

Acquiring Problem-Solving Experience in the Multimedia Domain

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ABSTRACT

Issues of sharing knowledge in distributed environments where people pursue the same interests and work in the same domain, often independently from each other, are becoming increasingly important. In this study the established process for elicitation of problem-solving experience from independent sources was studied and adapted to suit the multimedia domain. The resulting process facilitates domain-wide acquisition of best practices. The quality of the problem-solving experience is ensured by applying formalized approach to data analysis and by domain-wide inclusion of practitioners in capturing their design experience.

1. INTRODUCTION

Knowledge acquisition together with organizational learning, is an essential ingredient of knowledge management in organizations (Davenport and Prusak 1997). However, as modern organizations grow and become geographically distributed, knowledge acquisition and sharing challenges the traditional time and space barriers, and removes demands for direct employee contact and their face-to-face communication (Alavi and Leidner 2001). Issues of sharing knowledge in distributed environments, where people pursue similar interests, work in the same application domain, and yet are independent of each other, are becoming more important and attract growing researchers' attention (Stenmark et al. 1999).

There exists a number of well-known and accepted methods of knowledge and experience acquisition and sharing (Kalfoglou 2000; O'Leary 1998; Rising 1999). One of such methods – pattern mining – is the primary object of this investigation. Apart from the software development field pattern mining has not been applied to large domains. Most frequently it has been employed within the scope of a team or an organization. Therefore, this study aimed at introducing changes to the pattern crafting stage of pattern mining by expanding its scope to domain-wide as well as minimizing other identified deficiencies.

2. EXPERIENCE CAPTURE AND PATTERN MINING

Pattern mining is an approach for eliciting and recoding practitioners' problem-solving experience (Appleton 1997; Coplien 1996). The formalized best practices can be very effectively represented as patterns, a special literary form that helps problem-solvers understand the solution and its consequences (Alexander 1979; Appleton 1997; Gamma et al. 1995).

The pattern mining process (depicted on Figure 1) that has been adopted by the international pattern mining community commonly involves the following stages (Manns 2001):

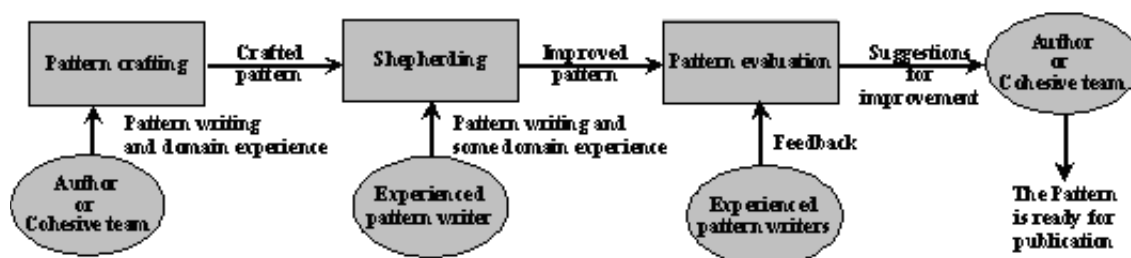
- Pattern crafting, or drafting the initial pattern, as done by an expert in the field or by a cohesive group of experts (e.g. members of the same development team).
- Shepherding – the process when the author(s) gets help from an experienced pattern writer in order to improve the quality of the pattern(s).
- Pattern evaluation at the workshop where experienced pattern writers share their opinions on positive aspects of the pattern and suggestions on the pattern improvement.
- Pattern improvement and publication.

The first stage - crafting the first draft of a pattern or sometimes a pattern language, can be done in many ways. Experienced practitioners always have best practices or at least commonly used practices to share. The most obvious and most frequently used one is "mining one's own experience" where pattern writing becomes a matter of organising and communicating personal knowledge (Manns and Rising 2002). However, often practitioners do not want to spend time or effort on the pattern writing process. Most knowledgeable people are frequently the busiest ones. However, there exist several other approaches where an experienced pattern writer with some knowledge of the domain, called 'ghost-writer' (Rising 1999), can do the formal writing, but the experience should still come from practitioners. A 'ghost-writer' can do Mining by Interviewing, Mining by Borrowing and Mining in Meetings (Rising 1999).

As previously reported (Linden and Cybulski 2006), after a thorough study of the pattern mining process it was determined that its earliest stage – pattern crafting – is in need of urgent attention. In particular, the following deficiencies have been identified (ibid):

- Produced patterns and pattern languages often reflect opinions of a relatively small and most likely cohesive group of people, whose practices may not even represent the best in the domain. Wider involvement of domain practitioners in experience sharing is desirable.
- Shepherding and evaluation relies on active participation of pattern writers, however quite often they have only superficial knowledge of the field.
- To participate in the current process, a practitioner has to learn pattern writing.

Figure 1. Stages in the pattern mining process



ing and become a patterns' author – it is time consuming and not everyone is interested.

Due to lack of domain experts participation in all stages of the pattern mining process, there is a need to address the identified deficiencies beginning with the first stage of the process, i.e. pattern crafting, where patterns originate.

3. EMPIRICAL WORK

Previous studies of the pattern mining process were limited in their scope and poorly formalized (Rising 1999). Research literature alone was not capable of offering many insights on the issues of pattern crafting. Therefore this study focused on the in-depth understanding of the pattern crafting process, ultimately refining it through a series of iterations.

The study centered on a domain that has suffered from multiple problems and where pattern mining has not been applied systematically. The multimedia domain met these criteria, however since there are too many aspects to a multimedia, it was decided to focus on a sub-domain of front-end web design.

Since there is not much prior knowledge to build upon, the understanding of the phenomena was constituted through the subjects' and researcher's live experience. Therefore this research took interpretivist stance (Myers 1997) with the following research objectives:

- O1. Apply the principle of 'contextualization' (Klein and Myers 1999) – understand the domain under study.
- O2. Since patterns are about recording problem-solving experience, identify problem situations as viewed by multimedia practitioners; discover the context for these problems and approaches to their resolution.
- O3. Investigate the feasibility of representing data collected from multimedia practitioners into patterns that are ready for evaluation.
- O4. Derive a formalized process for crafting patterns.
- O5. Evaluate the resulting pattern crafting process by comparing it with the existing pattern crafting approaches.

Since interviewing and focus groups have been used in pattern mining in the past (Rising 1999), these two research approaches were selected as data collection tools for this study.

The following activities were undertaken as corresponding to the objectives (see Figure 2):

- A1. A ghost-writer collects via interviews practitioners' stories describing design tasks, problems associated with those tasks and decision-making in relation to these problems (Objectives 1-2).

- A2. Domain understanding and finding common problem issues related to design tasks. A ghost-writer categorizes concerns around design tasks performed by practitioners. The outcome consists of pattern languages outlines and categorized excerpts of problem-solving experience (Objectives 1-2).

The research method and activities A1 - A2 are described in detail in (Linden and Cybulski 2006).

- A3. For step 3 two alternatives were investigated (Objectives 3-4).

- a. A category of concerns structured into a pattern skeleton (i.e. a pattern with some sections having large gaps due to unavailable details) was presented to a focus group of domain practitioner and experienced pattern writers for pattern crafting under the guidance of an experienced ghost-writer.
- b. Sessions with single practitioners were organized to explore an option of filling in the gaps in pattern skeletons.

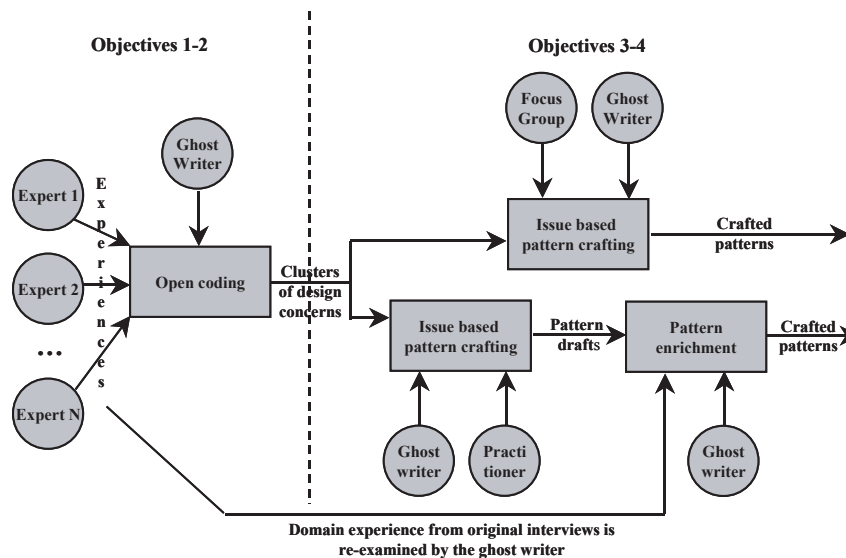
The patterns developed in the stage 3(b) were subject to enrichment and refinement since practitioners provided only content which needed to be refined to meet the pattern style requirements and due to limited number of interviews in this stage additional content could be sought from the original interviews.

The focus group session (A3a) involved four participants (two domain practitioners and two experienced pattern writers). They were presented with a problem situation (presented as a set of practitioners' statements resulting from activities 1-2). The objective of the focus group participants was to draw upon their domain experience and pattern writing skills and to produce a full pattern (or patterns) based on the provided problem situation.

The participants discussed options of re-arranging provided statements by splitting or merging them in a different manner. Pattern writers worked on the pattern style as well as queried the domain practitioners for knowledge on the subject matter while sharing their pattern mining skills with the practitioners. The participants carefully worded the problem, discussed forces and context, reworded the solution and named the pattern.

An alternative approach involved pattern crafting sessions with individual multimedia developers (A3b). Three such sessions were conducted. The participant's handout included brief explanation of what patterns are, pattern format to be used and problem situations (presented as a set of practitioners' statements resulting from activities 1-2). The task of the participant was to examine one of the problem situations and attempt pattern crafting using presented excerpts of data and their personal experience. However, since it was the practitioner's first introduction to the concept of patterns, the ghost-writer had to ask questions aiming at eliciting missing information, such as "In what context normally this question is raised?", "What is causing this problem?", "Are there any negative consequences of applying this solution?". For all three sessions the same handout

Figure 2. Derived pattern crafting process



was used and four full patterns were produced as a result of these session (Linden and Cybulski 2005).

While conducting the sessions the ghost-writer had to be very careful and restrict her contribution to pattern writing only, whereas content of the pattern was sourced solely from the domain experts.

Since individual practitioners could only contribute domain experience but not proper wording of the patterns, the data from the sessions required additional work. The resulting patterns required considerable editing to meet the pattern format requirements. Also the ghost-writer checked whether it was possible to enrich the patterns by analyzing again the interviews conducted in the first stage of the empirical work, this time by searching for comments relevant to the drafted pattern. This analysis resulted in some additional excerpts of experience that were added to the patterns. These resulting patterns the ghost-writer discussed with the second researcher who at this stage put on the "ghost-writer's hat". This experience of filling in the gaps showed that involvement of an additional ghost-writer could also be beneficial for the quality of the patterns. In the end the produced full patterns reflected experience of various practitioners with different work scope in the multimedia field.

As a result of the empirical work the following findings were noted:

- Open coding (borrowed from grounded theory) was very helpful with discovering real issues and clustering designer concerns. These clusters were used as the source of inspiration for participants contributing their experience in the focus group and in the individual pattern crafting sessions.
- In the focus group and in an individual session all participants were eager to share their knowledge. However, during the focus group session participating practitioners also gained deeper understanding of what patterns are and obtained some pattern writing skills. In the sessions with the individual practitioners they only discovered patterns as a new format for knowledge recording and sharing but did not gain any pattern writing skills. Therefore, a special set of questions aiming at filling in pattern sections without overloading the practitioner with the pattern-specific terminology was required.
- In the discussion focus group participants may point to potential patterns not noted by the ghost-writer in the preparatory data analysis.
- The focus group transcript shows that group members spent considerable time on careful wording of each statement thus ensuring that patterns follow the format requirements. This effect could not be achieved in the session with an individual practitioner and therefore the follow-up refinement of patterns was necessary.

Although both approaches resulted in good quality patterns the focus group approach was found to have additional benefits:

- It results in high quality patterns that are ready for evaluation without additional work by the ghost-writer.

- Domain practitioners get more intimate involvement with the pattern mining and obtain some pattern mining skills.

Although an impression may be that patterns produced by the focus group or by interviewing the individual practitioners reflect the opinions of the small number of practitioners, it was the activity 1 where large number of practitioners from a variety of backgrounds contributed their problem-solving experience. This activity guarded for identifying design problems important to the majority and for quality of the applied practices in solving the problems.

4. EVALUATION OF THE PROPOSED PROCESS

In this section the fifth objective is being addressed. The three approaches to pattern crafting are compared in relation to the identified problematic issues as described earlier in this paper (see Table 1). The problematic issues include the scope of involved practitioners, whether the stages of each approach are formalized or ad-hoc, whether the required knowledge restricts participation in pattern mining and how the process ensures the quality of patterns. Since some inspiration for this pattern crafting approach was drawn from the past experience described by Rising (1999), her approach was the obvious choice for comparison.

Rising took on the role of the ghost-writer and with the small group of assistants interviewed the company gurus and produced patterns reflecting best practices in the organizational procedures. Her work was restricted by clearly identified organizational boundaries. Rising's team attempted to verify the crafted patterns by going back to their sources, however not always successfully due to the sources being very busy.

Unlike Rising this study proposed and tested a formalized approach to data analysis based on coding in order to translate collected data into patterns. Although the pattern crafting approach applied by Rising (1999), improves the scope and involvement of domain experts within an organization, the proposed process brings the benefit of capturing into patterns cross-domain experience that is not limited by organizational boundaries. The proposed approach also resolves problems with engaging practitioners in the process, their ineffectiveness as pattern writers, their lack of time to formalize their design experience, and their inability and unwillingness to attend design sharing events outside their normal workplace.

5. CONCLUSIONS

Issues of knowledge acquisition in distributed environments are becoming increasingly important. Since patterns have proven successful in representing problem-solving knowledge, and in disseminating best practices in software development, this study explored application of patterns to sharing development experience in yet another domain – multimedia. As the currently adopted pattern mining process is normally unable to utilize multiple practitioners as a direct

Table 1. Comparison of the three pattern crafting approaches

Pattern crafting approach	Current, widely used	Rising	The Proposed Process
Pattern crafting process	Ad-hoc	Special informal process	Meta-process to find the domain-specific process
Scope of involved practitioners	Cohesive group of people	Organization	Domain
Data collection	Mining own experience	Interviewing In meetings	Interviewing
Data analysis	Informal	Informal	Formal coding
Patterns refining	Own experience	Iterations with practitioners – interviews with the purpose of verification (not always possible due to gurus busyness)	Iterations with practitioners – semi-structured and structured interviews, focus groups
Knowledge of patterns	Participating practitioners must have it.	Participating practitioners may not have it, however a ghost-writer must have both domain knowledge and pattern writing skills.	Participating practitioners may not have it, however a ghost-writer must have both domain knowledge and pattern writing skills.

source of such experience, the pattern crafting stage was targeted to minimize the process' deficiencies.

Involving individual practitioners in the experience sharing activities provides richer content for patterns, helps select really best practices as accepted by majority of practitioners and therefore improve the overall quality of patterns. Moreover, practitioners may discover patterns as a useful source of domain knowledge and participate in sharing their experience through pattern mining.

While the applicability of the refined process still needs to be empirically tested on a wider scale (future work), the results obtained so far indicate that this approach has strong benefits compared to the currently employed processes.

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