

Success Factors for Requirement Patterns Approaches

Exploring Requirements Analysts' Opinions and Whishes

Axel Hoffmann¹, Andrej Janzen², Holger Hoffmann¹, Jan Marco Leimeister¹

¹Information Systems
Kassel University, Germany
{axel.hoffmann; hhoffman;
leimeister}@uni-kassel.de

²IT- and Processmanagement
WINGAS GmbH
Kassel, Germany
andrej.janzen@wingas.de

Abstract: Research in requirement patterns has led to different approaches, fostering elicitation efficiency and requirements quality by reusing known solutions. However, such pattern-based approaches are not established within many companies, even though requirements are often reused in practice. In this paper, we present the results of five semi-structured interviews with experienced requirements analysts, in order to explore their opinions about requirement patterns, what they expect from a requirement patterns approach and what the success factors are. Our results show that the advantages of requirement patterns are well known and analysts would like to adopt them, but the required organizational changes have to be supported and decided upon by representatives from management. Depending on the lifecycle of the company, requirement analysts see different strategies for gaining their manager's support concerning the adoption of pattern-based approaches. One key aspect in their eyes is that requirement pattern approaches should focus on application in and integration into existing processes of the organization. With such approaches, requirements analysts would have the chance to benefit from the advantages pattern-based approaches provide within the scope of their organizational processes. We present new areas for requirement patterns research and provide arguments to help practitioners persuade their companies to adopt a pattern-based requirement engineering approach.

1 Introduction

Reuse is an established practice in software engineering and is used in requirements engineering by requirements analysts to elicit and document requirements [HHS13, RR06]. The reuse of requirements is supported by requirement patterns. A pattern, in general, describes a problem which occurs over and over again, and then describes the core of the solution to that problem in such a way that it can be used a million times over, without ever doing it the same way twice [Al79]. Requirement patterns are used for the software analysis stage. Research in requirement patterns has led to different approaches, fostering elicitation efficiency and requirements quality through the reuse of known solutions. There are different approaches that differ in scope, notation and application [FPQ10, HC07]. Pattern-based approaches are proposed to reduce the effort

of acquiring recurring requirements. Further benefits for requirements analysts are the reduction of time spent to perform the elicitation of the requirements and the improvement of the quality of the requirements book obtained.

However, pattern-based approaches are not established within many organizations. We could not find any evidence from literature that requirements analysts in practice use patterns approaches, except those involved in research collaborations. This correlates with assumptions of other authors [KKL11, PRA03] and the general discussion about the adoption of requirements engineering methods in practice [HBL09, KBB02] which conclude that industrial practice hardly introduces results from requirements engineering research. Research on requirement patterns approaches also faces this challenge.

In order to foster the adoption of requirement patterns in practice, we conducted an empirical survey with experienced requirements analysts from practice that do not use requirement patterns yet. Using semi-structured interviews, we explored their opinions about requirement patterns, what they expect from a patterns approach and what they think the success factors are. Therefore, the research questions of the study are:

1. For what purposes would requirements analysts from practice use requirement patterns approaches?
2. What do requirements analysts see as advantages of requirement patterns approaches?
3. What success factors for requirement patterns approaches are seen by requirements analysts?

In this paper, we summarize requirements analysts' opinions and wishes, and emphasize success factors that research on requirement patterns should pay more attention to, in order to overcome the obstacles of transferring the approaches into industrial practice. The paper is structured as follows. First, we describe the research approach, including the interview guide, the participating requirements analysts, as well as the data analysis techniques. The results are presented according to the research questions and discussed subsequently.

2 Research approach

We conducted a qualitative research [Ma00] in form of expert interviews to explore the requirements analysts' opinions and wishes. When dealing with a hardly researched area, it is important to focus on the data and the area to be researched. The advantage of qualitative research methods is that they enable the development of theories by means of an analysis of the research area.

We used open interviews to speak with selected requirements analysts, in order to answer the research questions. Open interviews are characterized by a primary orientation towards the content of those interviewed, instead of focusing on a fixed order of predetermined questions. The order of the questions is adapted during the conversation. Thus, open interviews make it possible to ask individual questions to given

answers, enabling a readjustment of the thematic interests during the conversation. This form of interview is classified as semi-standardized and problem-centered. Here, semi-standardized means that the collection of data is determined by not only the interview by means of the creation of open interview guidelines, but also by the interview partner due to the admission of the freedom to shape the course of the conversation. This flexibility, regarding the execution, enables unknown facts to be fathomed.

2.1 Requirements Analysts

The first preparation activity is the determination of the field of research. When selecting suitable interview partners for expert interviews, it is important to ensure that those chosen actually fulfill the requirements of an according expert status. In comparison to others, experts assume a special position concerning a specific problem area, depending upon the type and amount of available information. This specific role knowledge can result from having dealt with the problem area either directly or indirectly. Regarding the research questions, individuals, who were frequently directly involved in the analysis phase of software development projects in the past, are defined as experts in this study. Accordingly, they possess extensive knowledge in the field of requirements engineering. In contrast, experiences with the application of requirement patterns or similar approaches were not expected. This is due to the fact that requirement patterns approaches are not used often in organizations, and we focus on aspects that should be changed to enable application.

In the following section, the individuals and the companies selected for an expert interview in the course of this study are introduced. The names, company names and all further information that enables identification, i.e. project names, have been anonymized. Code names were assigned to the anonymized objects, in order to make an allocation of the data acquired from the individuals possible. These code names remain consistent throughout this whole study. As a result, the allocation of data is maintained while anonymizing the identification characteristics. The selected field of research comprises five individuals, who work at four different companies (Table 1).

P1 works in the Department of Information Management of O1. This department is responsible for supervising all IT projects and for the organization of the IT strategy. In addition to practical requirement engineering experience P1 also has extensive theoretical requirements engineering experience, due to that fact that he recently completed his academic career which involved intensive work with requirements engineering. O1 is an industrial company, which is a large organization with more than 1000 employees. O1 is active in the petroleum and natural gas sector.

P2 is team leader in the Department of Information Technology and responsible for the maintenance of several IT systems. For this purpose, customer requirements must be defined regularly and realized. Larger requirements are attended to in projects. P2 has been dealing with requirements engineering extensively for nine years. He works at O2, which is a service provider in the petroleum and natural gas sector. The company is a medium-sized organization with 100 to 1000 employees.

P3 works in application development. His tasks include, besides process analysis and optimization, the execution of requirement engineering. He has performed requirements engineering for eight years. He has spent the past half year before the interview dealing with the requirements of a tool that aims to manage the requirements in his own company O3. O3 has more than 1000 employees and is a service provider in the air transport industry.

P4 and P5 are in the same organization, namely O4. They both work in the Department of Program Management, which was previously referred to as Requirement Management before the recently carried out reorganization. P4 is the manager of the department. P5 also possesses extensive knowledge of requirements engineering, which she acquired in the twelve years in which she dealt with requirements engineering. O4 also has more than 1000 employees and is a power supply company. P4 and P5 were interviewed together. The time frame for the interview was expanded, in order to provide both analysts sufficient time to answer each interview question.

Requirements Analyst	Experience	Department	Size of Organization	Business Area
P1	2 years + academic career	Information Management	Large	Petroleum and natural gas sector
P2	9 years	Information Technology	Medium	Service provider in the petroleum and natural gas sector
P3	8 years	Application Development	Large	Service provider in the air transport industry
P4	15 years	Program Management (Requirements Management)	Large	Electric utility
P5	12 years	Program management (Requirements Management)	Large	Electric utility

Table 1: Involved requirements analysts

2.2 Interviews

After determining the research field, the preparation of the interview is the next step of the planning phase. With the aid of related studies, the interview guidelines were developed. The guidelines are used to outline the thematic areas to be questioned. Thus, the guidelines can be shaped openly and flexibly.

The interview guidelines designed for the expert interviews were divided into three question sets. The first set comprised questions concerning the individual and the company in which the individual works. The second set served to analyze the execution of requirements engineering in the according organizations. These questions aim to gain knowledge of how requirements engineering is conducted in the company, in regards of which approaches and methods are employed and which difficulties arise during the execution. The third set of questions dealt with the application of requirement patterns and is divided into three further sections in accordance with the research questions. One

section concerns questions about the application possibilities, another application purposes and the last success factors. In total, the interview guidelines consist of 19 main questions. Several of the main questions were preceded by a short explanation. These were used to create a transition to the according question, and in order to avoid misunderstandings (see also [HBL13]). Optional inquiries were predefined for each main question. They were posed depending upon the situation.

The interview partners were contacted via email. The research interest was illustrated and they were questioned in regards of their interest in the expert interview. If they showed interest, they were sent another email with more information. This included a proposal for this study, a shortened interview manual and a glossary. The interview guidelines sent to the interview partners only contained the 19 main questions, but not the optional inquiries that partially contain possible answers to the main questions. The glossary included several terms of relevance for the conversation. Thus, ensuring that knowledge of the same terminology was shared by the interviewer and the interview partners. The interview partners were hereby provided the possibility to become acquainted with the definition of terms before the actual interview was performed. Latest during the interview, the glossary was referenced together in the case of points which required mutual comprehension. For example, at a certain point, it was necessary for the interviewer and the interviewee to have the same understanding of the term requirement pattern, because the following question referred to the application of them.

The interviews were recorded with tape recorders and subsequently transcribed. With the aid of tape recording, the interviewer is provided the possibility to concentrate entirely on the communication process.

2.3 Data analysis

The tape recordings acquired in the interviews were literally transcribed in the following step. The transcription is a necessary intermediate step before the data can be interpreted. The transcription aims to record the conversations accurately, in detail and in written form, in order to prepare them for the analysis of data. During transcription, irrelevant passages, such as detailed descriptions of projects or correlating references, were deleted. Misspoken details were corrected. Rules were determined for the transcription and employed.

After transcription, two of the authors analyzed the interviews in two phases. In order to simplify the analyses of data, text passages of relevance for answering the research questions were identified in the transcripts and marked on the right-hand margin. For each marking, the core content was noted. The marked passages were also categorized by assigning them to one of the three research questions. After having identified the most significant passages, these passages were then examined more extensively in a second evaluation phase, in order to determine similarities and differences between the interviews and to build categories for further analysis. The proposed categories were discussed by all four authors and only used if an agreement could be reached. The results of the data analysis are presented in the next section.

3 Requirements analysts' opinions

In the semi-structured interviews we asked the requirements analysts for their opinions regarding requirement patterns and related approaches. They reported different properties, advantages and success factors, which are shown in the following sections. We are aware of the fact that some of the statements either reflect what is already known from a researcher's point of view, or maybe also contradict scientific knowledge. Our main goal, however, was to gain an insight into the mindset of requirements analysts working on real-world problems, and find out what their opinions on requirement patterns are.

3.1 Circumstances

To gain an understanding of what requirements analysts understand by requirements patterns we asked them under which circumstances requirement patterns approaches could be used in their organizations.

Requirement properties: In accordance with research on requirements patterns, the requirements analysts stated that requirements patterns should only be defined for recurring requirements (P1, P3, P4, P5). P1 suggested using requirement patterns for functionalities that are part of many systems (e.g., Log-In) and needs which are often requested by stakeholders. P3 and P4 suggested using requirement patterns for nonfunctional requirements. P5 emphasized that the foundation of the requirement patterns should remain constant over time. P3 said that requirement patterns would work best if they are defined for product requirements and did not try to define properties of system requirements also.

Types of projects: P3 suggested the usage of requirement patterns for bigger and long lasting projects with an extensive requirements engineering phase. Therefore, implying they should not be used for small projects. Further, P3 suggested the usage of requirement patterns for call-for-tender projects, because the developer is not known, and a clear and complete requirements documentation is necessary. The requirement patterns could be used at the beginning of a project to provide a basis for requirement elicitation, or at the end to check the completeness of the specification (P5).

Organizational role: The task to build and manage the requirement patterns catalogue can be done by different positions within an organization. P4 and P5 suggested the development department manage the collection and be supported by the functional departments. The former, namely, is the first department that is able to recognize recurring requirement. They assumed that more than one requirements analyst is working in the organization, who is not involved in every project. Therefore, only the development department has an overview of all projects. P4 and P5 further explained that this only works for projects the developer is known in advance. P1 and P3 saw the management of the requirement patterns as a task of the requirements analyst that can be categorized as between the functional and development departments. If there is no distinguished task of a requirements analyst, P1 suggested giving the responsibility to

the IT department. P2 would assign the requirements patterns to the IT governance department.

Coverage of requirements patterns collections: P2 suggested focusing on a specific type of software, or a specific domain when developing a requirement patterns collection. Requirement patterns could be used within an organization for recurring requirements, but are unrealistic for a corporation among organizations of the same branch or sector. They would not share their knowledge (P1, P3). P5 said that a requirement patterns collection across company borders developed by the organizations together could work for domain specific requirements. Whether this is possible depends on the competition between the organizations (P5). In the case of requirements that are necessary for many systems, an independent institution could also develop requirement patterns (P1, P3).

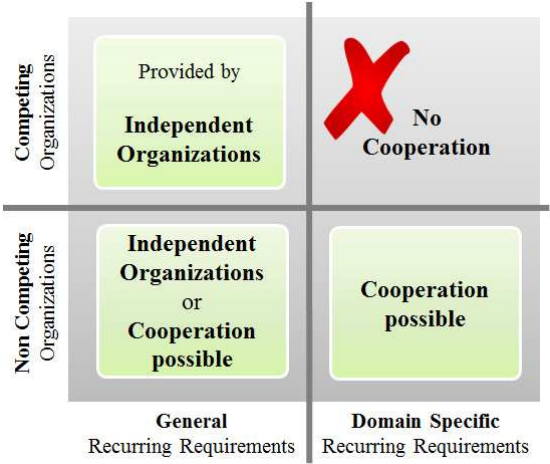


Figure 1: Possibilities for cooperative requirement pattern collections

Figure 1 summarizes the possible cooperation for requirement pattern collection. Therefore, for non-competing organizations a corporation is possible for general and domain specific requirements. For general requirements also competing organizations could use requirement pattern collection if they are provided by independent organizations.

3.2 Advantages of Requirement Patterns Approaches

In this subsection we present the reasons why requirements analysts from practice would use requirement patterns to elicit, analyze and document requirements (Table 2).

Efficiency in elicitation: The requirements analysts stated the efficiency as an advantage. A requirement pattern repository that requirement analysts could browse through could ease and quicken the requirements elicitation activities (P3, P4, P5). P4 said that stakeholders do not have much time to speak to requirements analysts, because of their daily amount of operational tasks. If an extensive elicitation is carried out, but only a few

results yielded, the stakeholders lose their willingness to participate. The requirements analysts need to make sure that even with minimal participation, the quality of the requirements is ensured. Therefore, the requirements analysts need to ask the right questions to elicit the right requirements that are relevant for the development of the system in a short period of time. Requirement patterns can help to reduce the involvement of the stakeholders to a minimum (P4). The acceleration of the elicitation and documentation yields economic advantages for both sides: stakeholders and requirements analysts (P1, P5). The most important argument for requirement patterns from P1s point of view was the fact that the collection can lead the participants through the requirements elicitation process. For example, the participants are forced to specify nonfunctional requirements, rather than only functional requirements (P1). This corresponds with the answers of P3 and P4. The elicitation process is standardized by the requirement patterns collection. The elicitation is therefore complete, repeatable, efficient, and leads to a better requirements quality as well (P4).

Requirements quality: The analysts stated that requirement patterns provide a structure for the requirements. This determines the required attributes of the requirements and prevents that important information is missed, or unnecessary information specified (P1, P3, P4). The defined attributes could also help to estimate the effort of the realization of the requirement (P3). Additionally, the requirements quality is raised by the fact that predefined requirements are provided that help to reduce mistakes if the problem is solved again. This, in turn, reduces reworking and additional effort in subsequent development steps (P5). Resulting requirements from requirement patterns could avoid further (mis-)interpretation by unknown developers, for example, in call-for-tender processes (P3).

Understandability of requirements: P4 said the communication with the stakeholders can be improved by requirement patterns due to the enforcement of terms. Synonymous terms that could introduce different conceptual models are prevented. Furthermore, long and incomprehensible requirements are prevented by the predefined requirement templates in the requirement patterns (P4). P3 said that requirement patterns could support the translation of the departments' languages to the language of the IT department if they are built for that. Furthermore, the definition of the requirement structure supports the communication of the requirements in different development steps. All information is collected in one place. Therefore, no further questions, references or information are necessary (P3). Another advantage pointed out by P5 lay in the reorganization that can ease the communication between stakeholders or requirements analysts by using the names of the requirement patterns.

Completeness of requirement Specification: P3 said that the use of requirement patterns could support the consideration of existing laws and regulations within the requirements specification (P3). Furthermore, they could help to document regularly missed requirements or requirements that are found to be obvious by the stakeholder (P1). P4 reported that functional departments have problems writing down their requirements. Due to their low level of expertise they have problems formulating requirements. Therefore, they require assistance. In practice, the requirements analyst pre-documents requirements suggesting those which are important for the department. He sends them to

the department. This document could be compiled with requirement patterns and the department could adjust and complement it. With the aid of requirement patterns the departments could compile an initial requirements list, even without an requirements analyst (P4).

Comparability of requirements: According to P3, results from requirement patterns can be checked more easily due to the given structure. Information and values that are verified are not hidden within long textual descriptions. These values can be defined as single attributes in the structure. The same information is listed in the same order for every requirement, providing better orientation when accessed (P3). Furthermore, requirement patterns could provide attributes that aid in controlling collaborative requirement validation (P4).

Traceability: According to the analysts the maintenance of dependencies between requirements could be supported in two ways by requirement patterns. First, the documentation of dependencies is enforced if such an attribute is defined within the requirement template (P1). Additionally, if there is a pattern system providing dependencies between the requirement patterns in a certain domain, the requirements analysts can identify the related requirements and use the dependencies in the requirements specification (P5).

Nr.	Mentioned Advantage	Analyst
1	Efficiency in elicitation	P1, P3, P4, P5
2	Requirements quality	P1, P3, P4, P5
3	Understandability of requirements	P3, P4, P5
4	Completeness of requirements specification	P1, P3, P4
5	Comparability of requirements	P3, P4
6	Traceability	P1, P5

Table 2: Advantages of requirement patterns approaches

3.3 Success Factors

In this section we present the success factors (Table 3) that are stated by the requirements analysts. In their opinions', the following aspects need to be fulfilled by requirement patterns approaches, in order to be ready for an adoption into an organizational context.

Effort: P4 emphasized that because stakeholders do not want to spend much time with requirements elicitation, the approach should cause a minimum amount of effort for them. Therefore, only necessary attributes should be used in the requirement templates (P4). P5 said that the approach need to be easy to use, and should reduce the additional effort to a minimum. In order to simplify the usage, the requirement patterns should provide selection options to adapt the requirements (P5). However, they should not provide too many options to reduce the complexity of the usage. Instead, the pattern should provide meaningful options (P3). Furthermore, the requirement patterns collection should be free from redundant requirements. Requirements with the same goal should be parts of the same requirement pattern (P2, P3, P4).

Information and support: One success factor named is the communication of the requirement patterns collection and the associated approach (P2, P4). Information regarding modifications, extensions and the proper use of the requirement patterns collection must be shared (P4). According to P5, the user of the requirement pattern should be supported during their first uses.

Responsibilities: P2 said that the organization must be appointed one or more persons who are responsible for the requirement patterns and their usage (see also subsection A.3). Moreover, there should be rules that determine which persons can add or adjust requirement patterns to ensure the quality of the collection (P4).

Level of abstraction: As P5 stated the templates in the requirement patterns should not be too abstract, and should provide a “solution” instead of just providing a frame for the requirements. In contrast, the requirement patterns should not be too specialized, so that they are still capable of generating a general solution independent of the specific context (P1). P1 noted that the requirement patterns should also not be too technical. The terms used in the predefined content should be understandable for the stakeholders. Also, the terms used as attributes in the requirement patterns should be understandable by all stakeholders (P3). In general, requirement patterns should be comprehensible for all participants in the requirements engineering process (P1, P3, P4). P1 declared the requirement patterns should bridge the gap between functional and IT departments.

Process of application: In order to support the successful usage of requirement patterns, P3 suggested there should be instructions on how to use them. These instructions should support the users with the selection and adaption. Furthermore, the process should include the maintenance and enhancement of the patterns collection (P3). This process should be used for certain projects and no bypasses should be allowed (P2, P4).

Tool-support: Regarding P2 and P3, the IT support was one of the most important prerequisites. A tool should provide a collaboration environment for the use of the requirement patterns, and should prevent changes in the given structure of the requirements. The tool should also provide a workflow that supports the search and selection of suitable requirement patterns (P3). It should limit the requirement patterns that conflict with already selected requirement patterns, and emphasize patterns that are linked. The tool should also provide distinct views for each involved role highlighting the important attributes of the requirement patterns related to the role’s task in the process (P3). P3 said that the providers of tools could furthermore support the organizations by defining and using standards for interchangeable formats.

Organizational change: One of the factors mentioned most often was the acceptance within the organization (P1, P3, P5). Besides the requirements analysts, management needs to support the introduction. The necessity to persuade the participants before and during the introduction of requirement patterns exists and is of great significance (P4, P5). According to P4, because requirements engineering is conducted differently in different organizations, the pattern-based approach should be adapted to the requirements engineering approach in the organization. The pattern-based approach should support the original process, not redefine it (P4).

Nr.	Success Factor	Explanation	Analyst
1	Effort	Reduce effort for requirements analysts and stakeholders (only necessary attributes, meaningful selection options, free from redundant patterns)	P2, P3, P4, P5
2	Information and support	Provide information and support for requirement patterns users (communicate existence and modifications of requirement patterns, support user while first usage)	P2, P4, P5
3	Responsibilities	Determine responsibilities for requirement patterns collection (person in charge, rights to add and change requirement patterns)	P2, P4
4	Level of abstraction	Appropriate level of detail and language (not too abstract, independent of specific context, understandable by all participants)	P1, P3, P4, P5
5	Process of application	Guide users when using requirement patterns (process for selection and adaption, process for maintenance and enhancement, forbid bypasses)	P2, P3, P4
6	Tool support	Provide a collaboration environment for users (workflow for search and selection, preselecting patterns, views for different roles)	P2, P3
7	Organizational change	Reduce but recognize necessary organizational changes (adaptable requirement patterns approaches, management support)	P1, P3, P4, P5
8	Introduction process	Provide different strategies for introduction (initial requirement patterns development, step by step introduction, iterative enhancement)	P1, P2, P3, P4, P5

Table 3: Success factors for requirement pattern approaches

Introduction process: P2 saw no possibility to introduce requirements patterns within an organization. In his opinion, organizations are only focused on maximizing their profit, and increasing the turnover. In an early phase of the lifecycle, organizations do not focus on reducing costs, and they do not introduce methods for such means. Instead, they attempt to reduce costs in later stages of the lifecycle. P2 said that organizations, once they reach these point, are too large and the identification of recurring requirements for requirement patterns would require too much effort. Therefore, he saw no chance to introduce requirement patterns within an organization at all. P3 suggested introducing a pattern-based approach step by step. Thus, it should be introduced in a few selected projects, and adjusted to the needs of the organization. If the members of the projects are convinced, the approach could be enrolled throughout all projects. For smaller organizations the creation of a requirement patterns collection is possible in one step, so P5. He suggested an iterative process for larger organizations. This corresponds with the opinions of P1 and P4. A basic collection of requirements patterns should be built out of previous requirements specifications in the beginning. Furthermore, after every project, the requirements should be analyzed in regards of whether they could recur. These requirements should be included in the requirement patterns collection that could be reused in subsequent projects (P4, P5).

4 Discussion

In the five, semi-structured interviews we have conducted with requirements analysts from four different application domains, the requirements analysts provided us with

insights about their opinions concerning requirement patterns, what they expect from a requirement patterns approach and what they consider to be success factors for requirement patterns based approaches.

Regarding the properties and use of requirement patterns approaches, the requirements analysts stated different areas of applications. They see a potential for using requirement patterns for eliciting and managing nonfunctional requirements, and even recurring functional requirements. These are requirements that requirement patterns were developed for in the past (e.g., [HHS13, RM09, Wi08]). The requirements analysts suggested different roles for the management of requirement patterns collection depending on the organizational structure of their companies. A common denominator is the high level structure of requirements analysts (i.e. their own role), the development department or the IT governance department. Due to the fact that every organization has different roles and structures, requirement patterns approaches should allow the management of the patterns collection by positions specific to the organizational setting. Furthermore, the requirements analysts voted for an organizational requirement patterns collection, but they could also imagine using a collection that is developed by an independent institution or a consortium of organizations with the same interests.

Four of the five requirements analysts saw advantages in employing requirement patterns approaches within an organization. They included the following aspects: efficiency during elicitation, requirements quality, comprehensibility of requirements, comparability of requirements, traceability and completeness of requirements specification. Efficiency and quality issues correlate with the arguments brought up by scientists proposing requirement patterns approaches. This shows that the advantages of requirement patterns approaches thought out in research are shared by requirements analysts in practice (even without having employed them yet), and that practitioners see the possibility in overcoming some of their daily problems in development projects by using requirement patterns. The other advantages mentioned by the requirements analysts that go beyond the proposed advantages of actual requirement patterns approaches should be considered for the further development of these approaches.

Even though requirements analysts know the advantages of requirement patterns approaches and have to deal with manifold project challenges that could be alleviated by using a pattern based requirements engineering approach, they rarely use such approaches for their work. Therefore, we explored the analysts' opinions about requirement pattern approaches' success factors. As one of the most important factor, requirements analysts stated the patterns need to be on a certain level of abstraction, and that the approaches should reduce the effort and need to include tool support. To be applicable in the work context, the approaches would require organizational changes – like the adaption of the internal processes to the pattern based approach and support for the users. These organizational changes, however, would require support from the management level. Therefore, it is not enough to convince requirements analysts of the advantages of requirement patterns approaches.

Consequently, the arguments to use requirement patterns need to first address higher management levels. Approaches should be tested according to performance indicators

that are relevant for the controlling within an organization. Management needs to be convinced, so they will support approaches that cost effort in advance, and whose advantages unfold only once some projects are conducted. This can also be done by providing a patterns collection right from the beginning. We saw that the experts could picture this. Therefore, the organizations could benefit right from the start.

Second, requirement patterns approaches should be supported with tools. This is in line with other requirements engineering approaches, but especially important for appropriate use of requirement patterns. The tool should enable the management of the patterns and should point out conflicting and depending patterns. The tool should also support the selection of the patterns and the compiling of the requirements specifications. As a result of providing tool support for requirement pattern based approaches, both the efficiency and effectiveness of the requirements engineering process would improve, ultimately leading to a higher acceptance of this practice by management.

Third, if developing a requirement patterns approach, the integration into the organizational processes needs to be considered. Every organization uses an individual requirements engineering approach. They often do not match the processes that are proposed by literature. The organizations need to be shown how the application process of the requirement patterns can complement their existing processes. Therefore, the requirement patterns approaches need to be applicable for different processes and situations. Moreover, they need to show how they can be adapted or even help them to adapt. If only little changes in the organizational processes are necessary, the chance of adopting a requirement patterns approach is higher.

5 Limitations

The empirical study faces threats to its validity that are discussed in the following section. Threats regarding the construct, internal and external validity, as well as the reliability are discussed, and the mitigation actions used are emphasized. So as to ensure construct validity, the following actions were conducted. We established protocols for data collection and data analysis. We granted the confidentiality of their names and organizations to the requirements analysts that were interviewed. Before the interviews, we underlined the exploratory nature of the study. The interview guide was piloted with one academic and one requirements analyst from practice, in order to improve the understandability of the questions. A glossary was sent before the interviews to the requirements analysts with the aim to provide key terms, i.e. requirement patterns.

The internal validity was addressed by different actions. We sent the glossary and questions to each interviewee in advance to encourage a shared understanding of the research topic. We analyzed the data by recording all interviews and transcribing them. After the interview, the participants were given a copy of their interview, and they had the chance to add or modify answers. Two of the authors assessed the data individually and generated their own categories. The categories were discussed by all four authors, and only used if an agreement could be reached. In order to increase the reliability, the

interviews were conducted by the non-academic author of this paper. Further, he also analyzed the data and agreed on selected categories.

The external validity of the study is limited by several factors. We did not randomly select the requirements analysts that were interviewed in the study. The contacts were provided by the non-academic author of this paper. The requirements analysts worked in German organizations. We do not claim that the findings of the study can be universally generalized. Nevertheless, this study is the first that explores success factors for requirement patterns approaches. It should work as a starting point for discussion and future research in this field.

6 Conclusion

In this study, we explored requirements analysts' opinions about requirement patterns, what they expect from a requirement patterns approach and what the success factors are. The results of the semi-structured interviews showed that advantages of requirement patterns that are proposed by scientists are also shared by most of the interviewed requirements analysts. They also saw chances to utilize requirement patterns for nonfunctional requirements and recurring functional requirements. Nevertheless, they proposed success factors that should be fulfilled by the requirement patterns approaches (see Table 3). The success factors emphasize the need to consider organizational change for requirement patterns approaches. Also the introduction process for the adaption of the approaches to the different organizational needs is of significance.

The study suggests that research on requirement patterns approaches should broaden its focus to address the concerns of requirements analysts in practice. The evaluation of requirement patterns approaches on effectiveness and efficiency in the requirements engineering process should be extended by evaluating performance indicators of organizations. While many requirements engineering techniques can be used by one requirements analyst on his or her own, a pattern-based approaches effects the whole organization. Therefore, the advantages of such approaches need to be made comprehensible for and by the top management levels. Managers may not be able to estimate the effect of the introduction of a new approach. An idea of the effect should be provided by research. Further, the approaches should be extended by strategies to integrate the application process into existing business processes. Albeit this study was conducted with requirement patterns approaches, we suggest that this is also true for other requirements engineering techniques that require the participation of many employees within one organization.

This study was conducted to learn from practice. However, with the collection of advantages that requirements analysts from practice attribute to requirement patterns approaches, we provide arguments for other analysts to persuade their companies to adopt a pattern-based requirement engineering approach. Further, we identified areas of application in which requirements analysts could imagine collaboration between different organizations that could ultimately lead to shared benefits.

Besides the new areas for research regarding the requirement patterns approaches, we would like to emphasize the importance of empirical studies that examine the needs of requirements analysts in practice. They should examine the needs and wishes in different branches and for organizations of different sizes. Thus, the chance of the adoption of requirement patterns approaches can be enhanced.

Acknowledgements

This work has been partially supported by the research cluster VENUS as part of the research funding program LOEWE. For further information, please visit: <http://www.itcg.uni-kassel.de/venus>.

References

- [AI79] Alexander, C.: The timeless way of building. Oxford University Press, USA, 1979.
- [FPQ10] Franch, X.; Palomares, C.; Quer, C.; Renault, S.; De Lazzar, F.: A Metamodel for Software Requirement Patterns. In: REFSQ, Essen, Germany. 2010.
- [HBL09] Hansen, S.; Berente, N.; Lyytinen, K.: Requirements in the 21st Century: Current Practice and Emerging Trends. In Lyytinen, K., Loucopoulos, P., Mylopoulos, J., Robinson, B. (eds.): Design Requirements Engineering: A Ten-Year Perspective, Springer Berlin Heidelberg, 2009; pp. 44-87.
- [HBL13] Hoffmann, A.; Bittner, E.A.C.; Leimeister, J.M.: The Emergence of Mutual and Shared Understanding in the System Development Process. In: REFSQ, Essen, Germany 2013, Springer, Berlin Heidelberg, 2013; pp. 174-189.
- [HC07] Henninger, S.; Corrêa, V.: Software Pattern Communities: Current Practices and Challenges. In: CSE Technical Reports 2007, ACM, 2007; pp. Paper 52.
- [HHS13] Hoffmann, A.; Hoffmann, H.; Söllner, M.: Fostering Initial Trust in Applications - Developing and Evaluating Requirement Patterns for Application Websites. In: 21th European Conference on Information Systems (ECIS) Utrecht 2013.
- [KBB02] Kaindl, H.; Brinkkemper, S.; Bubenko Jr, J.A.; Farbey, B.; Greenspan, S.J.; Heitmeyer, C.L.; Leite, J.C.S.d.P.; Mead, N.R.; Mylopoulos, J.; Siddiqi, J.: Requirements Engineering and Technology Transfer: Obstacles, Incentives and Improvement Agenda. Requirements Engineering 7 (3), 2002, pp. 113-123.
- [KKL11] Ketabchi, S.; Karimi Sani, N.; Liu, K.: A Norm-Based Approach towards Requirements Patterns. In: 35th IEEE Annual Computer Software and Applications Conference (COMPSAC) München 2011; pp. 590-595.
- [Ma00] Mayring, P.: Qualitative Content Analysis. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research 1 (2), 2000.
- [PRA03] Pantoquilha, M.R., R.; Araujo, J.: Analysis Patterns Specifications: Filling the Gaps. In: 2nd Viking Conference on Pattern Languages of Programs (PLoP) Monticello 2003; pp. 169-180.
- [RM09] Renault, S.; Mendez-Bonilla, O.; Franch, X.; Quer, C.: A Pattern-based Method for building Requirements Documents in Call-for-tender Processes. International Journal of Computer Science and Applications 6 (5), 2009, pp. 175 - 202.
- [RR06] Robertson, S.; Robertson, J.: Mastering the requirements process. Addison-Wesley Professional, Boston, 2006.
- [Wi08] Withall, S.: Software Requirement Patterns. Microsoft Press, Redmont, Washington, 2008.