Defining the Quality of Business Processes

Robert Heinrich[1] and Barbara Paech[2]

Abstract: Business process models are used to gain a joint understanding of complex processes. Often they are applied in change projects where either the supporting IT or the processes themselves or both are to be improved. So it is an important question to assess the quality of the modeled business processes. However, so far there is no standard definition of the quality of a business process. Furthermore, business process models are not tuned to capture quality aspects. The goal of our work is to collect important quality characteristics and attributes of processes and to enhance business process modeling languages with means to express these attributes. This paper is a first step in this direction. We define a first set of quality characteristics, attributes and measures for these attributes in a business process. As an example we evaluate how well these measures can be expressed in a BPMN model.

1 Introduction

Business process models aim at providing a joint understanding of business processes. Therefore, they typically cover information about structure and behavior like description of activities or decisions within the process. But they do not aim at providing quality information. Quality information, for example, is information about the reliability or the usability of a business process. That information is of high interest for organizations because business process models are often used in change projects where either the supporting IT or the processes themselves or both are to be enhanced. Furthermore, the quality of a business process highly affects the success of an organization. All the more curious is that there is no standard definition of what constitutes the quality of business processes. This is in contrast to the definition of software product quality which is standardized by ISO/IEC 9126 [ISO01].

This paper discusses how to assess the quality of business processes and business process models. There is a wide range of papers relating to business process quality, but only few try to provide a unifying basis for quality information. These typically try to adopt ISO/IEC 9126 for business processes (cf. [GD05], [HMR09]). However, the resulting set of characteristics is on a very high level of abstraction (see related work in section 5). Furthermore, it is not possible to understand what was adapted how. And it is not clear how relevant the characteristics are for practice.

In this paper we use a more systematic and detailed approach. As a first step we present a meta-model capturing and classifying the quality characteristics of a business process and their relationships. We want to use these characteristics to propose changes to

[1] Institute for Computer Science, University of Heidelberg, Im Neuenheimer Feld 326, 69120 Heidelberg, Germany, heinrich@informatik.uni-heidelberg.de
[2] Institute for Computer Science, University of Heidelberg, Im Neuenheimer Feld 326, 69120 Heidelberg, Germany, paech@informatik.uni-heidelberg.de

business process modeling notations. Furthermore, - as for the software quality characteristics - the characteristics are useful for evaluating specific processes or for defining quality requirements for specific processes. The characteristics are quite general and thus cannot be used directly for evaluation and requirements definition. Therefore, it is important to associate specific measures with them. As an intermediate step we collect attributes which describe important aspects of the characteristics that should be measured. It is *not* the goal of this paper to define a complete set of exact measures for these attributes. However, we collect important base measures which can be composed to complex measures depending on the purpose of measurement. By associating with the characteristics example attributes and measures adopted from practice problems we justify that the characteristic is relevant for practice. These measures then constitute the set of concepts which should be expressible by a business process model in order to support the assessment of the quality of the modeled process. As an example, we evaluate how the Business Process Modeling Notation (BPMN) can express these measures, as it is an up to date and very wide-spread modeling notation for business processes. It is important to note that we are *not* interested in the quality of the business process model as a model. Model qualities are discussed e.g. in [LC05], [MD09] and [MDN09].

The remainder of this paper is organized as follows. Section two introduces relevant standards and concepts. In section three quality characteristics, attributes and measures of the business process are presented. Section four evaluates how well BPMN can express the measures. Section five discusses related work and section six concludes the paper.

2 Background

This section clarifies the background of the paper by presenting standards and concepts relevant for the understanding of the paper.

There is a close relationship between software and business processes [Os87]. For the basic terminology we adapt the terminology from the software product quality standards: In analogy to the definition of data quality characteristic in ISO/IEC 25012 [ISO08] we define a *business process quality characteristic* as a category of business process quality attributes. Adapting the definition of attribute in ISO/IEC 25000 [ISO05], a *business process quality attribute* is an inherent property of a business process that can be distinguished quantitatively or qualitatively by human or automated means. Adapting the definition of data quality measure in ISO/IEC 25012 [ISO08] we define a *business process quality measure* as a variable to which a value is assigned as the result of measurement of a business process quality attribute. In the following, we use *characteristic* instead of *business process quality characteristic*, *attribute* instead of *business process quality attribute* and *measure* instead of *business process quality measure*.

While these definitions can be adapted from software quality standards, this is not that easy with the definitions of characteristics themselves. To validate whether our definitions are relevant we identified typical problems with business processes in practice such as inadequate capacity of resources or unqualified actors. Here we used as a source our own experiences [ABP10] and a process check list [Fi09]. A process check list is a collection of business process problems. Thus, it is based on the assumption that often the business process quality is threatened by similar problems in different organizations or projects. Problems represented in a process check list are typically more specific than quality characteristics. Thus, they can be adapted to attributes or measures.

3 Business Process Quality

This section presents business process quality characteristics, classifies them in a meta-model and provides attributes and measures of these characteristics. We have identified the characteristics from software product quality standards and adapted them while identifying attributes and measures based on the problems (see related work in section 5).

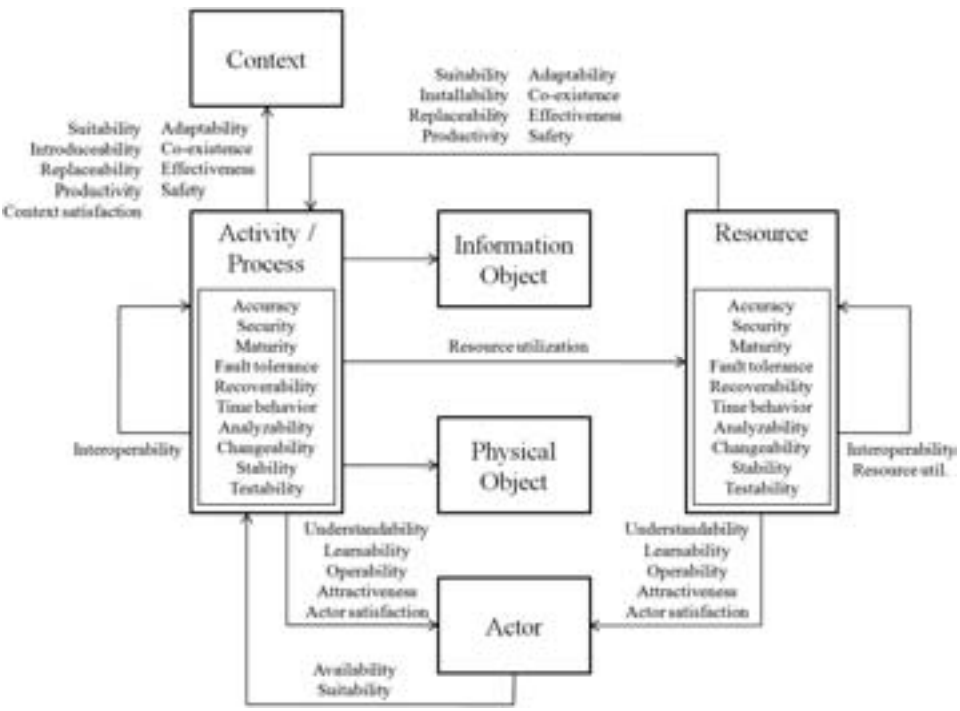

Fig. 1: Business Process Quality Characteristics Meta-Model

Business process quality refers to the components of a business process, to the process as a whole as well as to the context of the process. The context of a business process covers the conditions of use as well as the organizational environment. Components of a business process are the activities, the actors performing these activities, the information objects and physical objects handled and created by the process as well as the resources necessary for execution. So the characteristics are grouped by those categories. Figure 1 provides a meta-model of business process quality characteristics and visualizes their dependencies. The nodes correspond to the categories and the characteristics are listed either within the node or on an edge between nodes. If a characteristic is located on an edge, the assessment of that characteristic depends on information of another category, where A → B means that B must be considered to assess A. Information and physical objects are not studied in detail here (see 3.1.4). Therefore, their attributes are not shown in the figure.

3.1 Characteristics

Next we clarify the characteristics presented in Figure 1 by providing their definitions.

3.1.1 Activity Characteristics

A process consists of activities, where an activity can be atomic or can be a process itself (this means it contains sub-activities). In analogy to software we consider the documentation of the activity as a part of the activity. The following characteristics apply to activities (and by definition also to the process as a whole). We developed these characteristics based on ISO/IEC 9126-1 [ISO01]. ISO/IEC 9126-1 presents characteristics which are further subdivided into sub-characteristics. The latter are also called characteristics in the following and are listed indented below. Mostly, we took the definitions from ISO/IEC 9126-1 and changed only single words. For example, we replaced "software product" by "activity". Sometimes, we had to adapt further parts of the definition or changed the name of the characteristic. These characteristics are marked with "**(N)**" in the following and an explanation for the change is given.

Functionality is the capability of the process to provide activities which meet stated and implied needs when used under specified conditions.

> **Suitability (N)** is the capability of the activity to be appropriate for a specified context of use.
>
> *In ISO/IEC 9126-1 suitability of the software product is focused on "specified tasks and user objectives". We wanted to use uniform terms. Thus, we use "context of use" instead of tasks. Furthermore, as an actor is a process component we cover suitability for user objectives by "actor satisfaction". Moreover, the term "set of functions" is improper for activities, so we changed the wording.*
>
> **Accuracy** is the capability of the activity to provide the right or agreed results or effects with the needed degree of precision.
>
> **Interoperability (N)** is the capability of the activity to be executed before or

after one or more other specified activities.
With respect to activities the interaction corresponds to execution dependency, so we reworded the definition.
Security (N) is the capability of the activity to protect information and physical objects so that unauthorized actors or resources cannot access them and authorized actors or resources are not denied access to them.
An activity should also protect physical objects, so we extended the definition.

Reliability is the capability of the activity to maintain a specified level of performance when used under specified conditions.

Maturity is the capability of the activity to avoid failure as a result of faults in the activity.
Fault tolerance is the capability of the activity to maintain a specified level of performance in cases of faults or of infringement of its specified interface.
Recoverability is the capability of the activity to re-establish a specified level of performance and recover the information and physical objects directly affected in the case of a failure.

Usability is the capability of the activity to be understood, learned, used and attractive to the actor, when used under specified conditions.

Understandability (N) is the capability of the activity to enable the actor to understand whether it is suitable, and how it can be executed in a particular context of use.
*We replaced "*tasks and conditions of use*" as stated in ISO/IEC 9126-1 by "*context of use*" to use uniform terms.*
Learnability is the capability of the activity to enable the actor to learn its execution.
Operability is the capability of the activity to enable the actor to operate and control it.
Attractiveness is the capability of the activity to be attractive to the actor.

Efficiency (N) is the capability of the activity to provide appropriate performance, relative to the amount of resources and the actor time used, under stated conditions.
The efficiency of a software product may only depend on the amount of resources but the efficiency of a business process also depends on the actor time used, so we extended that definition.

Time behavior (N) is the capability of the activity to provide appropriate transport and processing times and throughput rates when executed under stated conditions.
In ISO/IEC 9126-1 the definition of time behavior covers response time. We removed response time because we consider that as inappropriate for activities. Moreover, we extended the definition by transport time which is typically used for business processes.
Resource utilization is the capability of the activity to use appropriate amounts and types of resources when executed under stated conditions.

Maintainability is the capability of the activity to be modified.

Analyzability is the capability of the activity to be diagnosed for deficiencies or causes of failures, or for the parts to be modified to be identified.

Changeability is the capability of the activity to enable a specified modification to be executed.

Stability is the capability of the activity to avoid unexpected effects from modifications of the activity.

Testability (N) is the capability of the activity to be validated.

In ISO/IEC 9126-1 testability requires "modified software" to be validated. We could not see any reason for this restriction.

Portability is the capability of the activity to be transferred from one context of use to another.

Adaptability (N) is the capability of the activity to be adapted for different specified contexts of use.

We shortened the definition of adaptability because the add-on "without applying actions or means other than those provided for this purpose for the software considered" *seemed unnecessarily complex*.

Introduceability (N) is the capability of the activity to be introduced in a specified context of use.

In our view "introduction" is more appropriate for business processes than "installation", so we changed the naming.

Co-existence is the capability of the activity to be executed with other independent activities in a common context of use sharing common resources.

Replaceability is the capability of the activity to be used in place of another specified activity for the same purpose in the same context of use.

Quality in use is the capability of the activity to enable specified actors to achieve specified goals with effectiveness, productivity, safety and satisfaction in specified contexts of use.

Effectiveness is the capability of the activity to enable actors to achieve specified goals with accuracy and completeness in a specified context of use.

Productivity (N) is the capability of the activity to enable actors to achieve specified goals with appropriate efforts in a specified context of use.

We changed the definition of the characteristic productivity because "enable users to expend appropriate amounts of resources in relation to the effectiveness achieved in a specified context of use" *seemed unnecessarily complex*.

Safety is the capability of the activity to achieve acceptable levels of risk of harm to people, business, process, property or the environment in a specified context of use.

Actor satisfaction (N) is the capability of the activity to fulfill a specific actor objective.

Context satisfaction (N) is the capability of the activity to fulfill a particular constraint in a specified context of use.

We split the ISO characteristic satisfaction into actor satisfaction which is

focused on a specific actor objective and context satisfaction which is focused on contextual constraints, like requirements of the customer, because we want to enable a separate consideration of these characteristics.

Compliance (N) is the capability of the activity to adhere to standards, conventions or regulations in laws and similar prescriptions.
In ISO/IEC 9126-1 for each characteristic there is a compliance sub-characteristic. We generalize these sub-characteristics using the characteristic compliance.

3.1.2 Resource Characteristics

A resource is used in a process, for example, a machine, a device, or an IT system. Activities usually need resources for execution. We use the term resource not only for a single one, but also for a whole resource landscape. The quality of these resources affects the quality of the activities. The context of use of a resource is the activity which uses the resource. Therefore, the characteristic context satisfaction is omitted for resources. As a resource is very similar to a software product one can adapt again all ISO/IEC 9126-1 definitions to resources. In the following we present the definition of resource characteristics which differ more substantially from the definition of the activity characteristic than just replacing "activity" by "resource".

Interoperability is the capability of the resource to interact with one or more specified resources.
Installability is the capability of the resource to be installed in a specified context of use.

3.1.3 Actor Characteristics

An actor performs one or more activities. The quality of a business process depends on the availability and skills of those who perform it. Next the characteristics of the category actor are listed. We developed these characteristics to capture attributes and measures from practice [Fi09] related to actors. Note that the actor characteristics differ from the resource characteristics. Thus, in analogy to related work [HMR09] we do not treat actor as a resource.

Availability is the capability of the actor to be able to perform the activity in the required unit of time.
Suitability is the capability of the actor to perform the activity well.

3.1.4 Information and Physical Object Characteristics

The quality of a business process also depends on the quality of its input and output. Input and output can be information objects as well as physical objects. ISO/IEC 25012 [ISO08] discusses data quality characteristics which can be easily adapted to information objects. Furthermore, there is more detailed work on information and data quality (cf. [BP85], [WS96], [KSW02], [Le02], [PLW02], [ES07]) which should be considered. We

could not find a standard which covers the quality of physical objects comprehensively. We suppose physical object quality characteristics can be adapted from data quality characteristics. Information and physical object quality will be the topic of a separate paper. So both categories are not within the scope of this paper.

3.2 Attributes and Measures

One goal of this paper is to refine abstract quality characteristics to specific measures. As an intermediate step we provide attributes for the characteristics. The following paragraphs do not represent a complete list of attributes and measures per characteristic but rather a collection of typical ones. One way to choose them is again the adaptation based on software product quality measurement elements in [ISO07]. However, we are even more interested to see whether the characteristics cover the process goals and problems encountered in practice. Therefore, we looked at typical business process problems represented in a process checklist [Fi09] and at measures we have developed ourselves in the medical context [ABP10]. If the ISO is not referenced as source below, we did not find an attribute for this characteristic respectively a measure for this attribute in the standard. The measures discussed in the following paragraphs are base measures which can be composed to complex measures. Typically they are not meaningful on their own (e.g. number of automated activities), but only in relation to the overall process (e.g. number of activities altogether) or the process component. We have omitted the latter base measure as it can be inferred easily. Note that we do not list all the characteristics of section 3.1 in the following paragraphs, but only the ones whose attributes and measures we found in the literature from practice. This does not mean that the other characteristics are not relevant, but yet we could not find attributes and measures for them.

Table 1 shows attributes and measures of the activity characteristics. The columns labeled with *Attr. Source* and *Measure Source* present the source if we took or adapted the attribute or measure from related work. The column labeled with BPMN is used for the evaluation of BPMN (see section 4). Measures or attributes marked with "E" focus on the behavior during the execution of the process and measures or attributes marked with "S" refer to structural process properties and documentation properties. This is also used for the evaluation of BPMN. Some of the rows are explained in detail after the table.

Characteristic / Attribute	Attr. Source	Base Measure	Measure Source		BPMN
Interoperability					
Interfaces		Number of message exchanges between activities	[ABP10]	E / S	Yes
Maturity					
Fault density	[ISO07]	Number of detected faults, activity size	[ISO07]	E	No
		Number of activities that terminate correctly	[ABP10]	E	Yes
Callback		Number of callbacks	[Fi09]	E	Yes

Characteristic / Attribute	Attr. Source	Base Measure	Measure Source		BPMN
Fault tolerance					
Exception handling		Number of handled exceptions	[ABP10]	E	Yes
Understandability					
Completeness of description	[ISO07]	Number of described activities	[ISO07], [ABP10]	S	Yes
		Number of documented process goals	[ABP10]	S	No
		Number of defined process beginnings and ends	[ABP10]	S	Yes
Variants		Number of XOR decisions	[Fi09], [ABP10]	S	Yes
Loops		Number of loops	[Fi09]	S	Yes
Parallel paths/activities		Number of parallel paths/activities	[Fi09], [ABP10]	S	Yes
Process components		Number of activities	[ABP10]	S	Yes
		Number of actors	[ABP10]	S	Yes
Process components per actor		Number of activities per actor	[ABP10]	S	Yes
Learnability					
Effectiveness of the documentation	[ISO07]	Number of activities successfully completed after viewing documentation	[ISO07]	E	No
Fit between expertise		Expertise needed for the activity, expertise of the actor	[Fi09]	S	No
Time behavior					
Mean amount of throughput	[ISO07]	Throughput, number of evaluations	[ISO07]	E	No
Processing time efficiency		Number of missing triage	[Fi09]	S	Yes
		Number of appropriately outsourced activities	[Fi09]	E	No
		Number of unnecessary activities	[Fi09]	E	No
		Number of automated activities	[ABP10]	S	No
		Number of unnecessary sequential flows between activities	[Fi09]	S	No
		Number of objects with complex handling	[Fi09]	E	No
		Number of media disruptions	[ABP10]	S	No
		Number of unnecessary repetition of activities	[ABP10]	E	No
Transport time efficiency		Number of inappropriate means of transportation	[Fi09]	E	No
		Number of inappropriate routes of transportation	[Fi09]	E	No
		Number of unnecessarily transported objects	[Fi09]	S	Yes
		Number of objects with complex handling	[Fi09]	E	No
Wait time		Number of missing groupings	[Fi09]	S	No
		Number of parallel paths with very different processing time	[Fi09]	E	No

Characteristic / Attribute	Attr. Source	Base Measure	Measure Source		BPMN
Resource utilization					
Mean occurrence of errors	[ISO07]	Number of error messages and failures, number of evaluations	[ISO07]	E	No
Capacity of the resource wrt. activity	[Fi09]	Number of cases in which a resource is not available	[Fi09]	E	No
Amount of resources		Number of resources involved	[ABP10]	S	No
Adequate resource usage	[ABP10]			E	No
Productivity					
activity time	[ISO07], [ABP10]			E	No
Actor satisfaction					
Opinion of the actor		Number of complaints by the actors	[ABP10]	E	No
Context satisfaction					
Opinion of the customer		Number of complaints by the customers	[ABP10]	E	No

Tab. 1: Characteristics, Attributes and Measures of Activity

In the following we discuss attributes and measures represented in Table 1 which may require additional explanation. The characteristic *interoperability* of an activity depends on the attribute *interface* because the interfaces determine whether an activity can be executed before or after one another. The attribute interface, for example, is assessed by the measure *number of message exchanges between activities*. The characteristic *maturity* is affected by the attribute *callback*. A callback is a question an actor needs to get answered to continue the execution of an activity. A callback, for example, is caused by an error or an ambiguity. The higher the number of callbacks, the lower is the maturity of the activity. The characteristic *learnability* is influenced by the fit between the expertise of the activity and the actor because an actor with a low expertise will have problems learning an activity which expects a high expertise. The attribute *fit between expertise* depends on the measures *expertise needed for the activity* and *expertise of the actor*. The characteristic *time behavior* is affected by the attributes *mean amount of throughput*, *processing time efficiency* and *wait time*. The mean amount of throughput depends on the measures *throughput* and *number of evaluations*. According to [ISO07] an evaluation consists of iterations with same input and same scenario. The processing time depends on the measure *number of missing triage*. Triage is a split handling of routine, moderate and problem cases into three separate activities. Triage decreases the processing time because it speeds up the handling of routine cases. Moreover, the processing time is influenced by the measure *number of media disruptions*. For example, if there is a media disruption between two resources, an actor may have to transfer information from one resource to another manually. This is time-consuming. The wait time depends on the measure *number of missing groupings*. Objects of the same or similar type should be processed in groups to avoid frequent changes of the object type. Frequent changes of the object type may increase the wait time. A missing grouping is a single-processed object which is better to be processed in a group. The measure *number of parallel paths with very different processing time* affects the wait time because the

objects on the path(s) with lower processing time have to wait until the path with the highest processing time is completed.

Table 2 shows the resource characteristics and allocates typical attributes and measures.

Characteristic / Attribute	Attr. Source	Base Measure	Measure Source	
Suitability				
Up-to-dateness	[Fi09], [ABP10]			S
Interoperability				
Interface		Number of message exchanges between resources	[ABP10]	E / S
Security				
Authentication		Number of different logins or authentication needed by one actor within one process	[ABP10]	S
Maturity				
Fault density	[ISO07]	Number of detected faults, resource size	[ISO07], [ABP10]	E
Recoverability				
Restartability	[ISO07]	Number of restarts which met required time during testing or user operation support	[ISO07]	E
		Time needed to recover the system	[ABP10]	E
Mobility of functionality in case of failures	[ABP10]			S
Understandability				
Completeness of description	[ISO07]	Number of functions described in the resource description	[ISO07]	S
Effort required for understanding	[ABP10]			E
Learnability				
Effectiveness of the user documentation	[ISO07]	Number of operations successfully completed after accessing user documentation	[ISO07]	E
Effort required for learning	[ABP10]			E
Operability				
Physical accessibility	[ISO07]	Number of functions which can be customized	[ISO07]	S
Effort required for operation	[ABP10]			E
Service (e.g. hotline)		Number of additional services	[ABP10]	S
Ergonomics of the resource	[Fi09]			E
Attractiveness				
User interface attractiveness	[ISO01], [ABP10]			S
Time behavior				
Mean response time	[ISO07]	Response time, number of evaluations	[ISO07], [ABP10]	E
Resource utilization				
Maximum memory utilization	[ISO07]	Memory utilization, number of evaluations	[ISO07]	E
Redundancy of functionality	[ABP10]			S

between resources				
Actor satisfaction				
Opinion of the actor		Number of complaints by the actors	[ABP10]	E

Tab. 2: Characteristics, Attributes and Measures of Resource

This paragraph provides further explanations on selected attributes and measures presented in Table 2. The characteristic *recoverability* depends on the attribute *mobility of functionality in case of failures*. The mobility is important to transfer the functionality from on resource to another in case of a failure of the resource, and thus to recover the functionality of the resource. The characteristic *operability* depends on the attribute *physical accessibility* because the physical accessibility is the prerequisite to operate the resource. A resource can utilize other resources, for example, to store data. Thus, the characteristic *resource utilization* is refined by the attribute *maximum memory utilization*.

The actor characteristics and related attributes and measures are summarized in Table 3.

Characteristic / Attribute	Attr. Source	Base Measure	Measure Source		BPMN
Availability					
Capacity of the actor	[Fi09]			E	No
Suitability					
Skills of the actor		Qualification, expertise, social competence, team skills, motivation, performance ability	[Fi09]	S	No

Tab. 3: Characteristics, Attributes and Measures of Actor

The characteristic *availability* depends on the *capacity of the actor* because an actor is available if he is able to provide the needed capacity at the required unit of time. The characteristic *suitability* covers all the *skills* an actor needs to perform a specific activity. Examples are qualification, expertise, social competence, team skills, motivation and performance ability.

3.3 Summary

The tables above provide insight in the adequateness of our characteristics. We checked the usefulness of the characteristics adapted from a software quality standard for business processes by comparing them with process problems from practice. The activity characteristics and the resource characteristics were sufficient for capturing most of the problems, we only had to develop two actor characteristics to cover all the problems we found in literature. However, only 9 out of the 26 characteristics defined for activities and 12 out of 25 characteristics defined for resources were needed. This might indicate that many of the adapted characteristics are not practically relevant. Moreover, it might indicate that different characteristics are relevant for activities and resources. Furthermore, as one can see, the measures derived from practice differ very much from the measures adapted from the ISO documents. While the ISO measures can often directly be derived from the definitions of the characteristics, the problems capture very

specific practical insights, e.g. measuring the usage of triages to reduce processing time. This clearly shows that the characteristic definitions are only a very first step to the understanding of process quality.

4 Evaluation of BPMN

In the previous section, we refined abstract quality characteristics to specific base measures. In this section, we study these measures wrt. a business process modeling notation. As an example, we evaluate BPMN models because BPMN is an up to date and very wide-spread modeling notation for business processes. The primary goal of BPMN is to provide a notation that is readily understandable by all business users to bridge the gap between the business process design and the process implementation [OMG09]. Business process models in BPMN are called Business Process Diagrams (BPD).

A business process model typically captures structural process properties. However, some of the base measures require knowledge of the behavior during the execution of the process, e.g. such as the time needed to perform a certain activity or the number of failures occurred while performing the activity. We consider a measure as expressible by BPMN if it is directly identifiable in the BPD. If a measure needs additional information to be identified or if there is only an indicator for the measure expressible in the BPD, we consider that measure as not identifiable in BPMN.

BPMN is a useful means for modeling business processes but there are some aspects which are not well covered. The evaluation (cf. Table 1 and Table 3) showed that BPMN is not able to express all the measures summarized in the tables above. With respect to the behavior during the execution of the process there are few measures expressible by BPMN, for example, the number of handled exceptions or the number of callbacks. As a major deficit we consider that BPMN is not able to capture time values. As was expected, BPMN is able to express a lot of the measures which capture structural process properties like number of XOR decisions, number of loops or number of activities. But there are some measures of structural properties which cannot be represented. As a major deficit with respect to structural process properties we consider that BPMN does not provide model elements to express the process components resource and physical object. Thus, measures presented in Table 2 are not expressible in the BPD. Moreover, BPMN does not directly allow modeling important information with respect to model elements like skills of an actor[3] or expertise required for an activity (cf. Table 1 and Table 3). Only modeler-defined property attributes can be used to capture this information. However, this is not possible for actors.

Altogether, 11 of the 24 structural measures and 4 of the 27 behavior measures are expressible by BPMN. Furthermore, 14 of the 40 measures captured from practice are expressible by BPMN, while only 1 of the 12 measures adapted from ISO is expressible.

[3] An actor is represented by the BPMN model elements Pool or Lane [OMG09].

5 Related Work

While there is no standard definition of what contributes to business process quality, there are several publications concerned with the definition of quality. These are discussed in the following.

As mentioned above, the process check list in [Fi09] presents a collection of problems from practice which should be avoided. We assigned these practical problems to the ISO characteristics (cf. section 3.2). Therefore, we reworded, abstracted or stated the problems more precisely because they are presented in question form in the process check list. Thus, the process check list corresponds to a subset of our attributes and measures. In the process check list the problems are considered as time and cost aspects.

[GD05] presents a model for measuring information system effects on business process quality based on the ISO/IEC 9126. The characteristics provided in this approach are covered by our (sub-)characteristics. They only represent a subset of the ISO characteristics which was used in a specific study. The paper does not explain the reasons for this choice.

A recent approach for a comprehensive definition of business process quality is given in [HMR09]. This approach associates several quality dimensions, which are based on the ISO/IEC 9126-1 and other related work, with different components of a business process. Unfortunately, it is not explained which adaptations were made why, and why some of the ISO characteristics were left out. Furthermore, the dimensions are of different granularity. Mostly, the level of abstraction of these dimensions is comparable to the level of abstraction of (sub-)characteristics. As no attributes are given, it is often difficult to understand the meaning of the dimensions. For all these reasons, it is difficult in our view to base further work on the definitions. Therefore, we used a more systematic approach.

[ABP10] gives a first idea of refining abstract quality characteristics of process quality, data handling quality and IT support quality in healthcare processes by allocating specific measures. This approach uses the terms “quality category” and “indicator” to talk about business process quality. The level of abstraction of the quality categories is comparable to the level of abstraction of characteristics and the indicators are comparable to attributes or measures. We assigned these indicators from practice to characteristics, thus they are a subset of our attributes and measures.

Beyond that, there are a lot of publications on the topic of quality metrics for business process models. [Va07] provides an overview of existing literature on that topic. Quality metrics, usually, are based on what we call base measures or a combination of these. Because this publication represents a summary of publications there are few measures discussed in detail. [Me10] focuses on a subset of our characteristics by discussing the measuring of a person’s structural understanding of a business process model. This approach presents definitions which formalize the attributes concurrency, exclusiveness,

order and repetition by describing very specific measures for these aspects. Our measures focus particularly on attributes relevant to practice.

6 Conclusion

In this paper we presented a first attempt to define the quality of a business process systematically. We introduced consistent terminology by adapting software product quality standards. We presented the characteristics coherently in a meta-model which enables an easy overview. By looking at typical process problems we derived attributes and measures for the characteristics. This seems to indicate that only part of the characteristics and the ISO-derived measures are really relevant for business processes. We discussed how many of these measures are expressible by BPMN. This seems to indicate that important notations are missing in BPMN to capture practically relevant measures.

In our view this is a good basis for further research on business process quality. First we want to apply our measures to real processes and check how much effort it is to capture these measures. This will also help in deriving relevant complex measures. Furthermore, this will provide insight in the completeness of our characteristics, attributes and measures. We do not believe that it will be possible to come up with a complete set of measures, but we aim at a set of measures which gives important feedback on quality and which can be captured with adequate effort. Second we want to study other business process modeling notations and define ways to capture our measures in a business process model. Then again it is necessary to apply the new notation to real processes and thereby assess its benefits and drawbacks.

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