TOWARDS A CONCEPTUALIZATION OF E-BUSINESS PROJECT KNOWLEDGE

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Abstract

In knowledge management, a conceptualization can be understood as a certain body of formally defined domain knowledge, which represents the content-related foundation of a specific knowledge base. Conceptualizations suitable for the knowledge management in IT projects have hardly been studied to date. This paper therefore demonstrates how a conceptualization of relevant project knowledge can be developed and used. For this purpose, the study exploits the potential of post-project reviews for the extraction of project knowledge concepts. In total, 271 reports from e-business projects are examined in this process. As a result, a conceptualization of e-business project knowledge is thereby developed. In general, this conceptualization expands the understanding of e-business projects. In particular, it represents the content-related foundation for the subsequent development of an appropriate ontology-based knowledge repository, which contributes to the effective knowledge creation and sharing in such complex undertakings.

Keywords: e-business projects, conceptualization, ontology, project knowledge, post-project reviews

1 INTRODUCTION

The success of a project depends greatly on the decisions made in its course, such as in the definition of the project goals, the scope and the budget, in the composition of the project team, or in the selection of technical solutions and external partners (Wateridge 1995). In the context of this decision-making process, however, there is often a lack of awareness and/or ability to learn from the mistakes - or even the successes - of past projects (Barclay & Osei-Bryson 2010). Much too often, relevant lessons from completed projects are not retained and get lost (Disterer 2002; Nelson 2003; Pan & Flynn 2003), or even when respective experiences have been documented, they are simply not taken into account in the planning of new projects (Newell et al. 2006). This ultimately leads to a loss of rich knowledge in project-based organizations (Almeida & Soares 2014; Boh 2007). As a consequence, an additional perspective on project work has been established in the last few years: project knowledge management (see, e.g., Hanisch et al. 2009; or Lech 2014). The objectives here are retaining the experiences from completed projects, creating and structuring relevant project-based knowledge, and making this available for future projects (Hanisch et al. 2009). For this purpose, the concluding reflection on the projects in a formal post-project review (PPR) is an essential process (Anbari et al. 2008; Koners & Goffin 2007; Pan & Flynn 2002; Parnell et al. 2005), which can be defined as "the final formal review in the course of a project that examines any lessons that may be learned and used to the benefit of future projects" (von Zedtwitz 2002, p. 256). PPRs thereby codify relevant lessons learned and secure significant project knowledge in organizational memories (Disterer 2002; Schindler & Eppler 2003). Nevertheless, several empirical studies show that even when the respective knowledge has been retained, it is comparably rarely used for the decision-making processes in future projects (Almeida & Soares 2014; Barclay & Osei-Bryson 2010; Frey et al. 2009; Newell et al. 2006; Reich et al. 2012). Two problems play a central role in this context. First, there seems to be a lack of structure in the often extensive knowledge stocks (Almeida & Soares, 2014). Second, more need-oriented knowledge is required, which could support decision-making processes more effectively (Reich et al. 2012). Against this background, ontology-based knowledge repositories represent an effective means in order to overcome these problems (Staab et al. 2001; Stojanovic et al. 2002; Varma 2007). Ontologies are computational implementations of specific conceptualizations, which are for their part "a body of formally represented knowledge" (Gruber 1993, p. 199). Ontologies thereby enable a structured storage and retrieval of knowledge. However, corresponding conceptualizations suitable for the practical IT project (knowledge) management have hardly been studied to date.

This paper takes up the problems presented and demonstrates how a conceptualization of project knowledge can be developed. For this purpose, the potential of PPRs for the extraction of relevant project knowledge is relied on. The underlying idea is that PPRs contain key experiences (lessons learned) that should be taken into account in future projects, and a structured synthesis of these experiences should therefore reveal representative knowledge concepts to be retained in knowledge repositories. The main focus is in on e-business projects which are particularly complex, since they usually contain fundamental changes to the business model and existing business processes (Kleist 2003; Tiwana & McLean 2003). Due to this complexity, a well-founded project knowledge management system is particularly relevant, since, in general, the following applies: The more complex the project, the more important effective knowledge management is (Disterer 2002). The central research goal of this paper is therefore *to extract a conceptualization of e-business project knowledge on the basis of PPRs.*

A total of 271 e-business project reports will be examined to attain this goal. For this purpose, a qualitative content analysis with established project knowledge categories is used. Meaningful project experiences are extracted and then synthesized into a conceptualization of relevant e-business project knowledge. In general, this conceptualization expands the overall understanding of e-business projects. In particular, it represents a content-related foundation for the development of a concrete ontology-based knowledge database, which for its part can contribute to the effective knowledge management of such complex undertakings.

This paper is structured as follows: Section 2 introduces into the research background. The characteristics of e-business projects are discussed here as well as the basics of project knowledge management. In Section 3, the methodology of this study is outlined. Section 4 presents the results and Section 5 discusses and evaluates these. In Section 6, the implications and limitations are recapitulated.

2 RESEARCH BACKGROUND

2.1 e-Business Project Characteristics

In general, e-business projects are "about re-engineering or redesigning business processes to match customers' expectations in the new economy" (Earl 2000, p. 35). The implementation of e-business technologies therefore often involves higher complexity than common IT projects, since such implementations often imply fundamental changes in the way existing business processes are executed (Kleist 2003). e-business projects have a heavy influence on the business model of a company, which not only includes the opening of new sales channels, but also big changes to the entire value chain (Amit & Zott 2001; Earl 2000). Furthermore, they are technologically and organizationally very complex, since they integrate new intra- and inter-organizational communication channels, which enable collaborative (automated) business processes between several organizations and networks and consequently require a cooperation with multiple stakeholders (Wang et al. 2012).

In light of their complexity, e-business projects also represent a particular challenge for project management (Kleist 2003; van Grembergen & Amelinckx 2002), and it is not uncommon for ambitious e-business projects to fail (McLaughlin 2009; Tiwana & McLean 2003). For this reason, several researchers have studied the special characteristics of such projects and provide insights into their particular success factors (see Gengatharen & Standing 2005; Ho & Lin 2004; Krasner 2000; McLaughlin 2009; Nah et al. 2001; Phan 2002; van Grembergen & Amelinckx 2002). The following characteristics of e-business projects were repeatedly identified (see also Table 3 in Section 5):

- e-business projects often severely change the business model of a company and therefore must be founded by a reasoned e-business strategy.
- e-business projects usually have a strong influence on customers and therefore require pronounced customer orientation for their conception and implementation.
- e-business projects contain significant changes to business processes and the way employees work. This means effective change management and targeted development of new employee skills (e.g., ICT skills) are necessary.
- e-business projects contain a large potential for innovation and therefore require a competent, interdisciplinary project team which not only has technical skills, but also a marked understanding of business, organization, and customer requirements.
- e-business projects often create intra- and inter-organizational networks with several stakeholders and necessitate an effective organization of these collaborations.

This paper aims to expand the understanding of e-business projects through the analysis of a large number of practical project reports. This has not yet been done in this form for e-business projects.

2.2 Project Knowledge Management and Ontology-Based Knowledge Repositories

IT projects are generally very knowledge intensive (Reich et al. 2012; Reich et al. 2008). In the course of such projects, innovative and highly-valuable knowledge for a project-based organization (PBO) is regularly generated (Boh 2007), for example, in regard to new business processes, technologies, business transactions, or cooperation experiences. This knowledge offers the basis for a continuously learning PBO and represents a significant part of its intellectual property (Almeida & Soares 2014). Consequently, a new project goal has been established in addition to traditional project goals (costs, time, and functionality): the effective retention of project-based knowledge (Hanisch et al. 2009; Lech 2014). This is the field of the respective project knowledge management (PKM), which "is knowledge management in project situations and thus the link between the principles of knowledge management and project management" (Hanisch et al. 2009, p. 149). The PKM creates relevant project knowledge and saves it in organizational knowledge repositories, structures it, combines it, disseminates it, and makes it ultimately available for future projects (Hanisch et al. 2009; Lech 2014). In this way, PKM reduces the risk of repeating past mistakes and improves access to existing approaches, thus avoiding the tendency ˈto reinvent the wheelˈ in future projects (Parnell et al. 2005). Several empirical studies were able to validate that a corresponding knowledge transfer across projects has a significant positive influence on project success (see, e.g., Chang et al. 2013; Hong et al. 2008; Koners & Goffin 2007).

The nature of IT-project-based knowledge has already been examined by several researchers (see Chan & Rosemann 2001; Kang & Hahn 2009; Reich et al. 2012; Reich et al. 2008). Although the respective classifications of the individual researchers involve different interpretations to a certain degree, the various facets of project knowledge can be grouped into comparable categories. This paper uses a summary from Zhao and Zuo (2011) which correspondingly divides project knowledge into the fife categories presented in Table 1: *Business Domain Knowledge*, *Project Product Knowledge*, *Project Engineering (Technical) Knowledge*, *Organization Management Knowledge,* and *Project Management Knowledge*. These categories will play a central role in the following study (see Section 3.3) and provide a structure for the coding of project experiences.

	Business Domain Knowledge	**Project Product Knowledge**	**Project Engineering (Technical) Knowledge**	**Organization Management Knowledge**	**Project Management Knowledge**
Question	What lessons can be drawn from a business domain perspective?	What lessons can be drawn with regard to the e-business innovation itself?	What lessons can be drawn from a technical perspective?	What lessons can be drawn with regard to the management of organizations?	What lessons can be drawn with regard to the management e-business projects?
Description	Refers to knowledge about a company´s business context (e.g., industry specifics, business processes, employees)	Refers to knowledge on how to select, develop, implement, or operate a specific e-business solution (e.g., system customizations)	Refers to knowledge about the technical characteristics of an e-business technology implementation (e.g., data migration)	Refers to knowledge on how to coordinate the various stakeholders involved in complex e-business endeavors (e.g., relationship management)	Refers to knowledge on how to conceptualize, plan, coordinate, measure, and manage e-business projects (e.g., project team composition)

Table 1. Classification of project knowledge (cf. Zhao & Zuo 2011, p. 268)

Common project management guidelines, such as the Project Management Institute's PMBoK and the PRINCE2 framework, generally emphasize the relevance of historical project knowledge for future projects (see PMI 2008; OGC 2009). In this context, post-project reviews (PPRs) are an important means for reflecting on experiences collected in a project (Anbari et al. 2008; Disterer 2002; Nelson 2003; Pan & Flynn 2002). By definition, a PPR has the objective of identifying and codifying project-based knowledge - especially the lessons learned (LL) - and thereby retaining them for subsequent projects. In this way, they represent a link between individual or project team learning and organizational learning (von Zedtwitz 2002). The LL to be identified stand for "key project experiences which have a certain general business relevance for future projects. They have been validated by a project team and represent a consensus on a key insight that should be considered in future projects" (Schindler & Eppler 2003, p. 220). Their codification in PPRs is executed in particular in textual descriptions, which, in contrast to numerical dimensions, can not only express the questions of "what", "where" and "how many", but also of "how", "why" and "with what effect" (Schindler & Eppler 2003). Nevertheless, at the same time this unstructured textual form makes the consistent creation as well as the structured storing and retrieval of comprehensive knowledge stocks much more difficult (Almeida & Soares 2014; Newell et al. 2006; Pan & Flynn 2003).

Ontology-based knowledge management systems represent an effective means for structuring large (textual) knowledge repositories and thus for searching and ultimately reusing knowledge (Stojanovic et al. 2002; Varma 2007). An ontology can be defined as "an explicit specification of a conceptualization" (Gruber, 1993, p. 199). This means, in essence, that ontologies define "a set of representational primitives with which to model a domain of knowledge or discourse" (Gruber 2009). Put simply: ontologies represent content-specific agreements for creating, storing, and sharing knowledge in computational form (Gruber 1993; Studer et al. 1998). In this context, a "conceptualization" can be understood as "an abstract, simplified view of the world that we wish to represent for some purpose. Every knowledge base […] is committed to some conceptualization, explicitly or implicitly" (Gruper, 1993 p. 199). This implicates that before a concrete ontology can be (technically) implemented, such an abstract, simplified concept of the desired knowledge has to be created (see Almeida & Barbosa 2009). This is usually done by representing the domain of knowledge in basic taxonomies (Staab et al. 2001; Studer et al. 1998). In the context of PKM, practical conceptualizations of project knowledge are relatively rare. In the following, this paper will develop a conceptualization (i.e. taxonomy) for the knowledge involved in e-business projects.

3 METHODOLOGY

3.1 Research Strategy

The development of conceptualizations is usually a manual process in which the key concepts and relationships in the domain of interest need to be identified (Uschold & King 1995; see also Staab et al. 2001; Studer et al. 1998). For example, Almeida and Barbosa (2009) used surveys and interviews in order to determine relevant key knowledge concepts for a Brazilian energy utility. In general, these key concepts should reflect a certain grade of agreement about the knowledge in the domain and furthermore require a precise textual definition of their meaning and content.

The following study is based on the idea that LL from practical projects can be used for the development of a representative conceptualization of project knowledge. LL represent key experiences that should be considered in future projects (according to Schindler & Eppler 2003) and a synthesis of LL should therefore uncover relevant knowledge concepts to be retained in knowledge repositories.

3.2 Data Collection

This study uses a purposive sample of 271 PPRs from e-business projects. A purposive sample (see Krippendorff 2013) stands for data collections which are purposively compiled by researchers for a very specific analytical goal (= extraction of LL from e-business projects). The 271 PPRs used here originate from a collection by the *Sectoral e-Business Watch* initiative[1]. This initiative studied the influence of ICT and e-business on companies, industries, and economies. In the course of the study, one of the most extensive collections of e-business project reports was compiled. The reports come from the time period of 2004 to 2009 and are publicly accessible as downloads in PDF format. They mainly contain textual descriptions and usually vary between 4-13 pages. The report contents can be regarded as reliable evidence since the reports follow a largely uniform structure and the quality of the documents has been assured by the initiative.

3.3 Data Analysis

This paper is an exploratory study whose aim is to extract LL in order to develop a conceptualization of project knowledge for e-business projects. Although common project management frameworks, such as the Project Management Institute's PMBoK and PRINCE2, emphasize the importance of reusing and analyzing historical LL, hardly any concrete methodological guidance is provided in this respect. The PRINCE2 framework, for example, recommends creating a "lessons log" on the basis of historical project experiences, but does not provide any details on how exactly this can be done. In order to overcome this lack of guidance, a textual analysis approach is used which is based on a qualitative content analysis (see Mayring 2000) and is expanded for the systematic extraction of LL from PPRs with suggestions from Schalken et al. (2006). Figure 1 summarizes the analysis process.

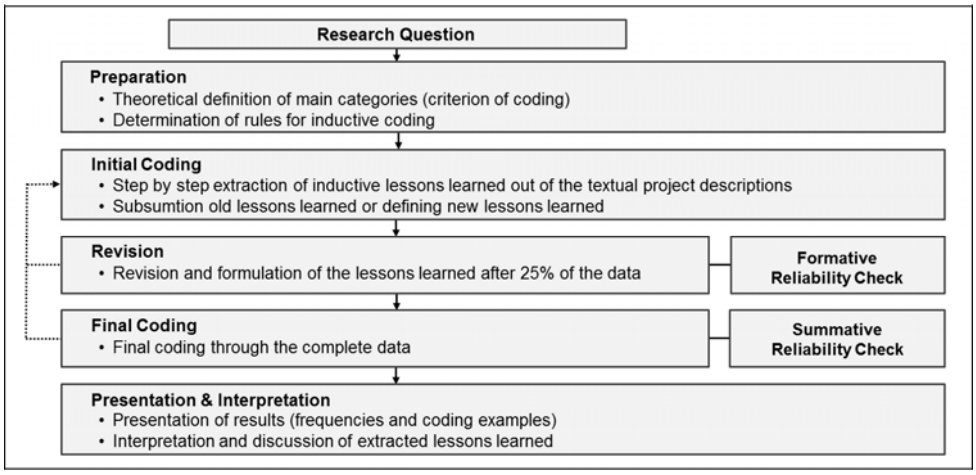

Figure 1. Analytical process of inductive lessons learned extraction (cf. Mayring 2000)

[1] See http://ec.europa.eu/enterprise/archives/e-business-watch/ for a presentation of the initiative.

The analysis extracts relevant LL in an inductive process from a qualitative database. The textual descriptions of the PPRs are read, relevant statements are extracted, and occurring regularities are formulated as relevant lessons. The advantage of this method is that the underlying material speaks for itself and the output of the analysis is not limited by predefined content or restricted variables. It is therefore an open and much more data-driven approach than, for example, surveys. Of course, the reading, interpretation, and formulation of LL are subjective and influenced by the researcher to a certain degree. For this reason, reliability checks of the coding procedure are considered.

The analysis process of this study (see Figure 1) will now be illustrated in more detail:

- *Research question*: The research process began by defining the research question and the objectives of the planned study (see Section 1).
- *Preparation*: Then the foundation for the inductive extraction of LL was laid. On one hand, the analytical framework of the study was derived from relevant literature (as suggested by Krippendorff 2013). In doing so, the project knowledge categories presented in Section 2.2 were used. These categories describe the content-related structure of the analysis and gave the coding procedure an expedient direction. On the other hand, coding rules were formulated. For coding, LL were defined as statements about factors which, in retrospect, had an influence (positive or negative) on the project success and are therefore relevant for future projects (according to Schindler & Eppler 2003). Accordingly, only such sections were examined which contained concluding discussions of project experiences. Irrelevant chapters, such as company presentations or product descriptions, were not considered during coding. In addition, LL of the same type were counted only once per report so that repeated lessons in the same document were not counted twice. The respective coding was executed in parallel by two independent coders (by one of the authors and by a trained research assistant) for later reliability tests.
- *Initial coding*: In the coding process, the textual descriptions of the PPRs were read manually and relevant statements about LL were identified. These statements were assigned to the appropriate project knowledge category and formulated in key knowledge concepts. An exemplary statement to illustrate this process: "Moreover, this application has been developed with the purpose of satisfying both customers' requirements and internal users' requirements. […] This aspect is a fundamental precondition in order to integrate a new application in the company's management system […]" (project #7, consumer goods sector). This sentence clearly refers to the orientation of the e-business application on customer and user requirements and was therefore assigned to the category *Project Product Knowledge*. The key knowledge concepts expressed in this statement was formulated as *Customer & User Orientation*. Comparable statements were subsumed under of this concept in the following, or deviating statements were formulated in potential new concepts.
- *Revision*: After coding approximately 25% of the PPRs (65), the previously detected knowledge concepts were viewed, revised, and precisely formulated. In addition, coding examples were assigned to the concepts, which served as assistance in the following coding process. In general, it was a challenge to objectively judge relevant statements about LL and separate them from irrelevant statements. For this reason, manual coding always involves certain reliability concerns. In order to estimate the reliability of the coding, a reliability check was performed in the scope of a (formative) revision. The results of the two different coders were compared for this purpose. The inter-coder reliability was examined using Cohen's kappa coefficients (Cohen 1960), which resulted in an acceptable reliability level of 0.79 (Landis & Koch 1977). In the event of a less satisfactory reliability, a specification of the coding rules (preparation phase) would have been recommendable (Mayring 2000). The occurred differences were then discussed and the concepts revised anew.
- *Final coding*: Based on the now precisely formulated concepts, the remaining 75% of the PPRs were analyzed. In the course of the coding, five new concepts were identified. To ensure that these five concepts were not overlooked in the first 25% of the PPRs, they were examined again in an iterative process. After finalizing the complete coding, a final (summative) reality check was performed.
- *Presentation & interpretation*: The key knowledge concepts brought to light were then summarized with their respective frequencies and coding examples (Section 4). The interpretation of the concepts was supported by a linked comparison with the common e-business project characteristics known from literature (see Section 5). The validity of the concepts in particular was estimated in this way.

4 RESULTS

The results of the content analysis are presented in this section. Through the coding of the 271 PPRs, a total of 1271 relevant statements (LL) were identified (mean: 4.69 per report). These were then aggregated to 25 key knowledge concepts and assigned to the suitable project knowledge categories (see Table 2). The resulting taxonomy represents the targeted conceptualization of e-business project knowledge. As mentioned before, its specific concepts should reflect a certain agreement and require a precise description of their meaning. In the following, the underlying key knowledge concepts and their respective LL are therefore introduced, whereby reference is made to their frequencies and exemplary statements from the project reports. Nevertheless, the specific concepts can only be briefly addressed due to the limited scope of this paper.

Project Knowledge Categories	Key Knowledge Concepts	Frequency
Business Domain Knowledge	**Knowledge regarding…**	**310**
	… Strategic Alignment	68
	… Business Process Reengineering	63
	… Standardization	45
	… Organizational Culture & E-Business Readiness	42
	… Reliance on Traditional Business Channels	34
	… Firm Size	24
	… Top Management Support	17
	… Legal Implications	17
Project Product Knowledge	**Knowledge regarding…**	**351**
	… Customer & User Orientation	177
	… System Development & Selection	75
	… System Integration	61
	… Continuous Improvement & Extension	38
Project Engineering (Technical) Knowledge	**Knowledge regarding…**	**142**
	… Data Management	56
	… Technical Implementation & Testing	54
	… Related Business & Legacy Systems	20
	… IT-Infrastructure	12
Organization Management Knowledge	**Knowledge regarding…**	**209**
	… Collaboration	81
	… Effective Communication & Trustworthiness	77
	… Convincement & Commitment	37
	… Regional Profiles	14
Project Management Knowledge	**Knowledge regarding…**	**259**
	… Change Management	85
	… Project Team Competencies & Composition	59
	… Project Conceptualization & Planning	57
	… Performance Measurement & Management	32
	… Project Knowledge Management	26

Table 2. A conceptualization of e-business project knowledge

Business Domain Knowledge:
e-business projects often represent a fundamental intervention into the business models from companies (Amit & Zott 2001). Such innovations should therefore not be executed prematurely and require consistent adjustment to the company strategy and the envisaged objectives. Accordingly, the importance of a clear s*trategy alignment* is often named in hindsight as a lesson in the PPRs (68 mentions). This statement provides an apt example:

> *"The lesson learnt […] is that over-confidence, poor management decision and strategic mistakes contributed to the failure of an enterprise that started with great ambitions."* (project #105, logistics)

Comprehensive *business process reengineering* is a regular consequence of e-business innovations (Earl 2000). A total of 63 companies learned that they underestimated the necessary process changes, or realized the necessity of changes too late, i.e., during or after the project:

"The biggest challenge […] was to modify the organization of most activities. The new system covered design, production and testing activities at the same time. Before, everything had its order and activities were performed successively, i.e. first designing, then production and, at the end, testing. Thus, we had to change completely the way the company operates internally and how it cooperates with its partners." (project #21, aeronautics)

A regularly discussed lesson was the problem of *standardization* (45 mentions). In addition to standardization of internal work processes, this challenge refers especially to inter-organizational aspects (e.g., communication and data-exchange with external business partners), since e-business systems often integrate collaborative networks and business processes with several organizations and information systems (Wang et al. 2012). An exemplary statement:

> *"[…] it was realised that the development of industry-wide standards was a prerequisite for a smooth integration of the industry supply chain."* (project #135, aeronautics)

Several e-business projects were confronted with resistance within their own organizations (42 mentions). Convincing employees of the advantages of the innovations and dispelling their fear of new technologies has therefore proven to be a challenge. This can be traced back to the *organizational culture* and lack of *e-business readiness* (see, e.g., Jackson & Harris 2003). The following statement provides insight into these problems:

> *"Both cases show that there is no well-grounded IT culture within both companies that would facilitate the implementation of the increasingly complex ICT systems, despite their overall commitment to use of advanced manufacturing technologies and steady improvement of the service quality."* (project #216, telecommunication)

Although the use of e-business applications was emphasized, the complete changeover to automated processes was often refused in particular in contact with customers. Accordingly, the continued *reliance on traditional business channels* was regularly discussed (34 mentions):

> *"[…] the effects of ICT-based, automated customer relationship were overestimated while, at the same time, the relevance of personal customer interaction was underestimated."* (project #155, tourism)

The *firm size* is an aspect often addressed in e-business literature (see, e.g., Taylor & Murphy 2004; OECD 2005). Companies of different sizes understandably have different goals and motivations, but also different knowledge bases, resources, and innovative potentials. Therefore, influences of firm size were also a lesson addressed repeatedly in the PPRs (24 mentions):

> *"However, special attention has to be paid to the size of the firms, their various needs and place in the supply chains. […] There is no single formula for delivering and implementing a successful e-business strategy and that it can vary quite significantly within the same sector."* (project #136, automotive)

Since fundamental changes of the business model and the business processes often accompany e-business projects, full *top management support* (17 mentions) is essential (see also Nah et al. 2001). This includes, for instance, the provision of sufficient employee capacities and financial means, or also support in the making of decisions:

> *"Leadership support is paramount to the success of such a large-scale project. […] the support of the leadership was vital because it could provide additional pressure on suppliers to accept the developed e-commerce solution."* (project #232, retail)

The consideration of *legal implications*, e.g., in reference to data security (data exchange and storage), was discussed repeatedly as a relevant (industry-specific) factor (17 mentions):

> *"The process of system integration within the hospital and with other institutions […] is hampered by a lack of clear state regulation about electronic data storage and exchange as well as a lack of standards for exchanging medical information."* (project #180, healthcare)

Project Product Knowledge:

One of the most central lessons refers to a consistent *customer & user orientation*, since the success of e-business innovations depends heavily on the acceptance of customers or internal users (see, e.g., Rotondaro 2002). To ensure this, consistent orientation on their needs (e.g., usability, security, and safety) and the early integration of the customers/users in the development process was regularly discussed as a lesson (177 mentions):

> *"It was very important while introducing the systems to handle matters from a user's point of view, not from a technical point of view."* (project #99, consumer services)

A central discussion in the PPRs centered around lessons in the context of *system development & selection* (75 mentions). On the one hand, this was about the technical requirements on e-business systems, and on the other hand, it was about the respective costs, the related make-or-buy decision as well as the selection of suitable IT vendors. These aspects were discussed in an entirely heterogeneous manner, often depending on the respective company strategy. The following statements provide insight into the diverse discussions:

> *"The company also estimates to have saved on costs, compared to the purchasing of a standard market solution which would have needed customisation anyway. According to YOOX's IT manager, full control of all technologies supporting the company's core activities is considered as a point of strength."* (project #80, textile)

> *"An important factor that decided about the success of the project was that TBB partnered with a technology provider who was able to provide it with a solution appropriate for their particular technology problem. In spite of the challenge of building a new facility with new and evolving technology, the company also provided substantial support to the development activities."* (project #125, automotive)

An oft-addressed problem is the *system integration* into existing system landscapes (61 mentions). Special attention was given to the question of which existing systems are to be integrated into the e-business system, or which maybe should be replaced, and which implications these decisions will have. Furthermore, the decision of the scope of integration is significant (use in individual companies or in a large cooperation). An exemplary statement:

> *"All these factors make the implementation process of this e-business system a very complex process, as they add more and more applications to the main core system. Given the complexity of the system the average learning time to use the system is 4 months."* (project #50, logistics)

e-business projects are often particularly innovative - and this innovativeness must continuously be retained. Companies repeatedly emphasize (38 mentions) the lesson that e-business projects do not end after implementing the system, but that the systems must be continuously developed and expanded (*continuous improvement & extension*), i.e. they must also be designed for this:

> *"The creative use of IT systems does not end once it is implemented, but it actually starts there. Re-discovering the system's functionalities and deploying them in a new context guarantees an efficient use of the applications."* (project #203, chemicals)

Project Engineering (Technical) Knowledge:

Challenges in *data management* were a regularly discussed lesson (56 mentions). On the one hand, the often challenging migration and distribution of existing data was often discussed, and on the other, challenges in the collection and use of the large amount of new data made available by the e-business application was addressed:

> *"another key difficulty was to deal with data migration from the old to the new application."* (project #25, telecommunication)

> *"[…] it is particularly important to consider the quality of information provided through e-services. A company investing in such a system should analyse precisely the different data creation processes and the quality of data produced."* (project #257, logistics)

The introduction of e-business innovations is a complex technical challenge with high potential for mistakes, since several systems and networks are often involved at one time (Wang et al. 2012). In the framework of *technical implementation and testing*, a careful, well-planned approach is therefore often recommended (54 mentions). This includes piloting, testing, and troubleshooting (see also Nah et al. 2001). A piloting can be done to determine what the systems can and cannot do, without significant failures occurring or customers being affected:

> *"The most significant lesson to be learned [...] was the approach of a step by step implementation. This process has made it possible to analyse the requirements of micro business areas within the involved departments (order processing, invoicing, etc.) each time, collecting the specific requirements of the staff, solving their problems and training human resources to reorganise their workflows."* (project #212, consumer goods)

Existing information systems (e.g., ERP systems) provide the technical (data) basis for the implementation of e-business and ICT technologies (Wang et al. 2012). Accordingly, the role of well-organized *related business & legacy systems* was addressed as a lesson in several PPRs (20 mentions):

"A company has to make sure it has a well-organized system in place where all the relevant business data are seamlessly linked, before it can build applications and services upon this basis. If you don't have such a system in place, it will inevitably be a nightmare." (project #87, industrial goods)

The existence of the necessary expandable *ICT infrastructure* - on the company and customer side - was a subject of discussion as an additional technical prerequisite (12 mentions):

"The presence of partners who do not have a minimum infrastructure sufficient for participation in a process such as this one." (project #69, consumer goods)

Organization Management Knowledge:

e-business creates and connects networks along the entire value chain (Amit & Zott 2001). Accordingly, the effective *collaboration* (e.g., with customers, suppliers, or other business partners) was often highlighted as a crucial element for project success (81mentions):

"More importantly, people had a very significant role in the assessment of the situation and in the implementation of the system: a close collaboration was established among all the people involved in the supply chain." (project #2, consumer goods).

For the coordination of the many involved partners, the importance of effective and transparent communication as well as an authentic, professional, and trustworthy appearance was often (77 mentions) emphasized (*effective communication & trustworthiness*). In doing so, in particular the comprehensible distribution of the advantages as well as success stories was addressed as important aspect:

"A lack of well-known success story in the ICT implementation may explain the reticence of the decision makers. A better understanding is needed about the impact of ICT on the company's efficiency and competitiveness, which would encourage the management to see the long-term results as equally valuable, if not more sustainable." (project #21, consumer services)

Inter-organizational e-business projects live from the active and reliable involvement of many stakeholders (e.g., suppliers or research networks). The companies repeatedly report (37 mentions) that it is often a challenge to persuade the many participants of binding involvement and achieve a contractual commitment in an ideal case (*convincement & commitment*):

"The main problem that arose was the reliance on third parties to fulfil their integration tasks in a set time frame. As there was no formal contractual agreement between each party with regard to the e-business project, the project time lines and milestones often slipped." (project #82, industrial goods)

The consideration of *regional profiles* (e.g., geographical, cultural, legal) is a lesson discussed in the implementation and management of international networks (14 mentions):

"The local needs, coming from both specific organizational habits and local law constraints in a variety of nations, had to be harmonized." (project #248, industrial goods)

"Because of linking international network of different businesses across the world, another important experience was mentioned by the company representative: learning about cultural differences and becoming sensitive about them." (project #99, industrial services)

Project Management Knowledge:

One of the most frequent LL is that the importance - and the time and effort - of *change management* cannot be underestimated in the context of e-business projects (85 mentions). It requires a lot of time to create the acceptance of the often profound changes and also to train the employees for their changing tasks (see, e.g., McLaughlin 2009):

"One of the major success factors of a project like this is to correctly address the change management aspect, as staff is directly affected in their way of working and organizational activities are heavily impacted." (project #54, utilities)

The aspects of *project team competencies & composition* were regularly discussed (59 mentions). On the one hand, the importance of interdisciplinary project teams was addressed, which should not only have technical skills, but also business and organizational knowledge. On the other hand, it has also been discovered that the integration of external expertise can be very fruitful (e.g., from consultants or external business partners):

"Quality and expertise of the principal multi-disciplinary teams in dealing with all the dimensions of the investment needs to be ensured." (project #180, healthcare)

"[…] it might have been beneficial to hire an external consultant to analyse the existing process model and the to-be model together with the developer team." (project #254, logistics)

Many companies underestimated the relevance of detailed *project conceptualization & planning* in the course of e-business projects (57 mentions). Such complex and highly innovative endeavors require early visualization of what the project, i.e. the e-business integration, is to achieve - and what is not to be achieved. This includes the exact definition of project goals, the scope of the project and detailed planning of project implementation. Otherwise, elaborate interruptions to the course of the project are probable. In this context, the underestimation of accruing costs is often discussed. Many projects have exceeded their originally planned budget, and this is often due less to scalable technical components, but more to "soft" aspects such as employee training or organizational coordination with partners:

"It is important to highlight that the most challenging part of this project was the organisation and management of the project and not the technical or financial parts of the project." (project #254, logistics)

"However, considering that we had to start from scratch, the main cost was caused by the lack of knowledge and expertise. […] Today, with this knowledge we could definitely carry out a similar project without spending so much resources." (project #38, chemicals)

The measurement of e-business projects is a difficult endeavor (see van Grembergen & Amelinckx 2002). Several PPRs emphasize that meaningful measures must first be found which are necessary to enable planning, evaluation, and continuously management of the project's progress. Accordingly, *performance measurement & management* is a regularly discussed lesson in this context (32 mentions):

"The main lesson learned from this case is probably the need to carefully measure the impact." (project #253, utilities)

Many companies enter new technological territory with e-business projects, which is why a lot of new knowledge was created or brought to the company by external parties (e.g., vendors or consultancies). Furthermore, the employees acquired a considerable amount of new skills (e.g., ICT skills). The relevance of *project knowledge management* was therefore regularly emphasized (26 mentions). Only in this way can the new know-how (e.g., in reference to new business processes, work descriptions, or systems) be secured for future operations and be transferred permanently to the organizational memory:

"Employees' informal know-how will be integrated and valued in the new organisation as much as possible." (project #137, aeronautics)

"[…] with this knowledge we could definitely carry out a similar project without spending so much resources." (project #38, chemicals)

5 DISCUSSION

The following discussion considers two different perspectives of the presented study: a content-related and a methodological perspective. From the content-related perspective, it can generally be determined that the qualitative analysis of the PPRs could reveal relevant knowledge for the initial development of key knowledge concepts. It also appears that these concepts go beyond general project characteristics (such as described in, e.g., the PMBoK guide), since several e-business-specific issues have been extracted (e.g., organizational culture & e-business readiness). In a comparison with the literature which discusses common characteristics of e-business projects (see Table 3), two things become clear. First, all concepts extracted in this study can be confirmed by the literature, or at least by specific articles. This confirms the validity of the knowledge concepts and the LL respectively. Therefore, it can be said that the intended focus on e-business project knowledge has generally been achieved. Second, the key knowledge concepts extracted in this study represent one of the most comprehensive compilation of insights into e-business projects. For example, the concepts regarding to legal implications, regional profiles, or project knowledge management have only been discussed in single articles. Especially the relatively wide scope of the five underlying project knowledge categories contributed to this comprehensiveness. This thereby underlines the potential of PPRs as a rich source of information for the profound extraction of project knowledge.

	Matching with e-Business Project Characteristics from the Literature						
Key Knowledge Concepts from PPRs	Nah et al. (2001)	Gengatharen & Standing (2005)	Phan (2002)	Van Grembergen & Amelinckx (2002)	Ho & Lin (2004)	Krasner (2000)	McLaughlin (2009)
Business Domain Knowledge							
Strategic Alignment	X	X	X	X	X	X	X
Business Process Reengineering	X			X	X		X
Standardization		X				X	
Orga., Culture & Readiness for Change	X	X	X	X	X	X	X
Reliance on Traditional Business Channels							
Firm Size		X					
Top Management Support	X	X	X	X	X	X	X
Legal Implications		X					
Project Product Knowledge							
Customer & User Orientation	X	X	X	X	X	X	X
System Development & Selection	X	X	X	X	X	X	X
System Integration	X		X		X	X	X
Continuous Improvement & Extension			X	X	X	X	
Project Eng. (Technical) Knowledge							
Data Management	X			X	X	X	
Technical Implementation & Testing	X	X		X	X	X	
Related Business & Legacy Systems	X				X	X	
IT-Infrastructure		X	X		X		X
Organization Management Knowledge							
Collaboration		X	X	X	X		X
Effective Communication & Trustworthiness	X	X	X				X
Convincement & Commitment		X			X		X
Regional Profiles		X					
Project Management Knowledge							
Change Management	X	X	X	X	X	X	X
Project Team Competencies & Composition	X	X		X	X	X	X
Project Conceptualization & Planning	X		X	X	X	X	X
Performance Measurement & Management	X			X	X		X
Project Knowledge Management				X			

Table 3. Comparison of the taxonomy with e-business project characteristics from the literature

From a methodological perspective, one could say that the qualitative content analysis for the inductive extraction of knowledge is effective and has proved to be sufficiently reliable. The approach is therefore applicable for the initial development of knowledge conceptualizations. Despite the effectiveness, however, the efficiency of this analytical approach is limited. The manual analysis of the total of 271 PPRs was done by two analysts (for the purpose of a reliability test) and took a considerable amount of time. Consequently, such manual analyses are limited if the document collections are very extensive.

6 CONCLUSIONS AND OUTLOOK

This paper argues that key project experiences (LL) from PPRs can be used for the discovery of project knowledge conceptualizations. In the course of this study, the richness of PPRs for the extraction of project knowledge was demonstrated and a conceptualization of e-business project knowledge was developed. This has not yet been done in this form for project knowledge management. In summary, this study makes two contributions in this context: (1) The conceptualization expands the general understanding of e-business projects. (2) The conceptualization represents the content-related foundation for the subsequent development of appropriate ontology-based knowledge repositories, which enable an effective knowledge management in such complex undertakings.

Before the proposed conceptualization can be used for storing and sharing knowledge, all the domain-specific knowledge needs to be explicitly modeled in respective ontology-based databases, which for their part enable a structured storage and retrieval in computational form. In the course of a follow-up project, the proposed conceptualization will therefore be used for the subsequent development of such a detailed ontology, which is able to reflect the taxonomy in knowledge management systems. In particular, this means that it has to be implemented in a formal or computer language (see Studer et al. 1998).

This paper offers some potential implications for practice. First, the conceptualization can be used as a general content-related guideline in order to reflect and codify future projects in a more focused manner (e.g., in the framework of a PPR). In addition, the extracted key project experiences provide concrete

hints for the planning and execution of future e-business projects. Furthermore, from a methodological perspective, the illustrated process of a qualitative content analysis has proven effective and provides instructions for the analysis of (textual) project reports. Companies could adapt this process in order to extract their own project experiences in different project environments (e.g., specific software development projects).

Implications for research arise in particular for further work with the proposed conceptualization. At this point, the analysis covered the initial identification of key knowledge concepts. These concepts need to be further defined, developed, and refined in further analyses (i.e., through a selective coding process in the sense of grounded theory; see Strauss & Corbin 1990). This also implies that the deeper nature and especially the relationships of these concepts need to be explored in order to create a consistent storyline of e-business projects. Therefore, future research could evaluate the proposed taxonomy through a review by experts (e.g., by using a Delphi study), through a repeated coding of other suitable data sets, or through practical implementations in real project environments. Gruber (1995) proposes five specific criteria (clarity, coherence, extendibility, encoding bias, and commitment) particularly well suited for the evaluation of ontologies and their underlying conceptualizations.

This study is of course not without limitations. First, the limitations of PPRs as a source of knowledge must be mentioned. PPRs do not always have to represent an objective or complete illustration of the real project. For example, relevant lessons, particularly mistakes, may be deliberately held back by the team members due to worries of negative sanctions (see Cheng et al. 2009). Second, the purposive sample with 271 PPRs surely only represents an excerpt of all e-business projects done in practice. Nevertheless, this study used a database with one of the most extensive collections of respective project reports available. Third, the comparably low page number of individual PPRs could be seen as a disadvantage. However, the uniform content structure as well as the general evaluation by the initiative should ensure a representative and trustworthy description of project experiences. Fourth, manual content analyses always involve certain reliability concerns. The identification of LL is therefore dependent to a certain degree on the care and subjective interpretation of the analysts. The execution of reliability checks, which indicate an acceptable reliability, should alleviate this concern. Fifth, in this paper, especially due to the limited scope, it was only possible to present the key knowledge concepts very briefly. Future research papers will therefore discuss the statements of the concepts more intensively.

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