews. The transcriptions were conducted by extracting those parts of the interviews that were important for deriving the above mentioned requirements. Afterwards, we analysed the transcriptions adopting a qualitative analysis. The analysis was carried out in two steps: First, due to the semi-structured concept of the interviews, our requirement suggestions were either verified or falsified by the interviewees. In a second step, further ideas of the interviewees were analysed conducting a bottom-up analysis. Initially, the issues mentioned in an interview – if not already introduced in a previous interview – were stored by creating a new node. If the issue was already mentioned, it would be added to the existing group of related issues. After completing all interviews, we reviewed the issue groups whether a new requirement could be derived based on these or not.

In the following, direct quotes of the interviews are shown as “<See quotes in the text> (Expert XYZ)”. Most of the interviews were conducted in German and had to be translated to be quoted in the paper. Moreover, the first interview was recorded in writing because a voice recorder was not available. Due to these facts, there may be slight variations between the original response of the interviewee and the quotation.

REQUIREMENTS FOR A CONTEXT-AWARE SERVICE MARKETPLACE

Interview Transcripts

In the interviews, every participant states that it is necessary that the customer of the service marketplace should be part of context. The customer may, for instance, be an enterprise which is registered for the marketplace. Possible context instances of the broad area of customer data are discussed in the remainder of this section.

Industry: <Industry is fundamental to context of a service marketplace> (Expert 2). It is essential because every sector has different service needs. Normally, variations of services for different industries exist. In terms of context, the service recommendations for a customer can be adapted based on his sector.

Location and Compliance: <The demographic factors of the customer are context variables. What is your country, what is your subsidiary, what is your political environment? [...] Furthermore, organizational and country-specific regulations, laws, policies, etc., i.e. the entire compliance area> (Expert 8). As a result, location and compliance aspects can be mentioned hand in hand. To every location, different legal restrictions and directives apply. Each company also has a different enterprise culture that can influence the marketplace and restrict and customise the service provisioning.

Maturity and Lifecycle: In addition, <the maturity and the lifecycle of the customer can be considered to be part of the context. The maturity measures the importance of the customer for the service marketplace owner> (Expert 1). Customers having a higher maturity possess a higher frequency and constancy of service requests. Considering the lifecycle of the customer, it can be concluded in which phase he is at the moment. For instance, newly founded, high growth companies may require different services compared to mature, established companies.

Security Preferences: Every single customer has different security preferences. These can e.g. be measured on the basis of the amount of information he wants to provide. Assuming he is a service provider, the quality of a service can be more easily guaranteed if more information about the provider and the service is stored. This can be achieved via enterprise audits.

External Applications: There is also a possibility to adapt the marketplace based on external applications that the customer uses. Similar to the entry point to the service marketplace, runtime information can be derived from the external applications of a user. A customer relationship management system may give useful information about customer behaviour and a supplier relationship management system is able to provide information about the suppliers of the customer. This can be considered as a part of context.

There are other attributes that could be outlined. It has to be evaluated to what extent the properties of the customer data can be created as a category on its own due to the size and the content of the values. Nonetheless, we are able to reach a consensus that customer master data should be included in the context.

Entry Point: Besides the pure customer data, <the entry point to the service marketplace is context and contains information [...] There is an economic and a technical context> (Expert 2). Thus, the external application from which the marketplace is accessed should be taken into consideration. Economic context is context of which the service marketplace can draw conclusion from the business areas in which the customer is situated. A popular use case is that the customer enters the marketplace via an enterprise resource planning (ERP) system. This system is configurable: that means the customer can activate specific modules and processes customised to his needs. For instance, he chooses to use the system for the business areas of human resources (HR) and procurement. Moreover, he enables a process variation: prices in procurement transactions with specific providers are not negotiable due to existing framework agreements. Based on this business configuration in the external application, the service recommendation and even the processes in the marketplace can be personalised. <The marketplace should only offer those services for the individual business configuration> (Expert 2). From a technical perspective, the type of the external application can be considered. It has influence on the marketplace whether it is accessed via an internet browser, a system on a mobile device, or an ERP system. In addition to the technical information about the system type, runtime information that is included inside the transaction of the application may carry further information. Thus, the entry point of the service marketplace should be considered as context.

Services: <The user has to say in advance [...] what services he is looking at> (Expert 3). Therefore, it is very useful for the service marketplace to know the preferences of every particular user and customer. Moreover, the service history of previous service transactions can encompass meaningful information to customise the offered services in the marketplace. This information has to be compared to the existing services offered in the marketplace.

History: A user has some type of history that can be stored. Referring to the field of a service marketplace, purchased services, existing contracts of services, browsed services, and prior payment behaviour are listed as examples. Based on these, multiple types of recommendation can be derived. As a result, the transaction history of a user/ customer is a major component in the context of service marketplaces.

User Data: As mentioned before, a customer of the marketplace could be any type of organization. Every organization has multiple employees using the system and – as a consequence – multiple licenses and accounts. Therefore, there are different users making use of different marketplaces adapted to their preferences and systems. Aspects in the context could be general system capabilities as the connection speed but even mandatory attributes as the user's role. Depending on the role of the user, access rights in the marketplace can be limited. A CEO of an organization ought to have more access rights and permissions than a regular employee in the HR department. Besides the role, the technical skills of the user are also relevant. *<Configurability of the user interface is important regarding the perspective of usability. Expert users have different requirements for a user interface than users who only use the marketplace occasionally>* (Expert 7). If he is an expert in using a marketplace application, he does not need support pages and uses shortcuts more often. In contrast, novice users probably would like to have a tutorial at the beginning and need more context information. *<Efficiency is not that important, rather support information in the application>* (Expert 7). We can summarise these aspects as the user's level of discourse and they should be considered. Summing up, the user master data is also context for a service marketplace.

Temporal Aspects: Temporal aspects can be considered a context. For instance, the time zone or the preferred peak usage times of the customers can be included. However, a few interviewees state that *<this should always be fulfilled and not be dependent on context>* (Expert 1). Others think of a *<resource management>* (Expert 7) functionality that can reallocate the load of the connection to improve the performance of the service marketplace. Other issues are to use an *<automatic agent for price calculation>* (Expert 7). Depending on the local time of the customer, the price will be calculated. This could also improve performance because the user can receive a rebate if he uses the system during non-peak times. It has to be decided on the context instance level if it makes sense to include time as context for the corresponding marketplace.

Business Process: Every process in a service marketplace is embedded into a bigger, more generic process. This means that before and after the action takes place in the service marketplace, there are other tasks and actions for the actors. This can have an impact on the service marketplace because *<the service provision varies depending on the superior process>* (Expert 5). One interviewee exemplified this by saying that a logistic process requires different services compared to a financial process. We can conclude that the business process superiority should be taken into account.

Business Process Actors: In a business process of a marketplace, the perspective of a business process actor plays a major role. Besides the consumer and the service provider as main actors, there are also other actors who influence the marketplace. Additionally, 3rd party providers or telecommunication providers play a role in the process as well. Every single one of these people has an influence on the entire process. For example, a user can mention preferred providers and, thus, the service recommendation can be customised based on this. *<If actors with whom you set up the service contract differ from those who conduct the service, then definitely all actors have to be included>* (Expert 7) in the context. Therefore, the area of business process actors also plays a major role for context in a service marketplace.

Apart from the mostly content-driven discussion, some structural aspects were also highlighted.

Extensibility of Context Structure: The structure of context in the marketplace is an issue. In the interviews, a consensus is reached that it does not make sense to order all categories on the same level. For structuring these, a hierarchy in terms of a context tree can be an effective instrument. In doing so, we do not need to consider every category initially. *<It is not possible to think about the entire context in advance>* (Expert 2). Thus, the proposal is to set up only rough, top-level categories whose context instances are already known. For example, countries standardised by an ISO standard, standardised business roles, international organizations, and laws based on countries are familiar to us. It is important that *<this is – as the service recommendations – just a proposal>* (Expert 3). At the lower levels, there does not exist a fixed structure apart from a collection of context instances and possible subcategories. As the tree is traversed, the lower levels (i.e. subcategories) of the context are instantiated. Thus, it does not have to be decided in advance which substructures will be used. Furthermore, the *<user should have the possibility to make changes – according to rules –>* (Expert 3) to the context structure of the marketplace. If the user wants to have a more detailed categorization of the context tree he ought to be able to create new hierarchy levels.

Functional vs. non-functional context: Based on context, we can draw conclusions from the result of the procurement process, i.e. a concrete recommendation for a service. Another example is the pricing of services based on context that directly affects the result (functional). However, based on context, we can also draw

conclusions from the experience during the procurement process, i.e. the performance, the user interface, or the support functions of the marketplace. One simple example is that we should not colour dependent-widgets in the user interface for a colour-blind user (non-functional). Both context types are not disjunct. There are context instances that can be classified as functional and non-functional context. If the application sorts the results of a service search based on certain criteria, the search can be influenced by the procurement result as well as by the prior experience of the user. Expert 7 distinguishes between the same context types using different labels: *<Content and Presentation>* (Expert 7).

Economic vs. technical context: If the user wants to buy a service, the context determines the potential, sensible services, and the variations inside the procurement process. For example, if the user is an accountant and logs on, the system knows the legal restrictions and the specific process variants of the customer and he does not have to choose between Basel II and SOX explicitly. Therefore, it is a facilitation of the procurement process for the service consumer and for the sales and marketing process for the service provider because the latter can exactly offer these services the first is interested in. Therefore, several experts state that this is the most important area: *<If this is considered by the marketplace, this would be the added value>* (Expert 2) and *<the added value for the service provider is that he wants to sell something and that is just an economic extension>* (Expert 4). Rather than looking at economic context, context also determines the user interface or opens new device channels of the marketplace. *<Those are general context characteristics of all information systems and not specific context categories for the application of a marketplace. It is about how to best set up the human-machine-interface>* (Expert 2). Examples for technical context are the locale, user preferences, the transaction history, or the trustworthiness customizing the application to the human in front of the device.

Static vs. dynamic context: *<Static context is independent on the current procurement process and does not change often.>* (Expert 7). User information is static context because initially the user sets up his profile and normally it will not be changed frequently. That means *<he sticks to his company, to a certain application domain, and to his preferences>* (Expert 7). Dynamic context is totally dependent on the current procurement process. The entry point into the service marketplace is dynamic context. It is possible to access the marketplace through different external applications. As a result, the information often changes which has to be considered in the implementation.

These three classifications of context are rather orthogonal to the constituting categories of the context discussed before. They are not included explicitly in the following summary. They rather assist in building a comprehensive conceptual understanding of context.

Interview Summary

The result of the interviews is the following requirements specification for context categories in a service marketplace. The requirements are not necessarily disjunct to each other. They are summarized in Table 2.

Table 2. Context Constitution of a Service Marketplace

Requirement	Requirement's Description
Customer Master Data	The customer of a service marketplace should be part of context. Customer data can consist of several properties of the customer: e.g. location, industry, security preferences, and external applications. If they add value, other properties of the customer should be included as well.
(Available) Service Information	Meaningful information with regard to services should be taken into account. This can include already purchased services, service preferences, or the services offered on the marketplace. This requirement may overlap with others but due to the importance of these aspects it has to be listed on its own.
Entry Point to the Service Marketplace	There is always an entry point from which the marketplace is accessed. All technical and – if available – economic information should be part of the context.
User and Customer Transaction History	All information about past transactions of the customer is part of context. This includes buying history, browsing history, existing contracts, etc.
User Master Data	Every customer of the marketplace can have multiple licenses. This results in multiple user accounts. Every user has his individual context. Even if the users belong to the same customer, their individual context may differ from another. Thus, the data of every single user should be considered as context. This can encompass user specific settings as e.g. the user role, access restrictions, system capabilities, and the level of discourse of the user. If they add value, other properties of the user should also be included.
Business Process Actors	Besides the service consumer and provider, other actors may exist in the ecosystem of the marketplace. Generally, all actors participating directly or indirectly in the marketplace have to be considered as context.

Business Process	Mostly, the processes in the marketplace are embedded into a superior business process. This process has to be taken into account.
Temporal Aspects	Time could be a relevant part of a service marketplace context. It can consist of e.g. performance-related aspects such as peak usages but as well of functional issues such as the price calculation of a service depending on the time. This could reallocate the load at preferred points of time or even initiate marketing mechanisms.
Extensibility of Context Structure	Context of a service marketplace has to be somehow structured. A hierarchy of the categories of context is necessary. It is not possible to determine the exact context of a service marketplace in advance. Thus, a rough categorization and structuring of context is sufficient. It is important that it is possible to extend the context later on. As a consequence, the context structure should be dynamically extensible.

ANALYSIS AND CONCLUSION

Based on the results of the expert interviews and the evaluation of the categorization models, we propose categories and a structure for categorization context adapted to the specific usage in a service marketplace. It is obvious that the results may be transferred to other application areas for context-aware information systems. The following table includes a proposal for context categories which are derived from the interviews above.

Table 3. Proposal for Context Categories of a Generic Service Marketplace Application

Context Category	Description
Customer Master Data	The category contains all information directly related to the customer of the service marketplace. Mostly, this is an organization that procured several licenses of the application.
Industry	The industry the customer is located in.
Location and Compliance	All information about the location and compliance issues of the customer. Since both points are strongly related, they are in one category.
External Application	The external applications of the customer and the user.
Entry Point to the Service Marketplace	The entry point of the user who entered the marketplace.
Transaction History	The transaction history of the customer and the user.
User Master Data	The specific data of the individual who is logged on to the marketplace. This may include e.g. security preferences, the level of discourse, and other meaningful information.
Business Process Actor	All actors involved in the current business situation of the customer and the user.
Business Process	Information about the current business process that is executed on the marketplace.
Time	Temporal information about the actors or the marketplace itself.
Service	All meaningful information concerning services that can be used to customise the service offers on the marketplace. This may include service histories, service preferences, or the existing services offered on the marketplace. This may require enhancing existing service description languages such as WSDL.

Figure 1 depicts a proposal for a context structure including all of the above context categories. Via *Context Intersection* it is possible to combine them and derive *Service Marketplace Context* for a specific use case. The construct of a context intersection puts multiple context values of different context categories into itself. In so doing, we can generate arbitrary subsets of context values from different context categories.

The findings are – of course – limited to the immediate area of service marketplaces and require further evaluation. However, as it is not possible to determine in advance how the concrete context of a certain service marketplace should look, we set up a context framework and a generic structure. Based on this, we are able to build up the concrete hierarchy for the categories. Consequently, we do not propose a specific hierarchy. That means that every context category can be the subcategory of a superior one and can have multiple subcategories. Only the included categories are selectable. This presumption has more advantages: if the context categories are insufficient, we can extend the framework with more categories. If the user wishes to have a specific subcategory for a context category, it is easily possible to configure the current settings and add this subcategory. Therefore, the structure is designed upon extensibility and flexibility. It would not make sense to design a static system, it ought to be dynamic. Since we attempt to find a meaningful structuring approach

for the context of a service marketplace, context categories are sufficient. Concrete context instances have to be determined individually for every use case of an arbitrary service marketplace.

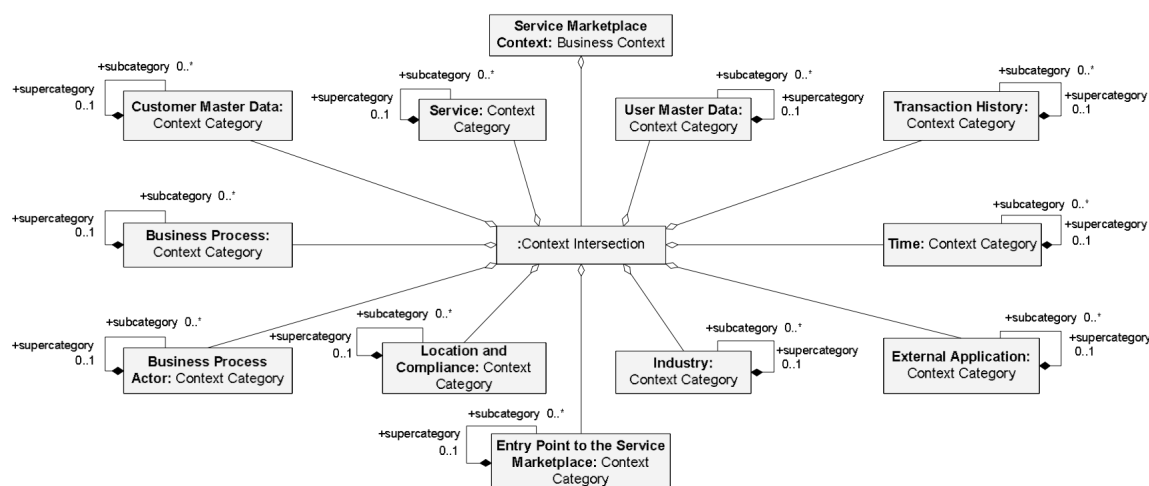


Figure 1: Proposal for a Context Structure of a Generic Service Marketplace Application

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