For a Better Assessment of Business Process Quality

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Abstract. The consistent qualitative assessment, after each applied change, aims not only to analyze the improvement or degradation of the quality of business processes but also to quantify the change impact on the QoS (Quality of Service) behavior. Our work, in this paper, is focused on the change management to assess the qualitative characteristics of business processes. In this respect, a variety of attributes and metrics have recently been proposed to assess the characteristics of the quality of business process models. We propose an overall quality approach which uses a relevant set of business process quality dimensions, characteristics, and metrics. It also proposes to use threshold values in order to evaluate the measurement results. It may facilitate the decision making during the business process evolution and may also help to maintain the high level of service quality.

Introduction

It is widely observed that the changes in Business Process Model (BPM) can affect the original business process quality along with the QoS. Therefore, it is important to control the salient quality features of process models such as the understandability, maintainability, and adaptability during their evolution while also considering the constraints of time and resources. It should also make sure that the system delivers the quality service while maintaining regular compliance with other related services. It is therefore vitally important to understand the dimensions and factors of process model quality and to identify guidelines to ensure the high level of service quality from the outset.

In the literature, some solutions are available to assess the BPM quality. These mainly intend to be comprehensive and applicable to business process models. This provides a variety of standards and frameworks to ensure the improved quality of BPM. These standards and frameworks use a set of metrics to evaluate the BPM quality. However, an evaluative study still lacks in current literature to better meet the bpm specifications [1] and evolving design approaches [2]. The BPM quality metrics can be adapted by certain quality metrics from the field of software engineering [3, 4] to measure some quality characteristics of process models. The significance of these metrics relies on a thorough empirical validation of their connection with the quality attributes.

The rest of the article is organized as follows: The section 2 discusses the context of this work. In section 3, we discuss in detail the approach to assess the business process quality. We intend to formalize the set of metrics to measure the different quality characteristics of business process models. Later on, in section 4 we briefly present the validation strategy of the proposed approach with the help of an example. Finally, in section 5, we conclude the contents of this article.

Motivation and Related Works

To obtain an understandable, reliable, and reusable business process model, it is important to ensure the high quality throughout the life cycle of business process. While there is a lack of standard definition of business process quality, some approaches [5, 6] attempt to associate several quality dimensions (which are based on the ISO/IEC 9126-1 [7]) to assess the business process quality. However, the resulting set of proposed characteristics remains considerably abstract and partial. Besides, it is often difficult to understand the meaning of the dimensions when attributes are not
given. In [8], the authors discuss the activity complexity, control flow complexity, data-flow complexity and resource complexity.

In addition to these approaches some metrics [9] aim to provide the qualitative basis for the analysis, design, development, and validation of business process models. The set of these proposed metrics, which are adapted from the field of software engineering for business process models [9, 2, 3, 4], can be classified into three categories: coupling, cohesion, and complexity as detailed in [10]. This adaptation is justified by the great similarity between software programs and business processes in their compositional structure [4, 5].

Most of these metrics are used to measure understandability and modifiability (quality factors) of business process model which focused primarily on structural aspect of processes and their models such as size, complexity, coupling and cohesion [3,4] without including the behavioral aspect and in this case the evaluation of the quality of service.

In conclusion, our analysis of the state-of-the-art approaches leads us to argue that the quality of business process model is mainly addressed in terms of conceptual business process models (i.e. design time) and rarely in terms of semantics and behavior of business process models (i.e. run-time). The existing literature propose various measures such as cohesion [2], coupling [3], complexity [10], goodness [11] and errors probability [12] etc. to assess prominent quality characteristics of business processes.

Qualitative Assessment of Business Process Models

Our major objective is to propose a quality assessment framework to complement the existing work in this regard. It may help to improve the quality of business processes throughout their life cycle and in particular, after each applied change on business process models. We consider multiple dimensions of quality in addition to the understandability and modifiability. However, there is no consensus about the standard definition of business process quality and the list of characteristics.

We propose a set of relevant metrics to measure the different quality characteristics of BPM quality factors discussed in this article, in continuation of the adaptation of metrics from software engineering to business process models. Among others, one of our objectives is to refine abstract quality characteristics to specific measures. We review, in the following, some of the important metrics, used to evaluate quality characteristics defined as below.

Measure Interoperability

Measurement of interoperability attribute can be done by using Data exchangeability (Dex) and Interface Consistency (InC) metrics.

The Dex metric calculate the ratio between numbers of data objects which are approved to be exchanged successfully with other processes or activities during testing on data exchanges. If we denote the total number of data exchanges by NDA and the total number of data objects to be exchanged by TND, then.

\[
D_{ex} = \frac{NDA}{TND} \quad (1)
\]

\[
TND = \sum \text{Data Object-In of the process} + \sum \text{Data Object-Out of the process} \quad (2)
\]

The InC count the ratio of the number of messages exchanged between participants to the total number of activities. It can be shown as follows:

\[
\text{InC} = \frac{\sum \text{message flow exchanges between participants}}{\sum \text{activities}} \quad (3)
\]

Measure Maturity

It is used to measure the maturity attribute. We can adapt two principal metrics, which are Fault density (FD) and number of Callbacks (NCB).

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Fault density metric count the number of detected faults during model inspection or testing. It computes density by calculating the ratio between number of detected faults \( NF \) and business process size.

\[
FD = NF \div N
\]  
Where: \( N \) represents the size (length) of business process.

Callback metric count the number of callbacks in the business process, it can be shown as follows:

\[
NCB = \sum \text{callback}
\]  

3.3 Measure Fault Tolerance

It is used to measure the fault tolerance attribute. We can adapt Exception Handled (\( EH \)) metric, shown as follows:

\[
EH = \sum \text{handled exceptions}
\]  

3.4 Measure Time Behavior

It is used to measure the time behavior attribute. We can adapt some metrics like Response time (\( RTM \)) metric and Throughput (\( Thg \)) metric.

The RTM metric measure the time it takes before the business process responses to a specified user request.

\[
RTM = \sum \text{Time of each activity to be completed}
\]  

The \( Thg \) metric measure the activities which can be successfully performed over a given period of time.

\[
Thg = \frac{NCA}{OTP}
\]  
Where \( NCA \) is the number of completed activities and \( OTP \) is an observation time period.

Measure Changeability

It is used to measure the changeability attribute we can adopt Modification Complexity (\( MC \)) metric. It can be calculated as follow:

\[
MC = \sum \frac{(WTSC\div N)}{NOC}
\]  
Where, \( WTSC \) represent the Work Time Spent to Change and \( NOC \) is the Number of Changes in business process.

Empirical Validation of BPMN Quality

Currently, we implement a software prototype (BPMN Quality assessment tool). It may help to evaluate the quality of business processes during their design and execution. The prototype uses Eclipse BPMN 2.0 Modeler plug-in to model business processes. The history of different measurements of business process quality is stored in XML format.

Let us consider a scenario of the expense reimbursement process which represents one of the examples of our empirical analysis series. The example illustrates a simple expense reimbursement process where employees of a company claim an expense reimbursement, for instance, buying the office supplies.

The considered example can be described as follows. After the expense report is received (Receive Expense Report), a new account is created if the employee does not already have one (Create Expense Account). The report is then reviewed for automatic approval (Review for Pre-Approval). If amount is less than $200 this one is automatically approved (Auto-Approve Expense Account). Otherwise if
amount is equal or more than $200, then it requires an approval of the supervisor (Approval Review by Supervisor).

In case of rejection, the employee receives a rejection notice through email (Notify Employee of Rejection), or otherwise, in case of acceptation, the reimbursement goes to the employee’s direct deposit bank account (Transfer Money to Employee's Bank).

After the deployment of business processes, many employees complain (who does not get any news from their requests). Therefore, the company has to add a service to meet their needs by carrying a change in the initial schema. The following changes are made, to satisfy this purpose:

- If no action has happened in 7 days, then the employee must receive an approval in progress email.
- If the request is not finished within 30 days, then the process is stopped and the employee receives an email cancellation notice and must re-submit the expense report.

The modified Expense Reimbursement Process schema is shown in Fig. 1. We attempt to measure the quality of Expense Reimbursement Process by using the metrics before and after the structural change, with the help of prototype tool as shown in Fig. 2.

![Expense Reimbursement Process schema evolution.](image1)

For a better visibility of the results of different measures, an evaluation graph can be computed as shown in Fig. 3. As visible in index, the threshold values are in the red line of graph while the blue
line in graph represents the variation of metrics as a result of applied changes. The horizontal axis represents the variation of business process model in time, whereas, the vertical axis represents the metrics values.

**Conclusion**

The research work presented in this paper lies in the premise to better understand the quality requirements of business process models after each applied change. To achieve this goal, we propose a framework which aims to investigate and analyze different quality dimensions of a business process. We implement the approach with the help of a BPMN Quality tool. The obtained measurements are analyzed using threshold values. This allows us to observe the produced variation in quality of business process for an intended change. In the future, we continue to further enrich the proposed set of metrics used to assess the business process quality with the help of empirical validations of BPMN models composed with different structural complexities.

![BPMN Quality tool: evaluation graph.](image)

**References**


