Abstract

Outsourcing of software development tasks has become a major issue for large software enterprises over the last decades. Nowadays, small and medium-sized enterprises (SMEs) follow this trend and outsource parts of their software development as well. However, most of the existing literature deals with large enterprises whereas the situation of SMEs is being neglected. Especially sourcing decisions and the organizational as well as operational setup may differ between large enterprises and SMEs. We choose an exploratory multiple-case study approach focusing on the German software market in order to shed light on these aspects of the sourcing behavior of SMEs. This paper addresses three complementing research questions. Besides the question of which phases of the software development process qualify for outsourcing, we explore the organizational setup of SMEs’ outsourcing scenarios. In addition, we seek to find out which characteristics a software component has to fulfill in order to qualify for outsourcing.

1. Introduction

As Information Technology (IT) outsourcing has become a major issue for software developing enterprises over the last decades, many facets of software outsourcing have been researched in several theoretical and empirical studies [1, 10, 11, 15, 28]. Not only economic benefits such as low labor costs in developing countries or cheap infrastructural costs but also the availability of a highly skilled resource pool for a dynamic hiring process of employees are drivers for the trend towards outsourcing [24, 25]. Furthermore, software enterprises also attempt to benefit from changing software development techniques like ‘follow the sun’ software development and faster release cycles [6]. In addition, less governmental control in many developing countries leverages the hiring and firing mentality for dynamic resource planning [34]. This led to an evolution of a number of different outsourcing arrangements with different actors involved. Initially, large software enterprises established captive offshoring centers with own developers in low-wage countries in Asia. After a while, offshore centers lost their captive role and, thus, offered their services to third-party enterprises in order to achieve economies of scale and scope [23, 30]. Moreover, additional arrangements of information technology outsourcing have been established in the last years. Initially, outsourcing comprised the externalization of the entire IT unit(s) to external vendors, including the transfer of human assets and physical assets [2, 3]. Later, the focus of IT outsourcing has shifted to selective outsourcing which focuses on specific activities in the software development and deployment life cycle as well as business process outsourcing [16, 27, 29]. Thus, shoring of software activities [9] has become an option for a larger number of software enterprises and lately also for small and medium-sized enterprises (SMEs).

Especially in Germany, SMEs play a vital role in the national economy and represent the largest part of the enterprises in terms of employees and total revenue. Since a lot of these enterprises have a long tradition and are mainly run by their owners, the decision processes ought to be different to the management of large market-listed enterprises. The responsibility as director of a family enterprise can impact the decision making heavily by influencing emotions, for instance. Therefore, SMEs should not be neglected in outsourcing research. Also, the business type of German SMEs serves as a role model for enterprises all over the world, since their successful character is historically proven by their fruitful evolution within the German economy [4].

As indicated, there are numerous benefits that can come along with outsourcing. There are also several pitfalls of outsourcing software development functions. To name some of them, geographical and spatial distances can be counterproductive in software engineering (SE) due to its highly creative and reciprocal character. Lacking communication due to linguistic dis-
tances as well as cultural distance are further difficulties in outsourcing scenarios [18, 20, 37]. Numerous studies have already explored the benefits and drawbacks of outsourcing partnerships [6, 20, 28]. Existing research mainly discusses outsourcing topics from an organizational perspective. For example, extra costs or supplier selection are topics that involve organizational principles like the resource-based view of a firm or transaction-cost economics [12].

However, only few studies have researched the operational character of IT outsourcing in application development scenarios. Lacity et al. provide an overview of practical research articles discussing issues such as strategy, risks, success determinants, and capabilities [27]. They show that the practitioners have already been provided with several studies, mainly on a strategic level. Additionally, the decision making in IT projects is up to now only considered as part of the organizational strategy when setting up an outsourcing relationship. For this reason, decision making was generally researched when the ‘make or buy’ question arose before project beginning [32, 36]. However, in our study we have observed that the decision making in SMEs is influenced by multifaceted factors which in general can be determined during the project runtime at the earliest.

Little research regarding the properties and contingencies of outsourced software components has been conducted so far. Most scientific papers lack the technological aspect when debating the outsourcing of SE tasks. Especially outsourcing on an operational level such as when to decide about outsourcing in SMEs, how to distribute SE workload in an SME’s sourcing scenario, or what are specific characteristics of artifacts that facilitate an outsourcing decision are not studied satisfactory. Thus, we address this gap by our multiple-case study that focuses on the following topics, starting with a general perspective and going into details of SE: (1) Which phases of a software development project qualify for outsourcing in SMEs, (2) who decides at which point in time based on which influencing factors which software component can be outsourced or not, and (3) what are the characteristics of software components that are considered appropriate for outsourcing to a vendor?

The remainder of this paper is structured as follows. In Section 2 we describe the applied research method and give a short introduction to our multiple-case study while we analyze the study in Section 3 along the given research questions (1) – (3). We discuss the findings of our interviews with regards to the state-of-the-art from literature in Section 4 and conclude this paper in Section 5 with limitations, summary and outlook.

2. Research Design

The aim of our multiple-case study was to get insights into SMEs’ opinions regarding the phases of a software development project that qualify for outsourcing, the organizational structure of SMEs with regard to outsourcing decisions, and the characteristics of software components that are considered appropriate for outsourcing. Our research is exploratory in nature since we conducted a qualitative multiple-case study with eight interviewees working for different SMEs in the German state of Baden-Württemberg.

The exploratory research approach was required due to the fact that decision making problems in SMEs of the software industry are continuously challenging the project management of the enterprise. As there is no theory available that explains the sourcing decision in such scenarios and there is only sparse research on our level of granularity, we decided to investigate the specific outsourcing phenomenon in a descriptive and explorative fashion in order to initiate new research hypotheses and additional research methods.

The case study method was chosen as it allows a more detailed, in-depth inspection of a phenomenon in its real-life settings than other approaches [5, 13, 38]. Semi-structured interviews were used as data collection method in order to gain a rich understanding of software development outsourcing decisions. Our multiple-case study aims at analyzing the situation of enterprises while the data collection is based on interviews with individuals. In order to avoid problems with the unit of analysis, we have focused on a selection criterion which requires our interviewees to be experts in outsourcing whilst being on management level. Consequently, these persons have gained experience in one or more outsourcing projects for multiple years and are representatives for their enterprises. We conducted a pilot study with four additional enterprises prior to our main study in order to familiarize with the topic, gain preliminary insights, and to develop relevant lines of questions for the final interview guideline [5, 38].

Each of the eight interviews contained 30 open questions and lasted between 45 and 90 minutes. The interviews were tape-recorded and transcribed literally. The transcripts have been sent to the interviewees for approval and corrected if necessary to make sure the essence of each interview was captured correctly.

We have coded and analyzed the resulting transcripts using the qualitative research software QSR NVivo while the answers of the interviews have been used to develop a set of coding categories that support a clustering of the interviews concerning the outsourcing decision. Following the coding by the second author, the first author assigned the statements to the re-
spective categories. The comparison of both codings resulted in an inter-coder reliability of 94 percent [21]. The reasons for mismatches were always very obvious (e.g., in that one coder had simply overlooked an issue within a statement). Afterwards, we analyzed the single cases for statements related to our research questions, followed by a cross-case analysis for pattern matching. Finally, we reiterated the single cases for deeper insights into the identified patterns and excluded rival interpretations to maximize internal validity [38].

Table 1 provides information about characteristics of the single cases. The table contains information about the eight enterprises except for the second column which provides information about the interviewee’s position. The names of the enterprises are masked using the letters A-H in order to ensure the confidentiality of information. All enterprises stem from the software development sector except enterprise A that defines itself as multimedia agency that develops multimedia solutions for large customers. However, the enterprise is mainly developing software solutions for Internet marketing and, therefore, has a substantial part of software developers in parallel to its graphic designers. Hence, it can be stated that all enterprises have experience in software development and in being software outsourcing vendors which distinguish them from SMEs of other domains. Each enterprise is subject to the common definition of the European Commission for SMEs with staff headcounts between 10 and 190 [14]. Regarding the type of software, enterprise B develops standard software whereas enterprises D, E and F are specialists in creating individual software. Enterprise C develops a standard software solution as well as individual solutions for specific customers. The other enterprises usually adapt standard software to customer specific needs. All enterprises are experienced concerning outsourcing, stemming from one to seventeen years in the year of investigation.

The major findings of the multiple-case study are presented in the following section.

3. Case Analysis

3.1. Software Development Phases Suitable for Outsourcing

Following the level of abstraction, we started to explore the outsourcing topic with a general view on SE and corresponding development phases. The first part of the interviews aimed at exploring typical parts of the software development process that can, from an SME’s perspective, be outsourced to an offshore location or to an external partner. We asked our interviewees about specific SE phases that we have primarily aligned to the waterfall process model [35]. Table 2 shows the corresponding results. Empty cells (also in the following tables) indicate that we have not found any evidence in the data.

It is apparent that there is strong consensus among all interviewees that especially the implementation phase and the testing phase of SE projects qualify for outsourcing. Each interviewee confirmed that opinion, as for example H stated: "If we source out, then it’s the development. We develop some parts here and some parts offshore". Interviewee E declared that his enter-
prise outsources development tasks “in 80 percent of all cases completely”. In addition, C elaborates: “From my point of view, only topics like development and testing qualify for outsourcing. However, I am a bit skeptical concerning the testing phase”.

Table 2. Software development phases and outsourcing qualification.

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<tbody>
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<td>n</td>
<td>n</td>
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<tr>
<td>Requirements</td>
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<td>n</td>
<td>n</td>
<td>y</td>
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<td>n</td>
<td>n</td>
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<tr>
<td>Management</td>
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<td>n</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>3</td>
<td></td>
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<tr>
<td>Implementation</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>8</td>
</tr>
<tr>
<td>Code Testing</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>8</td>
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<tr>
<td>Integration Testing</td>
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<td>n</td>
<td>n</td>
<td>n</td>
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<td>0</td>
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<tr>
<td>Quality Assurance</td>
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<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
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<td>2</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

*y: suitable for outsourcing; n: not suitable for outsourcing; yn: depending on additional factor*

Furthermore, almost common consensus can be discovered in the early stages of the SE process. Since five out of eight respondents neglected to outsource the process analysis phase while the others made no comment, the importance of that phase becomes obvious and can be underlined by the statements of B: “Process analysis, requirements management, specification, and architectural design are done here” and E: “Especially new technologies are developed by ourselves!” Requirements management activities such as requirements elicitation and documentation are in the same way not considered to be qualified for external execution. Enterprise E emphasizes this: “We already had projects in which we have involved our outsourcing partner in the requirements analysis phase. The reason was not to have a lower daily rate; instead, the people were involved early in order to understand what the customer expects […]”. Generally, we conduct this part (of the SE) on our own”. Likewise is the specification of the software architecture and of software components mentioned to be realized in house. We have to add, that interviewee E has conducted projects in which the outsourcing partner was involved in the requirements engineering and the specification phase and others in which not. We indicated this in Table 2 by ‘depending on additional factor’. Additional factors could be contractual agreements or decisions that the outsourcing vendor is involved also in early phases or the project is outsourced entirely.

Only a few interviewees made statements about finalizing activities such as integration testing and quality assurance. However, each respondent refused to outsource these activities to an external partner, since “quality assurance completely at the offshoring location did not work. Therefore, we have a quality management team here” (B). Furthermore, B added: “We were not able to find someone who does quality assurance as full time job”. Another statement concerning testing was made by F: “Software tests were written by the (external) developers, but these tests were executed in Germany and complemented with additional tests”. We also detected differing opinions when asking about the maintenance activity of a software product. The majority disapproved to have the final software maintained by a third party whereas 25% would outsource their maintenance activities for the following reason: “I cannot meet with a developer on short notice, explain the functionalities, and then the person would perform the task with a quality level I can rely on” (A). The hybrid sourcing behavior was stated by H: “Maintenance and operations can be run in parts here and in parts by the outsourcing provider”. Concluding can be stated that the implementation and testing phases are clearly considered well suited for outsourcing.

3.2. Temporal, Organizational, and Operational Aspects of Outsourcing Decisions

Following the levels of abstraction, we wanted to integrate the sourcing decision behavior with aspects of the outsourcing organization and its operations. Hence, our second goal was to explore the following topics: when is the general decision for outsourcing made, which role is responsible for the outsourcing decision, and what are influencing factors for these decisions?

Table 3 provides an overview of the point in time when a decision about outsourcing is made by the SMEs taking part in our study. The common opinion for decision making is defined as “before the project”. With only one exception, all enterprises decide about outsourcing when the customer submits an order for software. The decision is made “at the beginning. We usually decide that already in the course of presenting our offering, since we normally know during the sales process what the customer is willing to spend” (H). The statements of other enterprises underline this sourcing behavior: “That is something that is decided at the beginning. That is totally clear!” (D).
One enterprise behaves differently and starts with the outsourcing decision during the projects: “The smallest unit for decisions is our iteration period. We have an iteration cycle of six weeks. In case of doubt, we are able to outsource work packages during that iteration cycle” (G). Enterprise B follows a rather radical approach: the enterprise never has to think about make or buy decisions since every project is outsourced to an external partner with whom a trusting relationship exists. The enterprise’s plan is to hire only requirements engineers and project managers in its home country in order to realize a maximum of flexibility to be able to respond to market needs and to take advantage of lower labor costs in nearshore locations to a maximum level.

Furthermore, we analyzed the responsibilities for the decision making in SME’s. In addition to the temporal aspect of the sourcing decision, we also analyzed the organizational perspective. Hence, we have asked for the responsible roles concerning the outsourcing decision in the respective enterprises. Table 4 summarizes the results.

The majority of the respondents declared that the sourcing decision is in the field of responsibility of the enterprise’s managing director. In addition, project managers decide almost to the same frequency as the managing directors do. The interviews also showed that in some cases the head of development was the ultimate decision maker in outsourcing questions. For instance, enterprise C reported: “Basically, the heads of development, project leads, and the enterprise’s board decide”. Since our unit of analysis was on SMEs with a focus on their upper management, we can state that the project managers as well as the heads of development are generally reporting directly to the managing director of the enterprise or at least to a board member. For that reason, the sourcing decision is made by persons that are hierarchically not far apart. Enterprise F noted that software developers are involved in the decision making process in addition to the project lead. Finally, enterprise B notes that there is no decision making process since every project is outsourced to an external partner. Therefore, nobody is involved in this decision.

The analysis of influencing factors for outsourcing decisions was the last object of inquiry for this part of the interviews; the results are illustrated in Table 5. Since the question for these influencing factors is of a fairly open kind, the answers were manifold and had to be aggregated correspondingly.

Table 3. Temporal aspects of outsourcing decisions.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Before the Project</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>During the Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>y</td>
<td>y</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Always Outsourcing</td>
<td>y</td>
<td></td>
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<td></td>
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</table>

y: suitable point in time

Table 4. Responsible roles in the decision making process.

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</thead>
<tbody>
<tr>
<td>Managing Director</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Project Manager</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td></td>
<td>4</td>
<td></td>
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<tr>
<td>Head of Development</td>
<td></td>
<td></td>
<td>y</td>
<td>y</td>
<td>y</td>
<td></td>
<td></td>
<td>2</td>
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<tr>
<td>Software Developer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>y</td>
<td>1</td>
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<tr>
<td>Nobody</td>
<td>y</td>
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</table>

y: responsible role

Table 5. Influencing factors for the decision making process.

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Resource-based</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>5</td>
</tr>
<tr>
<td>Product-based</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>4</td>
</tr>
<tr>
<td>Project Characteristics</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>On a Gut Level</td>
<td>y</td>
<td></td>
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</table>

y: influencing factor for outsourcing decision

Most of the enterprises take resource-based information into account for making an outsourcing decision. By resource-based information, we have aggregated statements containing the experience of developers, the availability of professionals, and their skill levels. Statements like “we take the option (to outsource) when no adequate internal skills are available in the requested time frame” (A) underline our observations. Likewise, D states: “Our goal is always to utilize our own workers to a full degree, but at peaks or with tasks that we don’t want to put a strain on us, since we have other things to do, we go to an external supplier”. Other very important information sources for the decision turn out to be product-related characteristics. Among these, there are issues such as characteristics of specific software components, the product specification, required domain knowledge, interfaces, and the “complexity. The more complex software components are, the more likely they remain here. If I have a lot of simple components, then it makes sense to develop these offshore” (H). Similar to that, project de-
tails, containing the size of the project or the insularity of a project, are necessary to inform the sourcing decision. One respondent came with the following statement to the point: “Finally, the decision is made on a gut level” (G). For enterprise B, none of the above mentioned categories can be marked since this enterprise follows the approach to outsource every software development project. Therefore, no foundation of the decision making process is needed. To sum this section up, we can state that mostly board members are in charge of the outsourcing decision right before the project starts. Their decision making is primarily based on resource-related and product-related issues.

3.3. Characteristics of Software Components that Qualify for Outsourcing

The final layer of abstraction in this exploratory study targets a very granular level of decision making and, thus, our third research question has a focus on characteristics of software components (like, e.g., in object-oriented software engineering, embedded systems, etc.) that qualify for outsourcing. Therefore, we needed to know what type of artifact SMEs evaluate in order to decide the sourcing question.

Almost all interviewed enterprises decide about the outsourcing of the development of specific software components. Half of the respondents also transfer the entire software development project to an external partner or to their own offshore location. Partially, enterprises use specific requirements as sourcing objectives (cp. Table 6).

Table 6. Object of outsourcing.

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</thead>
<tbody>
<tr>
<td>Outsourcing of the Development of Specific Software Components</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Outsourcing of Software Development Projects</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Outsourcing of the Development of Specific Requirements</td>
<td></td>
<td>y</td>
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</table>

y: suitable outsourcing scenario; n: not suitable outsourcing scenario

Since outsourcing of specific software components is a widely used practice, we have elaborated on the characteristics these components must have in order to qualify for outsourcing. In Table 7, an overview of all mentioned characteristics and their frequency of nomination is given. These characteristics significantly influence the decision making of the interviewed enterprises. The items are marked with (+) if a higher degree of this characteristic fosters outsourcing decisions; likewise, the items are marked with (-) if a higher degree of this characteristics reduces the suitability for outsourcing.

Table 7. Characteristics of software components that qualify for outsourcing.

<table>
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<tr>
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<tbody>
<tr>
<td>Need for Explanation (-)</td>
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<td>y</td>
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<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
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<tr>
<td>Complexity of Components (-)</td>
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<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Technical Specificity (-)</td>
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<td>y</td>
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<td>y</td>
<td>y</td>
<td>4</td>
<td></td>
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<tr>
<td>Clear Interfaces (+)</td>
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<td>y</td>
<td>y</td>
<td>3</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Required Domain Knowledge (-)</td>
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<td>y</td>
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<tr>
<td>Isolation of Component (+)</td>
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<td>Number of Used Technologies (-)</td>
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<td>Anything can be outsourced</td>
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y: relevant characteristic; n: not relevant characteristic

A major concern of our interviewees is the need for explanation. Advantageous settings comprise a low level of need for explanation. For instance, enterprise A stated: “One can certainly outsource very complex things. However, I made bad experience with projects in which you have to thoroughly prove that everything is correct.” Additionally, interviewee E said: “If we find out that our people have difficulties in understanding the customer’s requirements, if they read documents and tell that they are not able to solve that ad hoc or they read a document five times and have to ask numerous questions about it, then nobody of us thinks about outsourcing the project.” Furthermore, issues such as complexity of components and technical specificity play significant roles in the decision making process as well. Thus, C explicates to outsource software components “that are easy to specify and describe” only. D has a similar understanding of these aspects: software components “should be quite clearly defined. They should be of such a specification level that there
is less room for misunderstandings and interpretations”. In addition, software components that qualify for outsourcing need clear interfaces. Moreover, two enterprises highlight that components that are strongly considered to be core topics of their businesses do not qualify for outsourcing. Two enterprises stated that the required domain knowledge is an important factor for the decision. For instance, G said that “it must be a topic that requires a relatively low amount of domain knowledge”. Contrariwise, other enterprises mentioned that domain knowledge does not play a significant role: “Domain knowledge is actually no reason (for not to outsource)” (D).

Additional factors like the isolation and encapsulation of components as well as the number of used technologies were mentioned only once and thus do apparently not play an important role for sourcing decisions. Again, B has a unique opinion when he states that there are no specific characteristics of software components that qualify for outsourcing since “anything can be outsourced”. In a nutshell, we can depict that SMEs preferably decide on outsourcing on the base of software components whilst considering numerous characteristics of these components as important for the decision.

4. Discussion

Within this section, the results of the multiple-case study are compared to the findings of existing literature. Hereby, the differences between the body of knowledge and the explored results of this study are highlighted. Furthermore, the differences between large enterprises and SMEs are explicated.

When considering a SE project, there is only limited literature about sourcing-related decision making in specific phases of the software development process. Generally, outsourcing literature discusses settings such as business process outsourcing or application development outsourcing scenarios having whole applications engineered offshore [3, 19, 31]. Nevertheless, the organizational setup of large software enterprises has the consequence that software tasks or projects are shifted offshore to enterprise-owned subsidiaries [25] which then are used as “extended workbench” [33]. Hence, at large enterprises outsourcing and offshoring activities are not always related with losing control since projects are often shifted geographically but not outside the enterprises’ boundaries. Thus, these enterprises have no need for defining software development phases that qualify for outsourcing.

In contrast, our study sheds light on the behavior of SMEs in such scenarios. As stated earlier, engineering tasks that have direct contact to the customer or that need interaction with a customer were mentioned not to be outsourced. Especially the early phases of a software development project in which the business processes and requirements are collected from the customers do not qualify for outsourcing since these phases are considered crucial and value-adding. Furthermore, integration testing and quality assurance, both play significant roles as well. Since SMEs outsource parts of their SE, the outsourced software components have to be integrated in-house. In this step, the outsourced software artifacts are linked to the self-created artifacts representing the core part of the desired outcome. Hence, the linking activity is a core element of the development process and is therefore not outsourced. Together with quality assurance, both activities are precious for SMEs in order to deliver high-quality software to their customers.

As stated in Section 3.1, SMEs’ opinions on outsourcing maintenance activities differ. Some enterprises would outsource maintenance activities, others would not. An explanation is certainly the fact that customers can be directly involved in maintenance activities. Previously, we have seen that requirements engineering is considered crucial due to its proximity to the customers. Consequently, in cases in which maintenance tasks have direct impact on the customer or vice versa, maintenance tasks are kept in-house. Else, the sourcing of maintenance tasks is an appropriate means in SE, as mentioned by our interviewed enterprises. Large enterprises, however, do not strictly differ between development phases when interacting with their captive offshoring centers [22]. In these cases the captive workers can have assigned several roles within the development process. This depends on the strategic decision of the enterprise’s board whether entire applications, entire projects or only special tasks are shifted offshore. As a consequence of this, the crucial software development phases from a SME’s perspective (e.g., requirements engineering, specification, etc.) can be conducted from offshore workers.

In Section 3.2 we have proposed the results of our study concerning outsourcing decision moments, outsourcing decision makers, and influencing factors for outsourcing decisions. With regards to the moment of decision making we have to differentiate between the point in time for the general sourcing decision and the point in time for the detailed sourcing decision. Whereas larger enterprises already decide about what to outsource during their strategic decision making, SMEs in their strategic planning only decide about the question if outsourcing will be applied in a specific project or not. As we know from Applegate and Montealge as well as from Dibbern et al., large enterprises mainly decide about outsourcing of whole IT functions or entire software projects [2, 11]. However, our study
reveals that the sourcing decision in SMEs is usually made before the project starts, but with the following implications: the decision is about having tasks performed in outsourcing scenarios or not. The decision is not about what activities or parts of the project will be outsourced and, hence, is significantly different to large software firms. This automatically leads to the question that has been a further topic in the same section: What is the rationale behind the outsourcing decision?

The findings of this research question widely correspond to existing research from literature [11]. Although economic aspects play a major role in IS outsourcing literature, SMEs mostly prefer outsourcing for resource-based reasoning. Nevertheless, even large enterprises shift SE tasks to offshore countries in order to hire skilled personnel. Additional important aspects are product related reasons. The separation of specific software components, required domain knowledge, and properly defined interfaces inform the outsourcing decision similarly. This implies a complex decision making process, since a software product is the result of a very creative development process and requires different product-based characteristics for the decision. In contrast, large enterprises seek to reach an evolution of their outsourcing decision process which results in long lasting relationships and a complex establishment process [7]. Hence, decision making is not primarily based on product specifics but more on strategic aspects. With regard to SMEs there is only scarce research work available in literature. For this reason we have further investigated in the domain of component-based outsourcing in SE projects.

Regarding the roles that make outsourcing decisions we can state that managing directors and project managers primarily are responsible for the decision making in SMEs. The reason for that is obvious: As managing directors of SMEs often also have the position of the project lead for their crucial projects, these people occupy a double role. Hence, they are responsible for the entire business and for strategic projects, such as hybrid scenarios when outsourcing is included. This differs significantly to large enterprises. For them, outsourcing is a strategic decision as well [17]. However, the decisions are usually made by the board and the operational outsourcing topics belong to the respective project lead. In that case the different roles are occupied by different personalities.

Finally, in Section 3.3 we have focused on the specific characteristics of software components that qualify for outsourcing on an operational level. The goal was to find out about certain criteria that inform the outsourcing decision and are primarily consulted by deciders in SMEs. Many of the decision criteria for software components are covered by a study from Kramer et al. [26]. In that study, decision criteria are grouped in intra-component items and inter-component items, whereof the ‘intra’ view denotes specific characteristics of a single component and the ‘inter’ perspective considers development-specific factors between numerous components. Furthermore, the work of Dedrick et al. shows a case study that combines management capabilities, the nature of an activity, and economic factors for the sourcing decision [8]. However, our study reveals that SMEs set their decision focus differently. While statements like ‘low complexity’, ‘technical specificity’, and ‘clear interfaces’ indicate that a technical decision base is most important for our interviewees, the negation of some respondents at ‘less domain knowledge’ (cf. Table 7) is evidence for a less crucially considered domain background. Hence, the results of this study show that knowledge about technology is considered more crucial to inform the sourcing decision than knowledge about domain specifics.

5. Limitations, Conclusion and Further Research

Our work should be interpreted in the lights of its limitations. First, statistical generalization is hardly possible due to the limited number of cases. However, statistical generalization is not the goal of the multiple-case study method; analytical generalization is still possible [38]. Our results provide valuable insights into outsourcing decisions of SMEs in Germany. Second, due to our decision to use open questions in the interviews, slightly different answers were given compared to using a closed questionnaire. For example, as presented in Table 2 we asked the interviewees for the phases of the SE process that are suitable for outsourcing from their perspective. If somebody used the term process analysis (or synonyms), we marked the respective category. If the person has not mentioned the term, we did not ask whether this might be a reason, as we would have when using a closed interview guideline. However, this research layout can lead to less interviewer biases [38]. Third, our results base on single interviews per case which may have an impact on the rigor of our results. However, since the interviewees are highly involved in the outsourcing decisions of their respective enterprises they can be considered as valuable sources for each case.

This study explores a number of outsourcing related decision influencing factors aligned to the software development phases within SMEs. We have shown that not all of these phases are considered applicable for outsourcing relationships. Since software implementation and testing have been designated by all of our in-
terviewees as suitable activities in such settings, we investigated further on how outsourcing is influenced by temporal, organizational, and operational factors. The results showed that outsourcing decisions in SMEs are planned early and are strategically of high importance.

Additionally, resource-related and product-relevant information provide the knowledge base so as to inform an outsourcing decision. According to our interviewees’ statements, these informing aspects can be covered best by component-based decision making. Hence, we can break down outsourcing decision making on an operational level and define software components as the object of investigation. Thus, this study has practical implications for SMEs when establishing outsourcing arrangements and having a hassle in decision making. Our findings might improve such decision making processes. In particular, a strong integration of existing software development tools with an improved decision making process could lead to an advantageous situation for SMEs. The usage of integrated collaboration platforms that provide profound traceability information, such as links and rationale between all artifacts of the software development process (e.g. requirements, design models, architectural models, software codes, and test cases), helps leveraging the decision making process by gathering and concentrating component-specific and decision-critical details. Various approaches from the domain of decision analysis and decision making can be applied to the component-based sourcing problem, e.g. heuristic methods can be adopted for aggregating traceability information and, thus, classifying software components according to their outsourcing suitability.

From a theoretical point of view our study contributes to the body of knowledge by enlightening the decision behavior of SMEs in the field of software development outsourcing. This aspect should be further addressed by in-depth qualitative research studies with practitioners from the software engineering domain involved. The studies could especially focus on required information needs about software components and how disposable information is applied in current decision making processes as well as how these information could contribute for improved decisions.

From our perspective, decision making of SMEs with regard to outsourcing settings is an important field of study. However, we find that such decisions are mainly analyzed on the organizational and strategic level but not on the operational level. There is only scarce research in the field of component-based outsourcing decisions. This opens up a broad area for additional research work in the field of software outsourcing, especially involving SMEs from the software industry. Therefore, our study should be complemented by further scientific studies about decision making processes and observed results.

6. References


