

Business Process Model Patterns: Classification and Repository of Published Work

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Abstract: Patterns have gained widespread interest and acceptance in various domains. Originating from architecture, patterns are nowadays also suggested as solution templates for various problems related to Business Process Management. Due to the abundance of pattern works, getting an overview on available works or searching for specific patterns can be very difficult. What is missing is an instrument for easy exploration and search. To mitigate this problem, we classified published works on pattern and developed a repository for business process model pattern works. The repository is publicly available and enables browsing and filtering of pattern works according to criteria recently developed by analyzing 280 pattern works.

Keywords: Business Process Management, Process Model Patterns, Pattern Repository.

1 Introduction

The idea of patterns can be traced back to the work of Alexander et al. [AII577] in the 1970s. This work deals with patterns for town planning and architectural design of buildings. In computer science, the software design patterns introduced by Gamma et al. [GHJV95] paved the way for pattern use. Alexander [Alex79] defines a pattern as a “three part rule, which expresses a relation between a certain context, a problem, and a solution.” Gamma et al. [GHJV95] and many other researchers share this understanding of a pattern as “a solution to a recurring problem in a particular context” [RiZü96]. For the purpose of our survey, we reuse the general idea of the pattern definitions above, but restrict it to the business process model domains as follows, see [FKLS18]:

“A business process model pattern is the description of a proven solution to a recurring problem that is related to the creation or modification of business process models in a specific context. This description is typically organized in a structured document supporting the reader in understanding under which circumstances the proposed solution will be useful.”

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The first patterns in the area of Business Process Management were suggested in [Ould 1995]. Afterwards, the workflow patterns [AaHo12] became a widely known instrument for describing commonly occurring needs in workflow management systems. Tough in the field of business process modeling, the term “pattern” is mostly associated with those workflow patterns, much more authors have used patterns for documenting their experiences. While a lot of patterns for business process modeling have been published, we realized that it can be difficult to find relevant works on patterns that can be useful in a given situation. Persons who want to reuse experiences documented by means of patterns and researchers searching for sound literature references are confronted with two problems: *First*, relevant publications can be found in a great variety of proceedings, journals and web sites. We missed a resource that provides an entry point for searching the full spectrum of pattern papers in the field of business process modeling. *Second*, patterns dealing with the same topic are not named in a unified way and persons who want to reuse patterns were confused. For example, patterns dealing with adaption and change between model variants are subsumed by *change patterns* [UrSe15], *adaption patterns* [DöZG10], *variability design patterns* [YSD16] or *high-level change operations* [LRW08].

Compared to related works on classification of business process model patterns works [BeK114, HaMA14], this paper presents a repository of published works on business process model patterns relying on an extensive literature search as presented in [FKLS18]. The pattern repository is available at <http://www.bmpatterns.org>. It aims to establish a starting point for the search for business process model patterns that can be used by practitioners and researchers alike. By providing a taxonomy that categorizes the types of different business process model patterns as well as a research classification to describe various properties of pattern publications, we hope to broaden the knowledge about patterns and their documentation. Published works on patterns addressed in this paper describe suggested solutions that the authors recommend to tackle problems. In addition, anti-patterns, coined in 1995 by Andrew Koenig [Koen95], are solutions that are known to have deficiencies. Anti-patterns are often recognized by the appearance of failures, which are identified during execution or system implementation [Long01]. The classification of related anti-pattern works is accessible in the repository as well.

The next section summarizes our iterative approach to derive the pattern taxonomy and research classification.

2 Business Process Model Pattern Classification and Repository

2.1 Business Process Model Pattern Taxonomy and Research Classification

In order to systematically describe available works in regard to business process model patterns, we developed a business process modeling pattern taxonomy (referred to in the following as “pattern taxonomy”, cf. Tab 1).

1. **Structure and Behaviour Patterns**
 - 1.1. Instantiation and Termination
 - 1.2. Process Structure and Flow
2. **Resources Patterns**
 - 2.1. Role and Resource Assignment
 - 2.2. Delegation
3. **Orchestration and Choreography Patterns**
 - 3.1. Communication
 - 3.2. Negotiation
 - 3.3. Collaboration
4. **Content Patterns**
 - 4.1. Domain-dependent
 - 4.2. Domain-independent
5. **Quality, Compliance and Risk Patterns**
 - 5.1. Business Process Compliance
 - 5.2. Risk and Security
 - 5.3. Environmental Impact
6. **Adaptation and Improvement Patterns**
 - 6.1. Differences and Variability
 - 6.2. Model Improvement
7. **Integration and Conversion Patterns**
 - 7.1. Model View
 - 7.2. Model Integration
 - 7.3. Model Transformations
8. **Process Architecture Patterns**

Tab. 1: Business Process Model Pattern Taxonomy

The development was conducted as an iterative process whereby 280 scientific publications have been classified following the method from Nickerson et al. [NVM13]. For detailed information, see [FKLS18]. The taxonomy is organized in eight main categories each with 2–3 subcategories. The categories are ordered from basic aspects of process models such as structure and behavior (category 1) to more advanced aspects such as the composition of process models to process architectures (category 8). Our pattern taxonomy is complemented by a classification scheme (cf. Tab. 2). Within the classification scheme, the pattern taxonomy is used to specify the value of the property *pattern category*.

In general, the classification scheme is used to express additional information about each pattern work in a structured way. It is organized in four sections. In the section **Basic Pattern Information**, the *title* of the publication as well as the *origin* of the paper (e.g. from research or industry) is specified. Additionally, the *method of creation* can be described in terms of the method used to create a pattern (e.g. literature review or automatic mining).

Basic Pattern Information					
Publication Title	<free text>				
Origin	Research		Other (e.g. Industry)		
Method of Creation	Informed Argument	Literature Review	Case Study	Automatic Mining	Manual Mining
Pattern Content					
Pattern Category	<ID from business process model taxonomy>				
View (ISO 19439)	Function	Information	Resource	Organization	
Intended User	Business Analyst		IT Specialist		Researcher
Scope	Domain-Specific		Generic		
Pattern Documentation					
Type of Article	Evaluation Research	Proposal of Solution	Personal experience	Survey	
Pattern Template	None		Light	Full	
Presentation	Textual		Formal	Graphical	
Notation	None	Existing, <free text>	Extension, <notation>	New	
Language-Dependent	Yes		No		
Extent of Documentation	Partial		Complete		
Pattern Application					
Instructions, Guidelines	Yes		No		
Tool Support	Yes		No		

Tab. 2: Business Process Model Pattern Research Classification

In the section **Pattern Content**, the *category* of a pattern should be specified by referencing a number (ID) from an entry in the pattern taxonomy (cf. Tab. 1). Moreover, the *view* or perspective addressed by the pattern can be classified according to the view concepts of ISO 19439. Moreover, the pattern work can be classified in terms of the *intended user* of the patterns and their *scope*. In the section **Pattern Documentation**, pattern works are classified according to various properties of their description and documentation. For more detailed explanations, see [FKLS18]. Unlike all other properties in this section, the property *notation* contains the values *existing* and *extension* that can be complemented by a string that allows to specify the name of an existing notation or the notation that was extended. Finally in the section **Pattern Application**,

the classification contains properties regarding the application of the respective pattern work such as *guidelines* or *tool support*.

In order to serve the business process community, we decided to create a pattern repository that contains the classification results of 280 pattern works using the pattern taxonomy and research classification introduced above. In this way, modelers and researchers can benefit from our classification effort by using the information to understand existing patterns, to compare patterns, and to have a collection of examples on how to define new patterns. The contents of the repository can also be useful for the design of new business process model patterns and may be helpful to understand differences, commonalities or improvements before publishing new pattern works. In the following, we derive key requirements for the pattern repository. Their implementation is described in Section 3.

2.2 Design of a Pattern Repository

First of all, regarding an easy access to the pattern repository, our development was inspired by other catalogues such as the collection of workflow patterns that are available online (<http://www.workflowpatterns.com>) or the Reference Model Catalog, also available online (<http://rmk.iwi.uni-sb.de/>). Hence we decided that our repository should also be *freely available on the World Wide Web*. Further, the repository should on the one hand provide an *overview on pattern works for browsing*. On the other hand, more advanced *filtering options* should be provided so that properties of our classification can be leveraged to identify pattern works. Moreover, the user should also be able to utilize a keyword search feature. However, since we do not expect the users of the pattern repository to know the terminology or names of patterns in advance, a *semantic search feature* is required so that a search term such as “environment” will retrieve a pattern work on “Green Business Process Patterns”. In summary, the requirements are as follows:

- **R1:** Worldwide easy and free access
- **R2:** Overview on pattern works for browsing
- **R3:** Filtering options using properties of the classification scheme
- **R4:** Semantic search feature

3 Implementation of the Pattern Repository

The Business process model pattern repository has been implemented as a single web page application available at <http://www.bpmpatterns.org>. Due to the publication as a web page without access restrictions, **R1** (worldwide easy and free access) is met. After loading the page, a short introduction text is displayed along with the possibility to expand the full pattern classification scheme (button “Show detailed criteria”).

Furthermore, the pattern taxonomy is displayed on the page (cf. Fig. 1, ❶). Next to the ordering number (ID) of each pattern category in the taxonomy there is a small number within a small grey-shaded circle as well as a question mark. The number represents the total amount of pattern works in that category. When hovering with the mouse over the question mark, the description of the pattern category is displayed. By clicking on the link of each category text, the website is dynamically expanded and all pattern works are shown in separate boxes (cf. Fig. 1, ❷). The title of the paper serves as a label for each of the boxes. The boxes are clickable buttons that link to a webpage associated with the paper (e.g. the publisher's webpage or authors page on scientific networks). Due to these features, **R2** (overview on pattern works for browsing) is met.

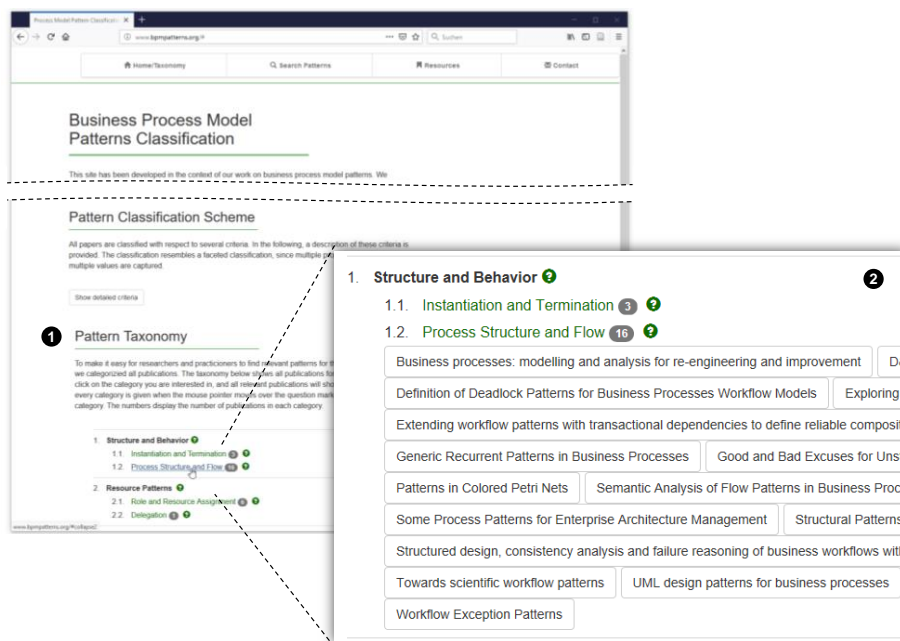


Fig. 1: Start Page of the Repository and Contents of Pattern Category 1.2

In order to utilize advanced filtering options, the user can click on the „Search Patterns“-button on the top of the page. A table of patterns appears whereby each pattern work is contained in a row that is further described in columns by values of a set of pre-selected properties that originate from the pattern classification (cf. Fig. 2, ❶). The user can dynamically add or remove columns to the table by just clicking on „Column visibility“ and then selecting or de-selecting columns in the context menu (cf. Fig. 2, ❷). In this way, the table can be customized and **R3** is met (filtering options using properties of the classification scheme). In order to further refine the contents of the table, the user can leverage the search-box in the upper right corner of the page. Every property of the classification can be used to filter the contents in the table, regardless if the property

values are displayed in a column of the table or not. Moreover, 800 keywords have been added to the table. In this way, the user can retrieve pattern works even if she or he is using a different terminology than the authors of the pattern works. For example, if the user types in “structure 1.” (cf. Fig. 2, ③), then the result table is reduced to three result rows accordingly. Whereas for two of these entries, the word “structure” is contained in the paper title, the third entry does not contain this word in the paper title. This abstraction from the syntactic level thus implements a semantic search feature (R4).

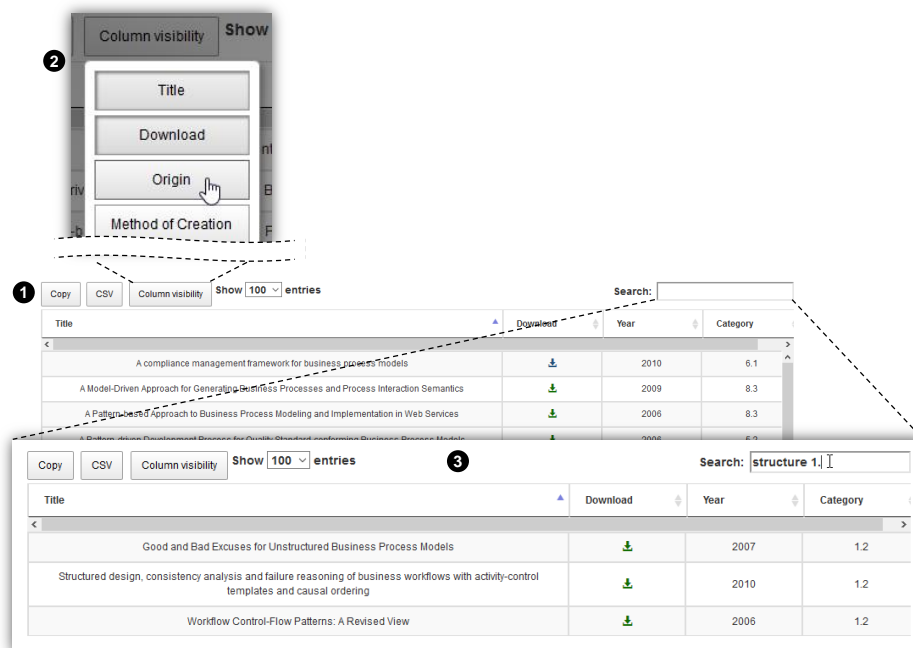


Fig. 2: Search Page of the Repository, Columns and (Semantic) Search

Moreover, the fraction “1.” of the search term entered in the example query acts as a filter for patterns falling into the category “1” of the pattern taxonomy. All of the search and browsing features are implemented in a lightweight way using HTML, CSS and JavaScript in a single webpage programming style. Finally, also export features are provided: The contents of the (filtered) table can either be copied to the clipboard or downloaded as CSV file.

4 Conclusion and Outlook

This paper summarizes our work on business process model patterns. We devised a classification of business process model patterns works and arranged them in a taxonomy. Both the taxonomy and research classification are based on an extensive

literature review. We hope that our online repository is helpful for business process modelers who want to publish BPM related patterns and to understand differences, commonalities or improvements. It is our aim to extend the collection of literature on business process model patterns and anti-patterns on the website that we set up at <http://www.bpmpatterns.org/> and we warmly invite other researchers to contribute to this endeavor.

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