

A Systematic Literature Review on Dynamic Business Processes

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Abstract. Organization's business processes are changing constantly due to a dynamic environment. Accordingly, all these changes need to be implemented into dynamic business processes, which at the runtime will ensure the required dynamicity of business. However these processes are not sufficient investigate what prevents their effective use. Thus far, there does not exist the generally accepted understanding of the dynamic business process (DBP), including its requirements, and measures of dynamicity. Therefore, this paper presents a systematic literature review of conference and journal articles on the topic of DBP. The review has been undertaken to define DBP, identify the DBP requirements and analyse proposed solutions for their implementation. In addition, this paper identifies gaps in current research in order to appropriately identify topical research activities in the field of DBP.

Keywords: Dynamic business process, dynamic business processes requirements, systematic literature review.

1. Introduction

Business process in organizations are constantly changing due to dynamic environment, so it is mandatory to be able to dynamically change business processes' components at runtime. However, there does not exist the commonly accepted understanding of the dynamic business process, including its requirements, and which measures of dynamicity do exist? Therefore, this paper presents a systematic literature review (SLR) in order to: definition dynamic business process and its requirements, summarise the state of the art in the topic of dynamic business processes, identify gaps in current research and explore possible directions for the further research.

Firstly, we defined research questions, which we used for selecting relevant papers and searching them for answers to the presented questions. Paper also briefly describes the process of SLR while presenting exhaustive overview of the SLR results.

The rest of the paper is organised as follows. Section 2 defines research methods used to conduct SLR. Section 3 provides information about conducting the review. Discussion on results are presented in the Section 4. Section 5 concludes the paper and provides a discussion on the further research.

2. Review Methods

In this section we propose to make systematic literature review process (Fig. 1), consisting of several steps as outlined in (Kitchenham *et al.*, 2007),

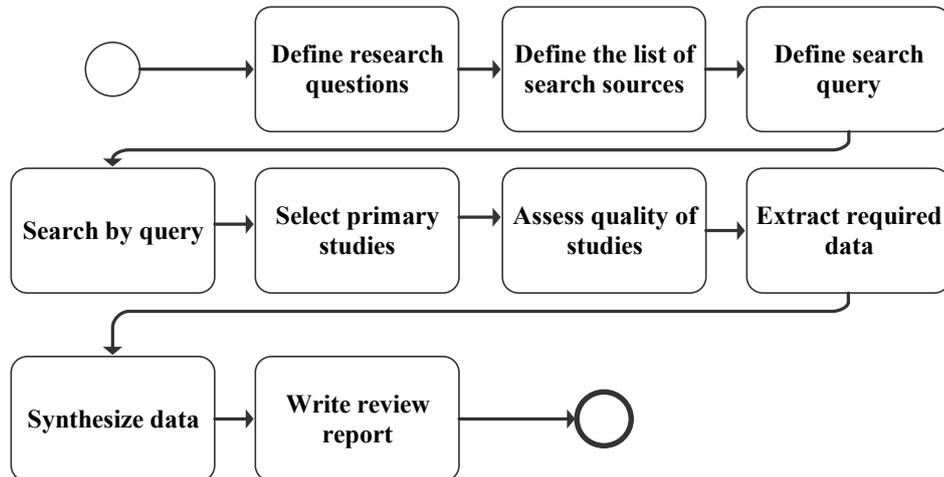


Fig. 1. Systematic literature review process

Step 1. “Define research questions”. In this step, we defined the following five research questions:

- Q1: How is dynamic business process defined?
- Q2: What are the requirements the dynamic business process should satisfy?
- Q3: What are the measures of dynamicity of dynamic business process?
- Q4: What solutions are proposed to ensure business process dynamicity?
- Q5: What gaps do exist in current research?

Step 2. “Define the list of search sources”. In this step, the list of search sources are defined. In order to retrieve relevant research studies, we search in digital libraries. Due to technical limitations, we had to limit the number of data sources, so we used only 4 scientific digital libraries (Table 1). However, our initial study of selected digital libraries, and their particular sections, has shown that they contain significant number of books, journals, peer-reviewed conferences and workshops relevant to the research field.

Table 1. List of digital libraries

No.	Data source	Website
1	ACM digital library	http://dl.acm.org
2	Emerald Insight	http://www.emeraldinsight.com/
3	IEEE Xplore	http://ieeexplore.ieee.org
4	SpringerLink	http://link.springer.com/

Step 3. “Define search query”. In this step, synonyms, related terms and their meaningful combination are defined as presented below.

((“dynamic business process”) OR (“business process dynamics”) OR (“dynamics in business processes”)) OR (“business process” AND (dynamicity OR dynamism OR dynamically))

We also tried to use such terms as ad-hoc, flexibility and adaptivity for our review, but in this case we received too many sources for our queries and were forced to defer their processing to the next opportunity.

Step 4. “Search by query”. In this step, search is performed by using 3 step terms.

Step 5. “Select primary studies”. In this step, primary analysis is performed. Analysed papers are excluded in the review list if they met at least one of the following criteria:

- Title clearly not related to the review OR
- Is not available in the English language OR
- Is not available as a full version paper, only an extended abstract or presentation OR
- Is a duplicate of the already included paper (we have selected the most recent version) OR
- The article isn’t available in full text.

Step 6. “Assess quality of studies”. In this step, quality of studies is assessed. (Kitchenham *et al.*, 2007) proposed that there is no commonly agreed definition of study “quality” it could be in some degree assessed by constructing check-lists of factors that need to be evaluated for each study. Therefore, we have relied on these (Zhang *et al.*, 2008) quality issues.

Step 7. “Extract required data”. In this step, required data is extracted according to the research questions, presented in the 1 step.

Step 8. “Synthesize data”. In this step, data is synthesized as specified in the 4 section.

Step 9. “Write review report”. In this step, review report is written.

3. Results

This section we propose step 4, step 5, step 6 and step7 results. After step 4, over 361 studies were obtained by searching digital libraries/search engines using the search string. After step 5, selected studies were reviewed considering exclusion criteria. The number of studies was reduced to 34. After steps 6 and 7, we reviewed in detail each of the studies according to the research questions and quality criteria. Therefore, the number of studies was reduced to 8. Information that is more detailed is given in the Table. 2.

The aim of the study was to provide an overview of the dynamic business processes, answering the research questions. Therefore, the distribution of the studies selected within the systematic literature review is presented in the Table 3.

Table 2. Summary of the Literature Review

No.	Data source	Number of paper by step 4	Number of paper by step 5	Number of paper by steps 6 and 7
1	ACM digital library	21	6	3
2	Emerald Insight	9	4	1
3	IEEE Xplore	39	10	3
4	SpringerLink	292	14	1

Table 3. Distribution of selected primary studies by year and publication type

Year	Journal	Proceedings	Conference	Total
2008	0	1	0	1
2009	1	0	0	1
2010	0	1	1	2
2011	0	1	1	2
2015	0	0	2	2
Total	1	3	4	8

4. Discussion

After conducting review we obtain answers to our first research question “*How is dynamic business process defined?*” and they are presented in the Table 4.

Table 4 Dynamic business process definitions

Authors	Definition	Comment
Hachani <i>et al.</i> 2002	Process model may change due to internal changes or external changes, and can add to, delete from or replace an activity with another one.	The authors talk about changes of context (external and internal) and activities, but there is said nothing about a possibility to change next components of process, for example conditions, content of the activity etc.
Zeng <i>et al.</i> , 2002	Dynamic processes can be nondeterministic and they have an ability to flexibly adapt to changing business environment.	The authors introduce a new requirement that process should be not defined, however they are not said about possible changes to the process.

Authors	Definition	Comment
Adams, 2010 and Pesic <i>et al.</i> , 2006	Process must be able to react to changing conditions (internal and/or external) of operation according to the client's individual needs in an appropriate and timely manner, at process instance runtime, without negative impact on the process essence or its expected completion.	The authors talk about changes of context (external and internal) and conditions, but there is said nothing about a possibility to change activity or content of the activity.
Jain <i>et al.</i> 2008	Dynamic business processes are capable of adapting themselves to internal events.	According to other authors, process must changes for internal and external context, however there authors talk just about internal context.
Hermosillo <i>et al.</i> , 2010	Process must be able to dynamically adapt in order to respond to different scenarios.	The authors do not detail how the process must adapt to different scenarios.
Mejia Bernal <i>et al.</i> , 2010	Dynamic business process must adapts, according to eventual modifications in the context information.	The authors do not talk anything about the components of the change
Van der Aalst <i>et al.</i> , 2010	Dynamic business processes are processes, which change regularly and changes are irreversible.	The authors do not talk anything about the process amendment moment.
Rajabi <i>et al.</i> , 2010	Processes must have flexible and adaptive execution, which can evolve according to specific situations.	The authors talk about changes of sequence of activities, executed in the process, but there is said nothing about a possibility to change content of the activity.
Zhu <i>et al.</i> , 2014	Processes need to be rapidly changed and adapted to changes in the external context.	According to other authors, process must changes for internal and external context, however there authors talk just about external context.
Kalibatiene <i>et al.</i> , 2015	Dynamic business process is not defined strictly at the beginning of its execution and it changes under new conditions at runtime.	The authors do not talk about changes of context. Also, they talk just about changes of conditions, however they state, that process should be not

Authors	Definition	Comment
		defined. About this requirement, talked just Zeng et al. (2002)
Trinkunas <i>et al.</i> , 2015	Dynamic business processes can implement a business process models whose components (a set of conditions, a set of activities, a content of activity, a set of activity sequences, a set of decision nodes, the participants) may vary and, if necessary, change with low latency at runtime due to changes of the context).	The authors present the definition, which includes all other authors proposed definition.

Also, we obtain answers to our second research question: “*What are the requirements dynamic business process should satisfy?*” and they are presented below:

According to Yoo *et al.* (2008) dynamic business process schema modification and adaptation can be achieved by defining a set of rules, which is a common way to adapt to changing business environment. According to Rusinaite *et al.* (2015) dynamic business process must fit these requirements:

- Business process should support changes of any process component (a set of conditions, activity, activity sequences, decision nodes and participants);
- Activity sequences are formed at runtime and should not be predefined;
- Business process should support changes due to any process context (a set of external and internal factors);
- The duration of alteration of context is much shorter than the whole duration of the process;
- The process changes can be initiated by any performer role, at any time, with very low latency compared with duration of the process.

We obtain answers to fourth our research question “*What solutions are proposed to ensure business process dynamism?*” and they are presented below.

Wörzberger *et al.* (2011) presented results of the DYPROTO project, where dynamic processes functionality is defined as ‘runtime dynamics’. This functionality supports dynamic modification of process’ instance models. Run time dynamics at least have to include dynamic adding of unpredicted activities, dynamic removing of unnecessary activities or dynamic reiteration of (previously executed) activities. Gong *et al.*, (2011) propose an architecture based on business rules and Semantic Web Services (SWS) to create dynamic business processes.

Hermosillo *et al.* (2010) presented Complex Event processing for Context-adaptive processes in pervasive and Heterogeneous Environments, a framework that intends to facilitate the integration of Complex Event Processing (CEP) into existing business processes and to allow these processes to be dynamically adapted to different circumstances. They proposed the Standard Business Process Language (SBPL), an extension of Business Process Execution Language that allows user to include the

adaptation points and conditions in order to create dynamically adaptable business processes. The SBPL uses special plugins to deal with the different languages of the CEP engines, allowing the users to write their process' specifications only once and deploy them in the engine they want.

Zeng *et al.* (2002) presented a PLM flow framework that dynamically generates workflow schema to enable business process composition by rules inference. The execution of a PLM Flow instance is enabled by business rules, which provide flexibility to adapt to changing business environments. Yoo *et al.* (2008) presented a rule-driven approach for dynamic business processes schema modification and instance adaptation. This approach uses rules that contain schema modification operations and conditions in which those operations are performed, thus enabling rapid schema modification when business environments change. They have also proposed specific system architecture by making best use of existing technologies and components.

Also, we obtain answers to our last research question “*What gaps exist in current research?*” and they are presented below:

- One gap exist because there is not done research on possible measures of dynamicity and the ways of dynamicity measurement;
- Next one exist because there is not done research on concurrently running dynamic business processes, when they are using different type of resources in concurrent manner;
- One more gap exist because there are not done full-scale research on impact of internal and external contexts on running dynamic business processes.

5. Conclusion

This paper reviews studies on dynamic business processes. The studies include peer reviewed scientific papers published in journals, conference proceeding and collections. The review was performed following the guidelines for systematic literature review presented by (Kitchenham *et al.*, 2007). From this review, we can conclude that although the research in the field of dynamic business process is important, relevant and growing, the relatively small number of the publications in scientific journals indicates that this field is still immature and requires further comprehensive research. In future research, we are planning to make a more detailed dynamic business process analysis, which use such terms as ad-hoc, flexibility, variability and adaptivity.

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