

On the Usability of Business Process Modelling Tools – a Review and Future Research Directions

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Abstract: The choice of a business process modelling (BPM) tool in combination with the selection of a modelling language is one of the crucial steps in BPM project preparation. Different aspects influence the decision: tool functionality, price, modelling language support, etc. In this paper we discuss the aspect of usability, which has already been recognized as an important topic in software engineering and web design. We conduct a literature review to find out the current state of research on the usability in the BPM field. The results of the literature review show, that although a number of research papers mention the importance of usability for BPM tools, real usability evaluation studies have rarely been undertaken. Based on the results of the literature analysis, the possible research directions in the field of usability of BPM tools are suggested.

1 Introduction

Business process modelling (BPM) has emerged as a popular and relevant practice in information systems (IS) [In09]. While academics tend to review existing and propose new approaches for process modelling and analysis, practitioners apply these approaches to real-world modelling projects. A successful BPM project requires proper management, in which preparatory activities play an important role [RSD11]. These activities start with the identification of relevant perspectives, communication channels and modelling technique, followed by selection of a BPM tool [RSD11].

The choice of a BPM tool is influenced by a number of factors, such as modelling methodology support, overall functionality or collaboration support [Ka07], [RSD11]. Numerous studies were conducted to compare BPM tools based on functionality aspects, such as collaboration support [RHI11], model analysis or process collections management [DRR12], [Ro11]. However, available research publication often neglect actual user experience and quality of user interaction with BPM tools.

Personal user experience during the interaction with a product is studied by performing usability evaluation [AT13]. Usability is an important aspect in such areas of IS as software engineering or web development. Nielsen states that nowadays usability is a

necessary condition for survival in a constantly changing web environment [Ni94]. Usability studies are becoming more and more popular in the area of eLearning systems [OKU10], IS design for people with disabilities [Fu05] or clinical information systems [Am09].

In the area of BPM usability plays an equally important role [PCV10], [MR13]. Considering that the target user group of BPM tools is shifting from modelling experts to domain experts from the departments without specific IT knowledge [FT09], [LR12] the usability becomes even more crucial. BPM tools have to become less complex and more understandable [LR12], easy to learn and memorize [Re08], and efficient to use for an overall effective outcome. Usability is seen as the fore factor for technology choice and acceptance [VD00]. Moreover, considering usability goals and guidelines already during the tool design phase reduce the costs of tool support after the product has been released [BB00]. Despite these statements solid usability studies seem to be underrepresented in the BPM community. Therefore the goal of this paper is to evaluate the current state of research on the usability in the field of BPM and identify a set of future research opportunities for BPM tools usability.

The paper is structured as follows: in the related work section we provide the usability definition and brief overview of available evaluation methods, together with the definition of BPM tools. We then proceed with the description of the research method and present the main findings from the literature analysis. We conclude the paper with a discussion of the obtained results and definition of possible research directions.

2 Related Work

2.1 Usability

Usability is a concept widely used in IS, e.g. in evaluation of the interface design and quality of interactive systems [IF08], [Ni94]. Numerous definitions of usability can be found in the literature [AT13]. ISO 9241-11 defines usability as an extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [In98]. [Sh91] and IEEE glossary [In90] extend the above definition by including also speed, time and ease of learn, retention, errors, amount of support needed when working with a software and user specific attitude to the product. Therefore usability is a multi-dimensional concept, composed of the following attributes [Ni94], [In98], [Sh91], [In90]:

- effectiveness – accuracy and completeness of achieving specified goals;
- efficiency – resources expended in relation to effectiveness;
- learnability – ease of learning the functionality of the software;
- memorability – retention of the functionality while using the tool on irregular basis;
- satisfaction – subjective attitude of the user towards the product.

A set of metrics has been defined for usability measurement and evaluation, e.g. task success, number of errors, time to complete a task, user satisfaction. [AT13]. Usability metrics reveal the personal user experience during interaction with a product, characterised by the dimensions presented above [AT13]. At the same time usability does not measure general preferences or attitudes, it only evaluates actual experience when using a particular software product. Usability metrics provide information, helpful for improvement of the product functionality and market position, as well as for comparison of various products [AT13].

The metrics are collected during usability experiments, which might employ quantitative, qualitative or neuroIS methods. By using quantitative methods, the performance aspects of effectiveness, efficiency, learnability and memorability can be estimated. Qualitative methods are mostly employed for measuring satisfaction, a subjective variable, which cannot be revealed by performance evaluation. NeuroIS methods, such as eye-tracking, emotion measurement or analysis of brain activity, despite their unusualness are becoming more and more popular among IS researches as an additional perspective on user behaviour evaluation [BRL11].

2.2 Business Process Modelling Tools

BPM tool is a piece of software, which provides the user with a possibility to create, store, share and analyse business process models. Typical examples of BPM tools used in academia and practice are: Software AG's ARIS Business Process Analysis Platform¹, ADONIS [KK02], APROMORE [Ro11] and a web-based modelling tools, such as Signavio [KW10] or icebricks [Be13].

[Ro11] distinguish between standard and advanced BPM tools functionality. While the first group incorporates such features as creation, modification and deletion of process models, access control, and simple search queries [Ro11] and is provided in both academic and practice-oriented tools, the extended functionality, such as quality and correctness analysis, pattern-based analysis, or reporting functions are at the moment not widely presented in the commercial software, but have a great potential to become a part of it in the nearest future [Ro11].

3 Research Method

To address the research questions a systematic literature review [Br09], [WW02] was chosen as an appropriate research method. We put the focus on analysing and criticising research methods and outcomes regarding usability in the BPM field. We argue that in order to get the full picture of the current state of usability research in BPM, both studies on BPM languages and BPM tools have to be taken into account. It is important to review and compare the usability investigation approaches in both areas. The future research directions derived from the literature analysis are targeted only on BPM tools.

¹ <http://www.softwareag.com/de/products/aris/bpa/overview/default.asp>. Accessed 19.05.2014

The results of the review should be of value to the academics, who perform design science research in the area of BPM, as well as to the general IS audience interested in BPM and usability.

Based on the key terms defined in the previous chapter, we came up with a set of keywords for the literature search: “usability” combined with “BPM”, “process modelling”, “process management” and “conceptual modelling”. We searched for the keywords in the digital publication databases (ACM, AIS, DBLP, EbscoHost, ScienceDirect and SpringerLink) as well as Google Scholar (first 100 hits). The time frame of the publications was not restricted, so all the peer-reviewed conference papers and journal articles, published before November 2013, which satisfied the search criteria, were taken for the consideration.

As a result of the search we got a set 2402 publications, which was reduced to 386 papers by analysing titles and abstracts. After removing duplicates, ensuring if the terms “process” and “usability” were both present in the full text, as well as checking the possibility of downloading the paper, we have taken 74 papers for detailed analysis. From 74 papers 12 turned out to be not suitable for the review either because the usability was not used in appropriate context, or because BPM was not the main topic. The rest 62 paper were thoroughly analysed and included in the concept matrix.

4 Findings from the Literature Analysis

As a basis for the analysis we have constructed a concept matrix with the following dimensions: (a) year of publication, (b) domain - BPM languages and process models themselves (1) or BPM tools (2), (c) usage of usability term - presence of references to the established usability literature, and (d) research phase, e.g. motivation, requirements specification, evaluation or future steps.

4.1 Year of Publication

All the analysed papers and journal articles were published between the years 2005 and 2013. Therefore the topic of usability in BPM is relatively new. Moreover, the growth of interest to the topic of usability can be noticed starting the year 2010 (see Figure 1).

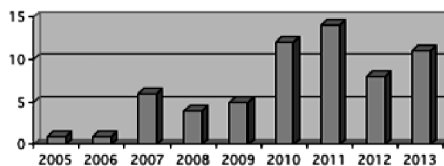


Figure 1. Publications' distribution by year

4.2 Publication Domains

We have identified the publications on different aspects of process modelling, such as development of new and analysis of existing BPM languages, evaluating quality of BPM models, as well as development of new functions for BPM tools. We then classified all the papers into two main groups: BPM languages and models (1) and BPM tools (2). Some of the papers covered both aspects and thus are included in both groups.

The first group includes 29 papers, which mostly propose new approaches to BPM [BSM11], [Bu10], [Fe10], [GK10], [Hu08], [Li12], [LR12], [SGN07], [Sc11]. Furthermore publications regarding evaluation [GHA11], [Ro09a], [Ro09b], [SG10] and comparison [BKO10], [BO10], [Fe10], [Fi10], [Ka07] [LS07] of already existing modelling languages (e.g. BPMN, UML Activity Diagram) were identified, together with extensions of the existing modelling notations (BPMN) [BFV11], [Ku11], [MB12], [Na11], [Pa11], [WS07], [WSM07]. Moreover, [GD05] proposed a framework for measuring business process quality, in which usability was one of the characteristics, [MRR10] analysed different activity labelling approaches and [FT09], [SA13] proposed a new business process visual query language.

The rest 38 papers either presented new, or analysed existing BPM tools. Most of these publications present prototypes or completely implemented tools for process design [An13], [Be13], [Bu10], [DV11], [Fe10], [JCS07], [KH09], [LWP08], [Mo09], [Re08], [RKG13], [Sc11], [WR06], [WBR10]. However, [Co13], [FT09], [KKR11], [KRR12], [KHO11], [Ku08], [LMR11] proposed functional extensions for existing BPM tools – a piece of some specific functionality, such as model querying or change tracking, recommendation based modelling or automatic labelling of process activities. Two papers were devoted to the architecture of process model repositories [GK10], [WW10] and four specifically investigated the collaboration aspects of BPM tools [AN11], [SCS13], [WO12]. Moreover, requirements for BPM tools were summarised based on empirical research [ASI10], [PCV10] or comparison of existing tools or repositories [EJ12], [MR13], [RSS13].

[KL11] conducted a solid usability evaluation of software process modelling tools. Although the paper does not fully suite the analysed domains, we still included it in the review as a good example of a thorough usability study.

4.3 Usage of the Usability Term

As the next point of analysis we looked if the papers provided definition of usability and used the references to the standard usability literature [In90], [In98], [Ni94], [Sh91]. Only 3 papers used the definitions from these sources [BKO10], [BO10], [Fi10]. Besides this, [Ro09a], [Ro09b], [SG10] used the definition from ISO/IEC 9126 standard² on software engineering product quality, where usability is a characteristic of external quality and is actually seen as understandability.

² http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=22749 Accessed 20.05.2014

Approximately the same set of publications discussed the metrics, used for usability evaluation [BKO10], [BO10], [GD05], [Ro09a], [Ro09b], [SG10]. In [SG10] the usability (understandability was used as the actual term in the paper) was measured as time, number of correct answers and efficiency, defined as the number of correct answers in relation to time. [Ro09a], [Ro09b] used answer time, success rate, efficiency, subjective evaluation as measures of usability (understandability). [GD05] employed an extended subset of metrics from ISO 9126 for evaluating the quality of process models: understandability (description completeness), operability (cancellability, undoability and monitorability) and attractiveness of interaction. [BKO10], [BO10] used efficiency, effectiveness, and satisfaction measures. “Number of commands used” metric and a standard usability questionnaire for the evaluation were employed in [DV11].

4.4 Usability as a Main Topic of the Study

Only in two publications [BKO10], [BO10] a systematic usability evaluation was presented. Both works compared the usability of BPMN and UML activity diagrams. As already stated in the previous chapter the papers have references to the standard usability literature and use the metrics of efficiency, effectiveness and satisfaction to measure the usability of two modelling languages. Other papers included the concept of usability only in particular steps of their research, as discussed in the next section.

4.5 Research Phase

We have identified six main areas, in which usability was mentioned in analysed publications: comparison of BPM languages or tools; requirements specification; evaluation; ensuring usability before conducting an experiment; and future steps. Figure 2 presents the distribution of papers depending on the research phase, in which the usability was mentioned. The most popular phases were requirements specification, evaluation and future steps. However, the works on BPM languages mention the usability more on in the requirements, and the papers on BPM tools – in future steps.

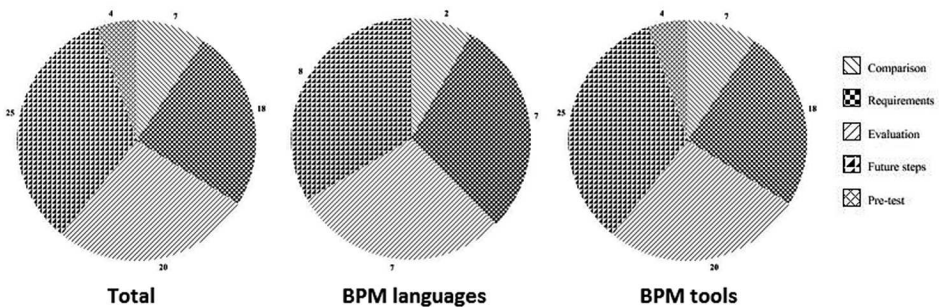


Figure 2. Relevant papers' distribution by research phase

Comparison

The more notations are developed for BPM, the more research publications on comparison of existing ones are made. Each of these publications tend to choose the most appropriate notation for a certain purpose. Thus, [BKO10], [BO10] analysed and compared UML Activity Diagrams and BPMN. One of the criteria for comparison was usability of the notations, measured according to [In98] as effectiveness, efficiency and satisfaction. [Fi10] used the usability definition, provided by [Ni94], and stated that usability is important in two cases: model creation and model interpretation. They further discussed representation of routing elements in BPM languages from the usability perspective. [LS07] compared graphical BPM approaches to the rule-based specifications of business processes, where they understood usability as simplicity of use. And finally [Ka07] proposed a selection framework of BPM method, in which one of the criteria was usability, understood as functional capability to express certain process behaviour.

The comparison of BPM tools is performed quite seldom, which is explained by the fact that research in this area is targeted on creation of new BPM tool functionality. [KL11] compared two software process modelling tools, using ISO metrics and [EJ12] compared existing BPM repositories to identify challenges that affect their usability in supporting re-use of process models [EJ12].

Requirements specification

Usability is seen as important characteristic of BPM languages and tools, and thus should be taken into account when proposing new solutions [KH09], [Sc11], [SA13]. The same statement is supported by empirical research [ASI10], [PCV10], [RSS13], [MR13]. Usability requirements arise mostly due to shifting of the target user group from IS engineers to business users [BSM11], [FT09], [Ku08], [LR12], [Mo09].

Despite the common belief that increasing usability usually means decrease in flexibility of the modelling tools [DV11], [Mo09], [Re08] or expressiveness of modelling approaches [BSM11], the authors still try to find a trade-off [BSM11], [DV11], [Mo09], [Re08]. Common usability requirements demand less complex and more understandable BPM tools and languages [DV11], [Ku11], [LR12], [Mo09], [Na11]; better graphical tool support and user-friendly visual representation of models [FT09], [Ku11], [Ku08], [Mo09], [Ku11]; intuitive interface and improved functionality together with shorten learning period for BPM tools [DV11], [WSM07], [Re08].

Evaluation

From the total 20 publications, which mention usability in the evaluation section, 7 were devoted to the evaluation of BPM notations or process models [BFV11], [Fe10], [GHA11], [Li12], [MB12], [Sc11], [SA13]. The authors used different evaluation approaches, such as conducting user survey [Sc11]; experiment, where the participants were asked to interpret process models [MB12], use two different process model querying techniques [SA13], and comparing how correctly users were solving modelling tasks [GHA11]. [Li12] performed the evaluation with use-cases, when different possible

modelling scenarios were implemented using the provided BPM language. [BFV11] evaluated the proposed notation by implementing it in a modelling environment and showing that the proposed constructs and rules are realizable. One of the interesting evaluation approaches was used by [Fe10], where the BPM notation was compared to user interface and its elements to the icons in a software program. Thus, it was possible to use a method of [Ni95], which was originally developed for evaluation of iconographic usability.

The other 15 papers were devoted to the usability of BPM tools. The most popular evaluation approach was conducting an experiment and surveying the participants on their personal experience with the tool [AN11], [Co13], [DV11], [Do13], [KHO11], [Mo09], [SCS13], [WW10], [WR06]. In one of the papers a special attention was put to the fact that “not computer scientists” participated in the interviews. In comparison to subjective evaluation, performance metrics were gathered only in two cases [KHO11], [SCS13], and in one case the clickstream data was analysed [WW10]. Participant observation was used in [An13], [DV11], [Do13], [WO12]. [WW10] and [Be13] based their evaluation on deployment of the tool in different settings and gathering the user opinion after some period of usage. [LWP08] made the “theoretical evaluation” by discussing the functionality of the tool, which were supposed to increase its usability.

Ensuring usability before conducting an experiment

[CI12], [Pi13], [Pi12a], [Pi12b] ensured the usability of the tool by conducting a pre-test before carrying out an experiment, which was not connected to the usability evaluation. Unfortunately the authors did not provide any details on the pre-test.

Future steps

A great part of the analysed papers mention usability among the future steps. Most of the papers state that they plan to conduct a usability evaluation of the proposed modelling approach or developed modelling tool in empirical study [MRR10], [Pa11] [SGN07], real world usage scenario [GK10], [RKG13], [WBR10] or experiment [FT09], [KRR12], [Sc11]. Others claim they plan to improve the usability by applying user-centric design approach based on prototype iteration [WS07], focusing on usability aspects [KKR11], applying design principles in support of usability and flexibility [Hu08], incorporating usability features based on conducted evaluation [AN11], [An13], [Be13], [LWP08], [Sc11], [WO12], following usability inspection methods [Fe10] or by just analysing and addressing usability and performance of the system while extension [JCS07]. Two publications compared the usability of the proposed approach to the existing ones [LMR11] using Delphi method [Bu10]. And only one author has explicitly specified that usability metrics will be discussed in future publications [RKG13].

Combination of several steps

In some cases usability was mentioned not only in a single research phase, but in a combination of two. [DV11], [Mo09], [SA13] state that usability is an important requirement for a BPM artifact and thus has to be taken into account when developing new solutions. They then performed an evaluation of the proposed visual querying

language [SA13] and BPM tools [DV11], [Mo09]. Similary [FT09], [Sc11] identify usability as an important requirement for BPM tool, but as the implementation of the artefact has not been yet finished by the moment of the paper publication the actual evaluation has been postponed to the future steps. Finally usability was mentioned in both *evaluation* and *future steps* sections. [Sc11] proposed a new BPM approach and [AN11], [An13], [Be13], [LWP08], [WO12] presented new BPM tools. All the publications stated, that the usability of the proposed artefact was evaluated and revealed possibilities for improvement, which were postponed to the future steps.

5 Discussion and Future Research Directions

Usability has established itself as an important topic in such areas of IS as web development and software engineering. The goal of this research paper was to evaluate the current state of research on usability in the area of BPM and identify a set of future research opportunities for the topic of BPM tools usability. For this purpose a systematic literature review was conducted, in which we have analysed papers and journal articles, which have either BPM languages or BPM tools as a main topic and at the same time mention usability as one of the aspects of their research. In this section we summarize the main findings from the literature analysis and synthesis and suggest possible research directions on the usability of BPM tools.

Foremost it should be said that usability is a relatively new aspect of research in the area of BPM and its popularity has been growing in the last five years. The empirical research underlines the importance of usability, which can be primarily explained by the shift of target user group of BPM tools from IS engineers to the business users without particular IT knowledge. Therefore it is definitely necessary to continue the research in this area.

However, the review also revealed quite unimpressive results concerning the usage of the term itself – usability is still often used just as a “buzzword”, without providing any concrete definition. Only few publications are referring to the established literature on usability. Taking into account that usability in web and interface design has been investigated already for 25 years, the academic works on BPM should benefit from the available research results by applying already existing usability practices.

The number of thorough usability studies in BPM is still quite small. Mostly these solid studies are conducted for BPM languages, but not for BPM tools. Usability has been successfully employed for comparing existing BPM notations (e.g. BPMN and UML Activity Diagrams), however comparison of BPM tools is rarely conducted. We suggest that more attention should be paid to comparison, evaluation and improvement of existing BPM tools, rather than implementation of similar functionality in new artefacts.

BPM publications without primarily focus on usability still mention it in separate research phases, such as requirements specification, evaluation and future steps. Our analysis shows that there is still a room for improvement at each of these phases. The usability requirements specified for BPM tools are still relatively vague and unstructured. We however argue, that based on the similarity of the available BPM tools’

functionality, the requirements could be summarized in a set of usability guidelines applicable to a generic BPM tool. Furthermore evaluation of the artefacts is nowadays mostly performed with surveys. Although qualitative techniques are valuable for measuring user satisfaction, performance metrics, which require quantitative analysis, should not be disrespected. One of the reasons for this deficiency is the absence of usability metrics tailored for BPM tools. Therefore development of a set of such metrics can be a potential research direction. The future steps part of the paper is always “a fertile ground for buzzwording”, however even here more attention can be paid to the aspect of usability by providing details on the possible evaluation approach or methods for ensuring and improving BPM tool usability. Finally, the researchers should not neglect employing the usability methods at several research phases to increase the quality of the developed BPM artefact. BPM tools will only benefit from the usability research and thus improve the acceptance of BPM in both academic and practical environments.

As a limitation of the current research we should mention that the suggested future research directions are just a first research step towards the construction of the final research agenda. In the future research we plan to evaluate the suggested research directions with BPM experts from academia and practice, prioritize them according to their importance and finally compose a research agenda for the topic of BPM tools usability.

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