Patterns For Business Process Improvement - A First Approach

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PATTERNS FOR BUSINESS PROCESS IMPROVEMENT – A FIRST APPROACH

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Abstract

The application of patterns is very popular in different fields of Information Systems (IS), like Software Development or Workflow Management. However, in the field of Business Process Improvement (BPI), research on patterns has so far been scarce, and, in particular, works on BPI patterns are missing. Thus, in this paper, the pattern approach is applied to BPI by identifying the necessary attributes that constitute a BPI pattern. For this purpose, a literature review for patterns and their structure is conducted in other fields of IS, where patterns have proven to be successful. Afterwards, the resulting attributes are investigated against the background of requirements in BPI. A metamodel for BPI patterns is developed and defines the attributes of a BPI pattern regarding their interrelationships. By means of this metamodel, BPI patterns for practical usage are derived. As a first step towards validating our approach, a number of BPI patterns that are based on the proposed metamodel, are currently being tested at a financial service provider.

Keywords: Business Process Improvement, Pattern, Metamodel.
1 Introduction

For more than twenty years, improving business processes has ranked among the top priorities in both research and business, and is numbered among “the most important and common titles in both literature and applications” (Coskun et al., 2008). Because it is the processes by which an organization accomplishes work and creates value for its customers, it is hardly surprising that process improvement has become an everyday task and is part of the processes’ lifecycle (Doomun and Jungum, 2008). An essential contribution in this field is the book “Business Process Improvement” by Harrington, which focuses on continuous improvement and evolutionary change of an organization’s business processes (Harrington, 1991). BPI is seen as essential for improving customer services as well as product and service innovation (Bhatt and Troutt, 2005). Thus, organizations have to make the continual improvement of their business processes part of their strategies (McNealy, 1993).

Despite the fact that a lot of approaches to perform BPI in organizations exist in literature which e.g. give instructions on what improvement should be aimed at (e.g. reduce costs, shorten cycle-time, etc.) they often lack concrete guidelines on how to ultimately improve a business process (Nwabueze, 2012), i.e. how to change the elements of a business process. The lack of concrete improvement measures is evidenced by previous research which showed this for BPI-approaches (see (Zellner, 2011)) or for BPI-techniques (see (Griesberger et al., 2011)). For example, Six Sigma, which is supposed to be an “overall business improvement strategy” (Antony, 2006), suggests within its improve phase to “develop potential solutions to fix the problems and prevent them from recurring” (Antony, 2006) without further elaborating on these solutions. Hence, what is missing are concrete improvement measures that can be applied, as Six Sigma mostly suggests creativity techniques to bring off measures that cause improvement (Heckl et al., 2010). This very phase of process management, the transformation of a business process from its “as-is” to a desired “to-be” state, namely the “act of improvement”, should get more attention, as there is consent in literature that this major challenge within BPI is lacking sufficient guidance (see (Vergidis et al., 2006)).

To close this research gap a pattern-based approach seems suitable. Patterns are reusable means which address a problem within a certain context by providing a solution (Alexander et al., 1977). This general approach has been adapted to many pattern-related research works up to this day. While pattern approaches have been successfully applied in other fields of IS (e.g. Software Development (Gamma et al., 1995), Workflow Management (van der Aalst et al., 2003)), the topic has so far barely been addressed in the field of BPI (Pourshahid et al., 2009). The use of patterns is a promising approach for supporting the “act of improvement”, as patterns by definition provide instructions for achieving a desired result. Accordingly, a BPI pattern guides through the application of an improvement action on a business process. This contributes to overcome the aforementioned shortcomings of current BPI approaches.

Our overall research agenda for the development of BPI patterns is based on the design science methodology (DSRM) by Peffers et al. (Peffers et al. 2007) with this paper specifically focusing on the DSRM-phase 3 (Design & Development). Thus, the aim is to define BPI patterns clearly and derive a metamodel which specifies the structure of a BPI pattern. The metamodel ensures completeness and consistency of pattern descriptions. In addition, the metamodel is helpful for the derivation of BPI patterns and facilitates their application. For that purpose, the mandatory attributes for BPI patterns are examined as they represent a vital part of the metamodel.

The remainder of this paper is organized as follows: in section 2, the conceptual basics for the study are explained. An investigation of the use of patterns, their benefits and notation formats in other disciplines of IS is addressed in section 3. In section 4, a metamodel for BPI patterns is developed, and the interrelations between the involved attributes are shown. Afterwards, the derived metamodel for BPI patterns is demonstrated by means of two illustrative examples. The conclusion in section 5 gives a summary of the performed work and addresses implications for further research.
2 Conceptual Basics

2.1 Business Process Improvement

Business Process Management (BPM) is seen as a holistic approach for describing the way organizations are managed, namely that they are organized according to their processes. BPM “helps organizations bring together processes and their context, including people, documents, information sources, organizational structures, and applications.” (Pourshahid et al., 2009) This comprises customer orientation, a horizontal focus, as well as the alignment of strategy, corporate objectives and operational aspects (Rosemann and de Bruin, 2005). BPM represents a life cycle which shares some similarities with Deming’s “Plan-Do-Check-Act (PDCA)”-cycle (Deming, 1986) in quality management. In the context of BPM, e.g. Rosemann defined a life cycle which comprises seven steps (identification, modeling (as-is), analysis, improvement (to-be), implementation, execution, and monitoring/controlling) (Rosemann, 2004). There are numerous other life cycles (e.g. 8 omega framework for business processes (Towers et al., 2005)) which are, however, very similar to the aforementioned one. Our research focuses on the improvement phase which is part of most BPM approaches where effects like e.g. cycle time reduction, increase of customer satisfaction, or reduction of cost are achieved (Kohlbacher, 2010).

The improvement of business processes results in change (Davenport, 1993, Harrington, 1991) and is aimed at gaining a competitive advantage by turning a business process into a progressive state (Vergidis et al., 2006). As starting points for changing business processes, we consider its elements, that is, activity, control-flow, resources, organizational units, organizational assignment, input, output, and the information-flow (see (Griesberger et al., 2011)). The change has to be reflected by enhancing the effectiveness and efficiency of the process (Harrington, 1991), e.g. by reducing costs or time. Useful heuristics that support the derivation of applicable improvement measures are e.g. provided by the 7 R’s of process innovation (Shapiro, 2002). The success of improvement efforts can be determined by process performance indicators. Common categories are cost, time, quality, or flexibility (see (Reijers and Limam Mansar, 2005)). It is important to differentiate whether a new business process is radically redesigned from scratch (Business Process Reengineering (BPR)) (Davenport and Short, 1990, Hammer and Champy, 1993), or whether an existing business process is taken as a starting point which is then gradually refined (BPI) (Harrington, 1991). Our research focuses the BPI approach, and hereby supports the task of the actual implementation of improvement (“act of improvement”).

2.2 Business Process Improvement Patterns

The meaning of the term “pattern” in the field of IS has its origin in the book “A Pattern Language” by Alexander et al. (Alexander et al., 1977). Alexander defines a pattern rather abstract as “a three part rule, which expresses a relation between a certain context, a problem, and a solution.” (Alexander, 1979) Although his works treat recurring problems in constructional architecture, the general idea of this approach is valid for other disciplines as well. What all pattern approaches have in common is their usage as descriptive templates for precipitating a solution that solves a problem in a certain context (in accordance to (Alexander et al., 1977))). To this effect, it is common opinion that a pattern has four essential parts: A context describing the application field, the problem which is to be solved by means of a pattern, and the solution which resolves forces that have influential effects on the solution (Fowler, 1997, Gamma et al., 1995). Patterns are often limited to their structure, i.e. the output of a pattern (e.g. a design pattern in graphical representation) is synonymous with the pattern itself (Störrle, 2001). This result-oriented perception of patterns (as in (Barros, 2007, Buschmann et al., 1996, Gamma et al., 1995)) has to be distinguished from those patterns that characterize the dynamic aspects of the occurring change by describing how to accomplish a desired output (procedure-oriented patterns as in (Gnatz et al., 2001, Hagen, 2005, Störrle, 2000)).
We define a BPI pattern as a reusable solution for a certain problem in a business process within a certain context. The overall goal is to transform a business process from an “as-is” to a desired “to-be” state. The application of a BPI pattern thereby results in some form of change, e.g. on the activities that constitute a business process or the required resources for its execution.

Since the improvement phase is considered to be the most creative phase during a BPM project (Rosemann, 2004), many improvement methods rely on human creativity rather than on rationality (Pourshahid et al., 2009). Although we do not challenge the improvements that can be achieved by one “brilliant idea”, the emergence of such ideas is uncertain and depends on the know-how of individuals.

However, in our research we argue that a systematic, structured, and reusable approach for improving business processes is promising and ultimately leads to improvement (see (Rohleder and Silver, 1997)). Furthermore, these structured guidelines rather support the creative skills of employees and therefore e.g. help to formalize improvement methods (Forster, 2006). Accordingly, Barros states that a “common theme in the more recent business process literature is the search for approaches that allow to formalize domain knowledge into structures, patterns or frameworks which can be reused to facilitate process redesign (…).” (Barros, 2007) Hence, we focus the improvement of business processes by means of reusable patterns as we see a variety of reasons that this is a meaningful approach:

First, as a pattern is defined as a reusable component that has proven itself in the past, it can be assumed that this solution can be helpful again under the same circumstances (e.g. for a similar problem in a business process which has the same context) within BPI projects (see (Stephenson and Bandara, 2007)). This may also save time and work expense when a solution in the form of a pattern already exists and therefore can be used without the need of additional improvement efforts. Second, alternative solution possibilities may exist if more patterns can be applied to solve a certain problem. Third, applying a pattern in BPI supports the involved employees with promising guidance, provided that the patterns are described properly. Especially novices can build on expert knowledge by using documented patterns for initial training (Jung and Sprenger, 2006). Fourth, each name of a documented pattern represents a detailed structure. Thus, the names of the patterns constitute a vocabulary which enhances the communication among participants (Jung and Sprenger, 2006). This vocabulary is also useful for the documentation of derived process models. Fifth, generated patterns could also be integrated into BPM software for instant visualization of a pattern’s impact on existing process models. Sixth, as patterns are well-proven and have succeeded elsewhere they may help to bridge the resistance to change which is a common phenomenon in BPI (Davenport, 1993).

2.3 Related Work

A number of research works in the area of BPI patterns can be identified:

- Forster describes the way towards a framework for structuring BPI patterns with focusing abstract forms of modification steps that “are activities undertaken to amend the process, organization, data or object, or, in general, all Business Process related issues.” (Forster, 2006) For the description of his derived patterns, he uses a synergy of the description concepts by Alexander (Alexander et al., 1977) and Gamma (Gamma et al., 1995) without, however, justifying this approach.

- Reijers/Limam Mansar provide best practices for BPR, whereby they also address a framework and its constituent elements in order to classify the best practices (Reijers and Limam Mansar, 2005). They describe 29 best practices adapted from literature that can be used within a BPR project. These best practices are described textually and do not follow a consistent form of description.

- Kim et al. elaborate on “Process Change Patterns” which are based on the workflow patterns by van der Aalst et al. (van der Aalst et al., 2003). They provide a list of 16 patterns that can be used within a BPI project, but which are only focused on the control-flow perspective (Kim et al., 2007). Although Kim et al. explain the functionality of each of their patterns, a consistent description of the individual patterns is missing.

- Appleton presents ten patterns that emphasize the differences and similarities of process improvement projects with product development projects (Appleton, 1997). The author uses nine attributes
for each description of a pattern. However, Appleton does not elaborate on why he uses the applied attributes for pattern description.

- Besides, many other publications on patterns simply adapt former schemes of description because they have proven to be successful, without really evaluating them. For example, the GoF-scheme (Gamma et al., 1995) is taken as a basis by Störrle “in order to increase the acceptance of our approach” (Störrle, 2001). But there are also works that stress the importance of a good description of patterns (e.g. (Gnatz et al., 2001, Hagen, 2005, Zimmermann, 2008)), which, however, do not focus the improvement of business processes.

Summing up, despite there being some approaches recognizable in literature that aim for improving business processes with the help of patterns, none of these research works elaborates on the essential attributes that constitute such a pattern nor provides an appropriate metamodel for these patterns. Especially, the attributes are not systematically derived and not clearly specified. But it is this very description of patterns that enables their adequate selection and successful application (Gnatz et al., 2001). The further specification by means of the metamodel supports the development of patterns which could ultimately lead to the creation of a pattern repository. At the same time, the metamodel serves as the basis for selecting an appropriate pattern and its proper application. Thus, the research at hand aims at investigating the necessary attributes for the description of BPI patterns.

3 Patterns in Information Systems

To get an overview of essential notation elements for describing patterns, we analyzed various pattern notation formats that are currently in use. Our literature review, which was organized in the form of a backward-/forward search (Levy and Ellis, 2006), comprised those domains within IS where patterns have proven to be successful, namely software development, enterprise application integration, workflow management, and business process modeling. Although patterns from those domains pursue different goals, i.e. they were not initially invented to support the act of improving business processes (moving from “as-is” to “to-be”), they provide valuable insights for the structure of patterns in IS. In addition, the field of BPI was investigated with regard to already existing recommendations for describing patterns. In the course of the literature review, characteristics as well as the benefits of patterns were analyzed (see section 3.1). This was considered to be useful to get a clearer understanding of their function and use thus enabling a more accurate evaluation. Afterwards, section 3.2 elaborates on the particular notation elements leading to the subsequent goal of deriving the essential attributes that are needed to properly describe BPI-patterns.

3.1 Characteristics of Patterns in different Fields of Information Systems

In the field of Software Development patterns have become a widely familiar concept. Design patterns (see e.g. (Buschmann et al., 1996, Gamma et al., 1995)) are result-oriented and used as building blocks, with utilizing proven experience to enhance software design and to avoid time-consuming resolving of recurring problems (Gamma et al., 1995). Additionally, they facilitate the handling of a system’s complexity (Buschmann et al., 1996). In contrast, process patterns (see e.g. (Gnatz et al., 2001, Hagen, 2005, Störrle, 2000, Störrle, 2001)) describe proven knowledge (Hagen, 2005) about development procedures in a well-defined way (Gnatz et al., 2001). Patterns as reusable modules (Gnatz et al., 2001) enable ad-hoc orchestrations of software development processes (Störrle, 2001). Enterprise Application Integration (EAI) is concerned with the challenging task of the company-wide embedding of applications, processes, data, etc. Patterns in this field “fill the gap between high-level vision of integration and the actual system implementation”, and, as they collect and convey experts’ knowledge, compensate the lack of own experience in decision making (Hohpe and Woolf, 2003). Further benefits are reduced time effort and cost as well as their application as an approach for quality assurance (Kühn and Karagiannis, 2005). Patterns in the field of Workflow Management aim at evaluating the capabilities of Workflow Management Systems (WFMS). Hence, workflow patterns
express business requirements using a formal petri net notation that abstracts away from specific workflow languages (van der Aalst et al., 2003). Additionally, they can be used to model deterministic workflows executable by WFMS, or else to select or develop a WFMS (Russell et al., 2006). Patterns in Business Process Modeling occur in different forms: basic constructs to create graphical process models (Atwood, 2006); process segments or sub-processes that deal with a specific problem (Barros, 2007, Jung and Sprenger, 2006) similar to reference processes; and structured textual process descriptions (Zimmermann, 2008). Modelers benefit from the experience captured by patterns which results both in an enhanced process design and an accelerated modeling process. When discussing patterns for Business Process Improvement we have to differentiate between technical and socio-cultural challenges (Reijers and Limam Mansar, 2005). The former particularly support the act of improving business processes, i.e. they reveal the measures that bring about the desired improvement (Forster, 2006). Thus, patterns support both internally driven (e.g. efficiency increase) and externally driven change (e.g. adaptation from regulations) (Kim et al., 2007). One advantage of patterns is that they provide precise operational guidelines while at the same time being flexible enough for being applied in different contexts (Forster, 2006). In addition, patterns stimulate creative thinking by listing possible improvements, expected consequences, and the prediction of the outcomes (Forster, 2006). Patterns that deal with socio-cultural challenges provide guidelines how to prevent, mitigate or solve accompanying problems when introducing new ideas in organizations (Appleton, 1997, Manns and Rising, 2005). Within BPI projects, they are used for knowledge management and as a common vocabulary to facilitate the communication between team members (Manns and Rising, 2005).

3.2 Overview of Notation Formats for Patterns

The literature review resulted in 21 references that deal with patterns and give indications on how patterns should be described (see table 1). In a first step, we extracted the particular attributes (e.g. problem, context, solution, etc.) that are used for the description of the patterns. All attributes were listed either according to the authors’ definitions or, where such a definition was missing, based on the provided patterns themselves. The resulting list covered a total of 211 attributes. Afterwards, all attributes found were validated by closely examining at least three of the provided patterns (if available) to clarify their actual meaning and usage. This step was needed because some authors use a formalized notation format with predefined elements while others do not. In a next step, candidates that show identical naming and meaning were merged; synonyms, homonyms, and diverging aggregation levels were resolved. This was achieved by comparing the description of the pattern attributes, which was performed, in the first run, by two researchers independently from each other. Afterwards, the results were consolidated in discussions with two other senior researchers. In a final step, the identified attributes were subsumed to a manageable number of core attributes. For that purpose, we applied the approach of inductive categorization (see (Mayring, 2010)). Thereby, categories are built by an iterative clustering and integration of attributes which share a similar meaning. As a result, 22 attributes could be identified that were classified into eight main categories as shown in column 1 of table 1.

Every pattern notation format (21/21) under study uses a “name” attribute to clearly identify a particular pattern and facilitate its dissemination and usage. The underlying purpose of a pattern is described either by the attribute “intent” or “problem”. 19 of 21 notation formats use one or both of these attributes to express the intention of a pattern and in which cases it may be suitable. The conditions and the environment where a pattern can be applied are characterized as “context” (15/21). While most of the notation formats rely on a textual description of the context, some (7/21) add positive and negative “influencing factors” as a more formalized approach. The attribute “solution” appears in 12 cases; it is linked to the problem statement and describes how the pattern could solve the problem. The description that further explains the solution in detail differs significantly regarding domains or intended purposes. In addition to general attributes, design patterns for software development (see (Buschmann et al., 1996, Gamma et al., 1995)) make extensive use of object-oriented concepts and distinguish
attributes to describe static and behavioral aspects as well as sample code. Patterns for software development processes (see (Gnatz et al., 2001, Hagen, 2005, Störrle, 2000, Störrle, 2001)) or business process modeling (see (Atwood, 2006, Barros, 2007, Jung and Sprenger, 2006)) focus on the sequence of activities, resources and deliverables to describe the essence of a pattern. However, an important aspect of an adequate pattern description seems to be the provision of reliable “examples” which are offered by 16 of the researched notation formats. We differentiate between solely illustrative examples, which provide a deeper insight into a pattern’s functionality, and real-life examples, that further serve as an evidence for a pattern’s practicability in the field. 13 of 21 pattern notation formats utilize attributes within the category “effects”. Most of them clearly point out the benefits, in some cases also the disadvantages a pattern may provide. The notation formats of workflow patterns (Russell et al., 2006, van der Aalst et al., 2003) miss some of the common attributes such as context, solution, effects, and validation. This is due to the fact that they are rather used to evaluate workflow management systems instead of providing reusable solutions to distinct types of problems. For patterns in BPI (Appleton, 1997, Forster, 2006, Manns and Rising, 2005, Reijers and Limam Mansar, 2005), the following attributes seem to be of greater significance compared to patterns in other domains: Positive and negative influencing factors that precisely describe the context in which a pattern might be applicable in terms of prerequisites; real-life examples that show its practicability; the effects, sometimes expressed by performance indicators, that clearly show the results which the application of a pattern would have.

4 Adaptation to Business Process Improvement

4.1 Metamodel of BPI Patterns

In this section, we discuss the attributes for the description of patterns in the field of IS (see table 1) concerning their applicability and necessity for BPI. As the disciplines we regarded (e.g. software development or process modeling) pursue completely different goals, some of the corresponding nota-

<table>
<thead>
<tr>
<th>Table 1: Notation Formats of Patterns in Information Systems</th>
</tr>
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<tbody>
<tr>
<td><strong>Software Development</strong></td>
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<tr>
<td><strong>Design Patterns</strong></td>
</tr>
<tr>
<td><strong>Process Patterns</strong></td>
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<tr>
<td><strong>Technical</strong></td>
</tr>
<tr>
<td><strong>Social-cultural</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Attributes of Patterns in Information Systems</strong></th>
<th><strong>Name</strong></th>
<th><strong>Purpose</strong></th>
<th><strong>Context</strong></th>
<th><strong>Solution</strong></th>
<th><strong>Description</strong></th>
<th><strong>Effects</strong></th>
<th><strong>Validation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation</strong></td>
<td>x x x x x</td>
<td>x x x</td>
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<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<tr>
<td><strong>Example (illustrative)</strong></td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<tr>
<td><strong>Structure (classes)</strong></td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
</tr>
<tr>
<td><strong>Runtime Behaviour</strong></td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>x x x x x x x x x x</td>
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</tr>
<tr>
<td><strong>Sample Code</strong></td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>x x x x x x x x x x</td>
</tr>
<tr>
<td><strong>Sequence of Activities</strong></td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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</tr>
<tr>
<td><strong>Known Uses</strong></td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
<td>x x x x x x x x x x</td>
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<td>x x x x x x x x x x</td>
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</tbody>
</table>

In this section, we discuss the attributes for the description of patterns in the field of IS (see table 1) concerning their applicability and necessity for BPI. As the disciplines we regarded (e.g. software development or process modeling) pursue completely different goals, some of the corresponding nota-
tion formats and their attributes are rather unsuited (e.g. “sample code”) while others seem to be highly qualified for being used in BPI. However, the derivation of necessary attributes is made against the background of requirements both for BPI (sect. 2.1) and for patterns (sect. 2.2) which can be subsumed under two main aspects: selection of appropriate patterns, and guidelines for its application.

According to the specification of patterns (sect. 2.2), each BPI pattern requires the attributes name and example. The former serves as an identifier and represents the underlying concept, whereas the latter reinforces the reliability of a pattern as proven knowledge when using real-life examples. Further on, an example illustrates the application of a BPI pattern and provides a performer with guidelines for its use. Having a collection of patterns, the selection of the best applicable pattern is a challenging task and should be supported by the provided attributes. The criteria to determine relevant candidates primarily come from the field of BPI. The problem statement is needed since improvements within BPI target the resolution or mitigation of problems, identified in the analysis phase (sect. 2.1). This requires evaluating which pattern conforms best to the problem at hand. Since BPI initiatives usually focus on outcomes that lead to certain competitive advantages (sect. 2.1), revealing the anticipated effects also gives decision support for selecting appropriate patterns. Therefore, we adopt the attribute effect which expresses the impact on a business process when applying a BPI pattern (in terms of cost, time, quality, and flexibility). To determine if an improvement effort meets the desired objectives (sect. 2.1), it is necessary to measure the resulting change with the help of convenient performance indicators. As a further requirement due to the evolutionary nature of BPI, the description of a BPI pattern has to allow for an assessment of its applicability within a given situation and the suitability of the solution (sect. 2.1). These situational aspects specify the context which is represented by characteristics that implicate conditions for the applicability of a BPI pattern. The characteristics correspond to the so-called “forces” (Fowler, 1997, Gamma et al., 1995) (sect. 2.2).

A second aspect that has to be considered when deriving the necessary attributes is the application of a BPI pattern. By providing detailed guidelines, a pattern enables performers, experts as well as novices to adapt a pattern within the current situation. Thus, comprehending how to construct the solution (sect. 2.2) based on a pattern is the crucial aspect (Lea, 1994). According to our definition of BPI, improvement always results from changing one (or more) element(s) of a business process (sect. 2.1). These change activities, which do not represent patterns as such, but unveil the way of proceeding and can be used within a BPI pattern, are reflected in the mechanism attribute. Examples of mechanisms are e.g. the elimination of activities, modifications of the control-flow, or the reduction of handovers. As stated in section 2.2, we distinguish two basic types of patterns: procedure-oriented patterns which give instructions on how to accomplish desired results (mechanisms), and result-oriented patterns which can be directly implemented in a business process. For the latter type of BPI patterns, the attribute building block is required. All of these attributes (solution, mechanism, building block) address the requirement of providing detailed instructions on how to change a business process or its elements to obtain an enhanced to-be status (sect. 2.1). Summing up, we consider the attributes listed in table 2 as mandatory for describing a BPI pattern.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name as a unique identifier of a BPI pattern.</td>
</tr>
<tr>
<td>Example</td>
<td>Illustration of the application of a BPI pattern for the problem at hand.</td>
</tr>
<tr>
<td>Problem</td>
<td>Formulation of the issue that needs to be solved by means of the BPI pattern.</td>
</tr>
<tr>
<td>Context</td>
<td>Characteristics that imply conditions that have to be present to apply the BPI pattern.</td>
</tr>
<tr>
<td>Solution</td>
<td>Concept for solving the problem complete with the necessary steps which have to be executed.</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Operations that are executed as part of the solution.</td>
</tr>
<tr>
<td>Building Block</td>
<td>Pre-built models for implementation within the problem-solving approach.</td>
</tr>
<tr>
<td>Effect</td>
<td>Resulting effects of a BPI pattern regarding cost, time, quality, and flexibility.</td>
</tr>
<tr>
<td>Performance Indicator</td>
<td>Indicators for measuring if the application of a BPI pattern has resulted in the desired change.</td>
</tr>
</tbody>
</table>

Table 2: Attributes of a BPI Pattern

Along with the derivation of the attributes, we developed a metamodel (see figure 1) which defines the structure of a BPI pattern more precisely. Starting from the core attributes of a pattern (problem, context, and solution), it has been gradually extended and refined and depicts the proposed attributes and
their interrelationships. In the center of the metamodel, the object type BPI pattern is located, which has (like every other object type) a name as its unique identifier. Every BPI pattern is specified by a single problem, a single context and a single solution which is described by the interrelationships between the BPI pattern type and the related problem type, the context type, and the solution type. The solution type is linked to the mechanism type as well as the building block type, which means that every solution contains a single mechanism and optionally one (or more) building block(s). The application of the BPI pattern is geared towards the reduction of e.g. costs or time, which is described with the object type effect and its corresponding attributes (cost, time, quality, and flexibility). In addition, the performance indicator type depicts performance measures which capture the actual outcome of improvement.

Figure 1: Metamodel of a BPI Pattern

4.2 Examples of BPI Patterns

Using the notation format specified by the metamodel, we formulated descriptions of a number of BPI patterns, with some of them being exemplarily shown in the following. The first example covers the processing of a loan request and shows how our attributes can be used to describe BPI patterns in a generic, modular, and reusable form. One possible specification of the BPI pattern “Dissolve Bottleneck” regarding a particular problem and context is shown in figure 2.

Figure 2: BPI Pattern Example “Dissolve Bottleneck”

Other specifications of this BPI pattern result from e.g. applying different mechanisms. Alternatively to the example in figure 2, a further specification of the BPI pattern is the application of the mechanism “Add Resources.1” within the solution “Adjust Capacity.1”. Thus, new resources are added to execute the activity. On the one hand, this also reduces the cycle time of the process, but, on the other hand, it certainly causes higher costs. Accordingly, the utilization of different mechanisms results in different effects. Those mechanisms with the most suited constellation of effects (cost, time, quality, and flexibility) should be preferred. Hence, by using our metamodel, it is possible to recombine individual parts of a BPI pattern according to specific needs. A second example of a BPI pattern shows how improvements are accomplished by combining activities (see figure 3).
Both examples are taken from a BPI pattern catalog that uses the proposed metamodel for describing BPI patterns. This catalog is currently being tested in a pilot project at a financial service provider to evaluate its applicability for real-life processes, to validate the integrity and comprehensibility of the notation format, and to discuss the relevance of the attributes with practitioners. After the first applications, the set of attributes contained in the metamodel turned out to be an adequate basis for the selection and application of BPI patterns. However, it also became obvious that for the selection of an applicable BPI pattern a clear and concise description of the individual attributes must be given special attention when further developing BPI patterns.

5 Conclusion

The aim of this paper has been to precisely define the structure of a pattern for the context of BPI. Based on a literature review, we gave an overview of pattern notation formats in IS, laying particular emphasis on the fields in which patterns are most prominent, like software development or workflow management. As a result of our analysis, we identified generic (e.g. name, problem, and context) as well as field-specific attributes (e.g. implementation, runtime behavior). In a next step, the relevant attributes were determined with regard to the context of BPI. Based on these results, we defined a metamodel for BPI patterns which provides a basis for describing the specific characteristics of BPI patterns to support their selection and application. This metamodel integrates the core attributes of BPI patterns and denotes their structure. We illustrated the proposed notation format by showing two examples and demonstrated its applicability in a pilot project. In so doing, we discovered that the appropriate structuring of complex attributes such as problem or context is an important issue when it comes to the identification and selection of suitable BPI patterns. To further develop our notation format we are currently doing research on a refined structuring of such complex attributes.

Following, we list the benefits resulting from our findings to both BPM researchers and practitioners:

- A theoretical basis for the use of patterns in BPI as reusable instructions for achieving a desired result is provided. The execution of a systematic analysis of the attributes that are needed for properly describing these BPI patterns (see section 4.1) is described in detail.
- The definition of a BPI pattern is additionally based on a metamodel which specifies the attributes and their interrelationships. The derived metamodel supports the definition and application of a BPI pattern for practitioners and illustrates its overall functionality.
- The modular structure of a BPI pattern enables an individual configuration by combining the components suited best to a specific problem (e.g. different mechanisms or performance indicators).
- Different starting points for the use of an appropriate BPI pattern are possible, as their selection can be made depending on the individual attributes (“Does the effect of a BPI pattern conform to the goals?”, “Does the current situation correspond to the underlying context of a BPI pattern?”).

This research is not without limitations. Although we conducted a comprehensive literature review for the notation elements of patterns, it was limited to those fields in IS where patterns had already proven...
to be successful. The theoretical background of our research is mainly based on BPI and pattern literature. It is likely to benefit from the inclusion of other research areas, e.g. method engineering from where specific technical aspects (e.g. description of method components, structure of the method repository) could be transferred. In addition to the pilot project, further validation of the metamodel in real-life situations would provide deeper insights about the general applicability of our approach. At the same time, a starting point for further research implicates the extension and refinement of the BPI pattern catalog. On the one hand, patterns which are successfully used in practice could serve as sources; on the other hand, extracting BPI patterns from proven BPI techniques could also be a meaningful approach to develop BPI patterns. As patterns are commonly used in co-operation, a further development of the metamodel could be its extension in view of the interrelations of BPI patterns. In addition, the metamodel is a promising basis for the development of a BPI pattern language.

References


