A Look into Business Process Modeling Guidelines through the Lens of the Technology Acceptance Model

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Abstract. Business process modeling is one of the first steps towards achieving organizational goals in the requirements engineering phase. This is why business process modeling quality is an essential aspect for the development and technical support of any company. Modeling experts rely mainly on their personal experience, and the tacit knowledge. In order to help less experienced modelers, many authors have formulated modeling guidelines as a mean to achieve better model quality. Our research goal is to assess the acceptance of these guidelines for teaching purposes through a survey. To achieve this objective we investigate usefulness, ease of use and the intention to use of a collected set of pragmatic guidelines according to the technology acceptance model by means of a survey amongst Cuban PhD students. Results reveal the "best" and "worst" guidelines as perceived by novice modelers. We also witnessed that perceived ease of use has an important influence on the perceived usefulness, and, at the same time, both influence the novice modelers' intention to use the guidelines. This implies that to ensure usage of the guidelines by junior modelers, they should be understandable and their utility should be well-motivated.

Keywords: Business process modeling, Quality guidelines, Technology acceptance model

1 Introduction

Business process modeling has recently received considerable attention in information systems (IS) engineering due to its increasing importance in practice [1]. Although business process modeling has been around for many years, only lately research has started to examine quality aspects pertaining to it [2]. Business process modeling quality can be defined as “all desirable properties of a model are fulfilled to satisfy the needs of the model users” [3]. Pragmatic guidelines have been proposed by different authors as a way to provide useable and effective guidelines [4] to help modelers achieving better quality of models [5]. Many of these guidelines have resulted from experimental research that determines advised thresholds below which processes should be more understandable, correct, modifiable, maintainable, etc. While the practical importance of the guidelines is recognized by different authors in first place because of their applicability for novices and non-experts in practice, a first problem is that they remain scattered across different research works, leading to a fragmented and even potentially incoherent set of guidelines. For example, some studies propose modeling guidelines to support the builders of business process models (e.g. [6, 7]) base on empirical research, or present guidelines that results from discussions on how to apply concepts comparable to structured programming to business process models (e.g. [8]). Some other studies focus on how different factors affect model understanding (e.g. [9]), or perform studies that produce new knowledge from where it is possible to extract modeling guidelines (e.g. [10]). To tackle this problem, we performed a Systematic Literature Review (SLR) on the quality of business process modeling [11]. From that SLR we collected 30 pragmatic modeling guidelines. We describe the complete collected list in section 2.2.

On the other hand, designing high quality information systems is a difficult task that requires good skills to convert real business requirements into high quality conceptual models. According to [12], the knowledge of modeling concepts, of the modeling language and of the domain to be modeled are important key factors affecting the quality of a conceptual model and, more specifically, of a business process model. Teaching such knowledge and skills to novice modelers is a challenging task considering that system analysis is by nature an inexact skill. As a result, the effectiveness of novice modelers becomes an important aspect for IS education. A second problem we deal with in the current paper is that the usability of business process modeling guidelines for teaching purposes and their impact on the modeling process has not been researched so far. For this reason, our goal is to assess the acceptance of the collected guidelines for teaching purposes through a survey of the use of business process modeling guidelines by novice modelers. We use the technology acceptance model (TAM) [13] to predict the usage of the guidelines in terms of their perceived ease of use, perceived usefulness and intention to use. We then examine empirically whether the perceived ease of use and the perceived usefulness of the guidelines are correlated with intention to use. We proceed as follows. In Section 2 we describe the research design. Section 3 presents the findings of the paper, section 4 discusses the results and section 5 concludes the paper.

2 Research Design

2.1 Technology Acceptance Model

A possible model to evaluate the usability of the guidelines is the technology acceptance model (TAM) proposed by Davis in [13]. Since its beginning TAM has served as the basis for research aiming at examining usage intentions and behavior of users of IS (e.g. [14]). Over time, different variants of the TAM were created, one being the Unified Theory of Acceptance and Use of Technology (UTAUT) [15] which integrates eight models used in IT acceptance research. Research on technology adoption shows that the UTAUT has the highest power in explaining behaviour intention and usage: the UTAUT explains 70% of acceptance while other models explain about 40% [16]. The question remain whether the use of a TAM which targets the use of a "product" applies to the use of a "method" as well. According to Moody [17], there are clear parallels between user acceptance of IS and practitioner adoption of methods. For this reason, a theoretical model used to explain and predict user acceptance of IS may be used to explain and predict the adoption of methods, like for example pragmatic modeling guidelines. In this context, pragmatic guidelines can be interpreted as technology and their perceived usefulness, ease of use and intention to use evaluation can be investigated through technology acceptance models. On the other hand Riemenschneider et al. [18] found that extending the boundaries of these models from the domain of products to methods has demonstrated their resilience in adapting to a new domain and the differences required by the new domain. Yet their research investigated the adaptation to a software development methodology, which tends to be mandatory rather than voluntary and radical rather than incremental. The use of modeling guidelines on the other hand, tends to be rather voluntary than mandatory and incremental rather than radical. In this respect, and in line with Moody's finding, we believe the acceptance model can be considered as model to predict the adoption of guidelines. There remains the question of which model to use. A key purpose of TAM is to provide a basis for tracing the impact of external factors on internal thinking, attitudes and intentions [19]. The two core constructs that underlie TAM are perceived usefulness and perceived ease of use, which both lead to behavioral intention. As defined by Davis in [13] perceived usefulness (PU) is "the degree to which a person believes that using a particular system would enhance his or her job performance" and perceived ease of use (PEU) is defined as "the degree to which a person believes that using a particular system would be free of effort". Ease of use is thought to influence the perceived usefulness of the technology. Another primary construct in TAM is the behavioral intention to use (BI). Behavioral intention to use is a measure of the likelihood a person will employ the technology. Finally the actual use (Usage) reflects the actual usage of the system [20].

The more extended UTAUT model adds to this several other constructs [15]. *Performance expectancy* is the degree to which an individual believes that using the system will help him to gain in job performance and therefore amounts to PU. *Effort expectancy* is the degree of ease associated with the use of the system and therefore matches PEU. *Social influence* is an additional construct about the degree to which an individual perceives that important others believe he should use the new system and *facilitating conditions* are another additional factor referring to the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system. Facilitating conditions determine use. Social influence, performance and effort expectancy determine the intention to use a system. Behavioural intention in turn determines use. UTAUT also identifies moderating factors: gender, age, experience and voluntariness of use. The UTAUT suggests the following: (1) gender and age moderate the effect of performance expectancy on behavioural intention; (2) gender, age and experience moderate the effect of effort expectancy on behavioural intention; (3) gender, age, experience and voluntariness moderate the effect of social influences on behaviour intention and (4) age and experience moderate the effect of facilitating conditions on behavioural intention.

Another extension of TAM is the Model Evaluation Method (MEM) [17]. MEM combines two different but related dimensions of method “success”: actual effectiveness and adoption in practice. The constructs of MEM are:

Actual Efficiency: the effort required to apply a method.

- Actual Effectiveness: the degree to which a method achieves its objectives.
- Perceived Ease of Use: the degree to which a person believes that using a particular method would be free of effort.
- Perceived Usefulness: the degree to which a person believes that a particular method will be effective in achieving its intended objectives.
- Intention to Use: the extent to which a person intends to use a particular method.
- Actual Usage: the extent to which a method is used in practice

Common factors between TAM, UTAUT and MEM are the Perceived Usefulness (PU), Perceived Ease of Use (PEU), Intention to use (IU) and actual use (Usage).

For our research, not all factors are required to be taken into account into the survey. Due to the use of the guidelines in a teaching context, some of the variables are constant across the entire population and hence do not need to be included in the survey. This applies to actual usage, voluntariness of use, age, experience, and facilitating conditions. The students were not free in their decision to use the guidelines or not. They were asked to at least try to apply each of the guidelines. As a result, we can only investigate future intention to use, and not actual use since the latter is the same for all students. Likewise, voluntariness of use will not vary across the population. *Facilitating conditions* are not available, since the guidelines were to be used without possibility of further guidance. The *age* is approximately the same for all students. Also the *experience* is the same for all students since none of them had prior education in business process modeling. As a result, the only factor that would be relevant to investigate on top of the basic TAM construct is the social influence by peers. Student may have perceived that the teacher believes (s)he should use the guidelines. We did not investigate to what extent this applies to the different subjects and how this might have affected their intention to use the guidelines.

2.2 Collected Modeling Guidelines

As a result from the previously performed SLR [11] we collected 30 pragmatic modeling guidelines that were spread over different studies. In those cases where guidelines overlapped, we chose the guideline taken from the most recent empirically validated work. For example, guideline "S1-do not use more than 31 elements" has been proposed in different formulations across different research works (e.g. [6, 7, 21]). We selected the guideline from the most recent empirically validated study which also suggests a precise number of elements by means of the threshold value (i.e. [7]). For the current study, we did not optimize the guidelines; we only grouped and presented them as they were collected from the literature. To make the paper self-contained, we list the guidelines below. For more details and sources of the guidelines, the reader is referred to [11] which classifies the collected papers on modeling guidelines along the different aspects of model quality (syntax, semantics, pragmatics, etc.).

- Size: The size of the model has undesirable effects on understandability and likelihood of errors: larger models tend to be more difficult to understand [6]. For this reason, there are guidelines whose objective is to guide the modeler in the creation of small models. In this group we include five pragmatic guidelines.
  - S1: Do not use more than 31 elements.
  - S2: Keep the path from a start node to the end as short as possible.
  - S3: Use no more than two start and two end events in one process level.
  - S4: Distinguish success and failure end states with separate end events.
  - S5: Use no more than 12 gateways in your models.
- Modularity and Structuredness: Modularity is achieved by using subprocesses [22]. This entails reducing the size of the model at the top level in the model hierarchy to improve understandability of the model. There are various guidelines in the literature that guide the modeler in the number of items from which the modularity should be included in the business process models and criteria for subprocess discovery [23]. Since model size is a prerequisite to introduce modularization, guideline S1 is also related to modularity. The structuredness property on the other hand, has been discussed as a guideline to avoid errors, first in research on programming, and later also in business process modeling [24]. A business process model is structured if every split gateway matches a respective join gateway of the same type [8]. In this group we collected six guidelines.
  - M1: Model as structured as possible: every split gateway should match a respective join gateway of the same type.
  - M2: Avoid deeply nesting structured blocks.
  - M3: Avoid decompositions into subprocesses with less than 5-7 activities.
  - M4: Good candidates for subprocesses are fragments of a model that are components with a single input and a single output control flow arc.
  - M5: Good candidates for subprocesses are those fragments of a model of which the nodes are more strongly connected by arcs to each other than the nodes outside this collection.
  - M6: Avoid inclusion of many small process models.
- Complexity: According to several authors, there is a relationship between the complexity of a model and its understanding and error probability: more complex models tend to be more difficult to understand and more prone to errors. That is why several research works advice to achieve the lowest as possible complexity in business process models [25]. This group contains eight quality guidelines.
  - C1: Minimize the routing paths per elements: no more than three (inputs + outputs) per gateway).
  - C2: Minimize the heterogeneity of gateway types.
  - C3: Select the less complex alternative when modeling.
  - C4: Avoid redundancy in process models: use a subprocess instead of the same fragment several times.

- C5: Avoid creation of multiple model variants for different scenarios: match process variants towards the creation of more generalized models.
- C6: Avoid OR routing elements.
- C7: Minimize parallelism in your process models.
- C8: Avoid cycles.

- Layout and label style: This group collects guidelines pertaining to the visual presentation of the model. In order to improve the understandability of business process models the layout of the models proves an important aspect. Several pragmatic guidelines refer to the generalization and conceptualization of mechanisms to change the layout of a process model. In addition, an exploration of the label styles used in business process models demonstrated their importance in the understandability of the models. This group resulted in eleven pragmatic guidelines.
  - LS1- Use verb-object activity labels.
  - LS2- Use shorter activity labels.
  - LS3- Use a uniform style for names and flow descriptions.
  - L1- Minimize the number of crossings of connecting elements.
  - L2- Minimize the area of the drawing.
  - L3- Minimize the number of bends of connecting elements.
  - L4- Minimize the number of overlapping (connection) elements.
  - L5- Maximize the number of orthogonally drawn connecting objects.
  - L6- Maximize the number of connecting objects respecting workflow direction.
  - L7- Adapt the size of objects such that elements have enough space.
  - L8- Consider the use of partitions, e.g. pools and swimlanes.

2.3 Instrument

To collect evidence on the PU, PEU and BI of the guidelines, we administered a survey to a sample of 40 students enrolled in a pre-doctoral program at the Universidad de Ciencias Informáticas, in Havana, Cuba. 28 participants were male while 12 participants were female. They received around 50 hours of training in BPMN using Bizagi process modeling tool. We first asked the interviewees to model a medium sized business process case extracted from real systems using BPMN (3 pools with each 10-15 tasks). Then, we asked them to read carefully the collected guidelines and to consider their application to the obtained process model. The students were not free in their decision to use the guidelines or not. They were asked to at least try to apply each of the guidelines. They haven't shown practical implication on process models by the guidelines. After finishing the modeling task, we asked the interviewees to fill out a questionnaire based on TAM about every guideline. The questionnaire used in our study consisted of 9 items divided into three variables. The questions were taken from the original instrument developed by Davis and reformulated according to the context of evaluating guidelines. All items in each of these variables were measured on a five-point Likert Scale ranging from Strongly Disagree (1) to Strongly Agree (5). Each of these questions was scored for each of the 30 guidelines by each participant. Fig. 1 shows the items and the proposed relationship to be tested in our study.

3 Data Analysis

We first conducted Cronbach's alpha analysis to assess the reliability of the instrument used in this study. The Cronbach's Alpha value for each of the variables is well above the threshold of 0.7: perceived usefulness, 0.952; perceived ease of use, 0.953; and behavioral intention, 0.873. This confirms our confidence in our instrument.

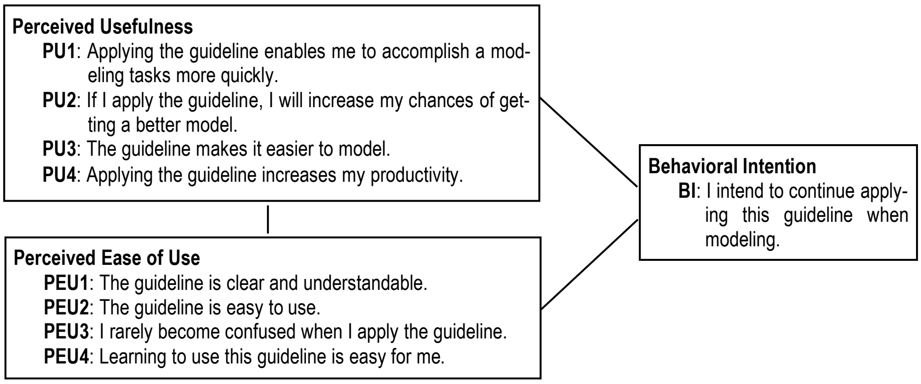

Fig. 1. Research model based on the TAM

3.1 Most and least useful guidelines as perceived by novice modelers

To investigate how novice modelers feel about the guidelines we calculate average, median and mode of the collected data from the survey. Table 1 shows the obtained results for each guideline. According to these values we can select the most easy to use, most useful and the highest intention to use guidelines as perceived by novice modelers. We highlighted those guidelines for which there is agreement on higher scores in all three constructs of TAM. Two of these guidelines belong to the complexity group while five belong to the layout and label style group. Size and modularity guidelines were not consistently highly scored by the participants. However, guideline S4 (i.e. distinguish success and failure end states with separate end events) received the highest score within the size guidelines. Also, guidelines M2 (i.e. avoid deeply nesting structured blocks) and M1 (i.e. model as structured as possible) received the highest score within modularity guidelines. Table 2 also shows the guidelines with the lowest scores for ease of use, usefulness and intention to use according to the survey participants. The highlighted guidelines are those that appear in all the three sets (i.e. the ones with lower scores). Among these guidelines three belong to modularity guidelines, three belong to complexity guidelines and one belongs to layout and label style guidelines.

3.2 Relationships between PEU, PU and BI

To assess whether a relationship exists between the different variables we computed Pearson's correlation coefficient. Fig. 2 shows the correlation between the variables and their significance. In order to further quantify the relationships amongst these variables we carried out a Principal Component Analysis (PCA). PCA is a useful statistical technique which supports the reduction of a complex data set to a lower dimension [26]. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy and the Bartlett's Test of Sphericity indicate the adequacy of the analysis (see Table 3).

Table 1. Average, median and mode values for the modeling guidelines

	Average			Median			Mode		
	PEU	PU	BI	PEU	PU	BI	PEU	PU	BI
S1	4.325	3.912	4.175	4	4	4	5	4	4
S2	4.331	3.975	4.35	4	4	4	5	4	5
S3	4.287	3.806	3.95	5	4	4	5	4	4
S4	4.268	4.1	4.525	4	4	5	5	5	5
S5	4.118	4.106	4.3	4	4	4	4	4	4
M1	4.043	3.925	4.225	4	4	4	5	4	4
M2	3.975	4.187	4.225	4	4	4	4	4	4
M3	3.931	3.587	3.675	4	4	4	4	4	4
M4	4.018	3.756	3.85	4	4	4	4	4	4
M5	3.131	3.331	3.125	3	3	3	2	3	3
M6	3.95	3.962	4.125	4	4	4	4	4	5
C1	4.443	4.306	4.575	5	5	5	5	5	5
C2	4.168	3.993	4.025	4	4	4	5	4	5
C3	4.211	4.506	4.65	4	5	5	5	5	5
C4	4.531	4.7	4.65	5	5	5	5	5	5
C5	3.3	3.843	3.974	3	4	4	3	3	5
C6	3.337	2.85	2.810	3	3	3	4	3	2
C7	3.575	3.287	3.131	4	3	3	4	3	3
C8	4.125	3.915	4.075	4	4	4	5	4	4
LS1	4.9	4.525	4.9	5	5	5	5	5	5
LS2	4.580	4.318	4.55	5	4	5	5	4	5
LS3	4.656	4.602	4.65	5	5	5	5	5	5
L1	4.331	4.143	4.625	4.5	5	5	5	5	5
L2	4.506	4.093	4.4	5	4	5	5	5	5
L3	4.337	4.206	4.358	4	4	4	4	4	4
L4	4.241	4.156	4.575	4	4	5	4	4	5
L5	3.918	3.725	4	4	4	4	4	4	5
L6	4.331	4.237	4.5	4	4	5	5	5	5
L7	4.573	4.174	4.55	5	4	5	5	5	5
L8	4.420	4.443	4.525	5	5	5	5	5	5

Table 2. Guidelines with higher and lower PEU, PU and BI

	PEU	PU	BI
Higher Scoring Guidelines	S2, **C1**, **C4**, **LS1**, **LS2**, **LS3**, L1, L2, L3, L6, L7, **L8**	M2, **C1**, C3, **C4**, **LS1**, **LS2**, **LS3**, L3, L6, **L8**	S4, **C1**, C3, **C4**, **LS1**, **LS2**, **LS3**, L1, L4, L7, **L8**
Lower Scoring Guidelines	M1, M2, **M3**, **M4**, **M5**, M6, **C5**, **C6**, **C7**, **L5**	S1, S3, **M3**, **M4**, **M5**, **C5**, **C6**, **C7**, C8, **L5**	S3, **M3**, **M4**, **M5**, C2, **C5**, **C6**, **C7**, C8, **L5**

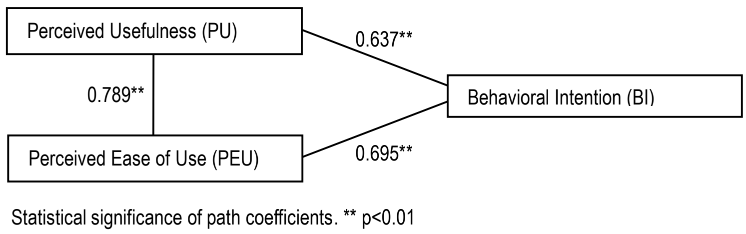

Fig. 2. Structural path diagram for Pearson's correlation coefficient

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.786
Bartlett's Test of Sphericity	Approx. Chi-Square	345.155
	df	36
	Sig.	.000

Three factors explaining 86.588% of the Total Variance Explained were computed, as shown in Table 4. Factors are listed in decreasing order of importance. The results of applying the Varimax Rotate Method are shown in Table 5, where a blank space represents low correlations values.

Table 4. Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	6.205	68.948	68.948
2	.933	10.362	79.310
3	.655	7.278	86.588
4	.407	4.528	91.116
5	.280	3.115	94.231
6	.225	2.500	96.731
7	.171	1.903	98.635
8	.084	.932	99.566
9	.039	.434	100.000

Factor 1 is the most important factor, explaining a 68.948% of variance. It coincides with “Perceived Ease of Use” because the four variables with higher correlations are PEU1, PEU2, PEU3, and PEU4. Factor 2 explains a 10.362% of the total variance. It coincides with “Perceived Usefulness” because the three variables with higher correlations are PU1, PU3, and PU4. Factor 3 explains a 7.278% of the total variance. It coincides with “Behavioral Intention (BI)” as the variable with highest correlation is BI. Notice that there are others variables with high correlation in this factor.

Analysis per guidelines. A more detailed analysis of the guidelines and their correlation values between PEU/PU and BI allows to asses which guidelines are more correlated and to know which groups they belong to. The correlation between PEU and BI was positive and significant for all the guidelines, except for guideline S1 (i.e. do not use more than 31 elements) and guideline S2 (i.e. keep the path from a start node to the end as short as possible) which belong to the size guidelines. For these two guidelines, there is a positive and significant correlation between PU and BI, while for PEU this is not the case.

Table 5. Rotated Component Matrix[a]

	Component		
	1	2	3
PU1		.815	
PU2			.737
PU3		.613	.576
PU4		.842	
PEU1	.626		.691
PEU3	.732		
PEU4	.854		
PEU2	.774		
BI			.894

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 9 iterations.

The Pearson correlation between PU and BI was positive and significant for all the guidelines except for guidelines LS1 (i.e. use verb object activity labels) and L1 (i.e. minimize the number of crossings of connecting elements). These guidelines belong to layout and label style. In the case of the guideline L1, some students disagree with the fact that using this guideline modelers will increase modeling speed. For guideline LS1, some students present neutral position when answering questions related to modeling speed, ease of use and productivity increment. However, they intend to use both of them when modeling a business process.

The Pearson correlation between PEU/PU and BI was positive and significant for all the Complexity and Modularity guidelines.

Analysis per questions. A further analysis of data per question allows to confirm that there exists a positive and significant correlation between understandability (PEU1), modeling speed (PU1), quality of the obtained model (PU2), modeling assistance (PU3), productivity (PU4) and BI. From these aspects, it seems that the improvement of the quality of the obtained model was an important factor for novice modelers when assessing intention to use the guidelines (i.e. the best correlation exists between PU2 and BI). This is followed by the understandability of the guidelines (i.e. PEU1 correlates very well with BI for almost all the cases).

4 Discussion Section

Our research has implications both for research and practice. For the practical contribution we present a collected set of pragmatic guidelines for business process modeling after performing a literature review by the authors. We presented them as they were collected from the literature, without further optimization. When having the collected guidelines assessed by the novice modelers we noticed that the most easy to use guidelines include complexity and layout-label style guidelines. Modularity guidelines never showed up in the most ease to use guidelines. Indeed, all the modularity guidelines appeared in the least perceived easy to use set. When looking at the different scores received for the modularity guidelines and PEU, we notice that students understand modularity guidelines (i.e. PEU1 has the highest score) but they realize they are difficult to apply to the model. This might signify that modularity guidelines need further refinement to make them easier to apply. For example, more details may be required on how modularity should be inserted into the process models; this could be something that eases their application. Modularity is a very important aspect to improve the understandability of business process models and a convenient set of guidelines that clarify modularity insertion into the business process models would be of great value. The behavior intention to use the guidelines is not as good as should be, probably due to the fact that students find them difficult to apply, according to our interpretation of the results.

Among the guidelines perceived as most useful we see all the categories (i.e. complexity, modularity and layout guidelines) appear, except for the size guidelines. Novice modelers do not perceive size guidelines as useful, especially for obtaining better quality models (PU2) or to assist them in the modeling process (PU3). They, however, believe size guidelines are easy to use, and they intend to use them. Another interesting aspect is that all label style guidelines appeared in the top 7 set of guidelines. These guidelines seem to be understandable by novice modelers and they also perceive them as useful and intend to use the guidelines.

When looking at the correlation coefficients found as a result of this study, we confirmed as expected that the Pearson correlation between perceived ease of use and perceived usefulness, between perceived ease of use and behavioral intention and between perceived usefulness and behavioral intention was positive and significant. This might indicate that perceived ease of use increases perceived usefulness and behavioral intention, and that perceived usefulness increases behavioral intention of the guidelines. The fact that perceived ease of use correlates with the behavioral intention to use is in line with what can be expected: when someone has just learned a new modeling technique and is asked to apply it, it seems reasonable that ease of use is the first parameter by which one is guided in order to decide to apply the technique in the future. It is only after some practice that a subject can leverage ease of use against usefulness. It makes therefore no sense to bestow guidelines onto people without giving them at least some guidance in applying the guidelines.

When looking into the finer details of the correlation analysis we notice some guidelines correlate better than other. That is the case for modularity and complexity guidelines, whose average correlations are positive and significant. Some size and layout guidelines did not correlate. In those cases we notice, in general, that modelers felt neutral when assessing PEU or PU of the guidelines and they however intend to use them. As a main conclusion we deduce that guidelines should be perceived as easy to use in first place to achieve their usage in the practice of modeling, and additionally, they should be well motivated.

5 Conclusion and future work

The increasing importance of business process models in practice demand an appropriate set of guidelines that assists modelers in the process of modeling. In this paper we have presented a set of pragmatic quality guidelines that were collected from different research works. Since “perceived efficacy” and “usage” are important measures of the "success" of a method and also of the impact of research in practice [17] we investigated how people feel about the guidelines through a survey. An analysis of the results brought the most/least useful, the most/least easy to use and the highest/lowest scored for intention to use guidelines according to the novice modelers’ perception. According to the results, we conclude that layout and label style guidelines are perceived as the most useful, easy to use and receive the higher scores on intention to use from novice modelers. On the other hand, modularity guidelines were perceived as being the least useful, least easy to use and with lowest score of intention to use among the guidelines for novice modelers. Complexity guidelines appear in both resulting sets. Furthermore, results indicate perceived ease of use might increase the perceived utility of the guidelines, as well as perceived ease of use increase the behavioral intention to use the guidelines. Also, results show that perceived usefulness of the guidelines increase the behavioral intention to use.

Using students is not the same as using practitioners. In particular, given their experience in modeling, practitioners might evaluate the usefulness of guidelines in a different way. As future work we propose to replicate this survey on larger scale with expert modelers from the industry. This would allow to investigate the effect of age and experience on the appreciation of ease of use and perceived utility and their impact on intention to use. On the other hand, we can expect the same type of relationships between the variables as it was confirmed in [17] that relationships between variables are more generalizable between population (i.e. to practitioners) than, for instance, specific characteristics.

When looking into the business process modeling guidelines, different questions come to the surface after. According to this, we acknowledge this set of 30 guidelines is still vast and it needs further refinement. How should this set be in order to achieve its application in current practice of business process modeling? Does it need to be different for teaching purposes and for practitioners use? How should it be in order to help in obtaining high-quality business process models? In general, we believe that the "most intended to use set" of quality guidelines should be optimized in different ways. First, priorities could be defined amongst the guidelines according to targeted levels modeling quality (basic quality versus higher quality levels), or they could be partitioned according to envisaged quality goals such as understandability, correctness, maintainability, etc. of models. Second, the perceived usefulness of guidelines may not always match the utility of guidelines as established through research. The set of guidelines can be improved, e.g. by providing convincing motivations for each guideline. These motivations might be instrumental in teaching practice as they will foster a deeper understanding of modeling quality. The same holds for ease of use: the formulation of the guidelines should be enhanced such as to making them easy to apply, especially by inexperienced people who do not yet have sufficient insight in the consequences of modeling decisions in order to apply guidelines at the right moment and in the right way. Moreover, guidelines should be supported by empirical evidence. One direction of future work would be related to this, in order to make the modelers perceived the guidelines in such a way they have intention to use them. Finally, from a theory-building perspective, it would be good to build this set of guidelines on quality frameworks fundaments (e.g. SEQUAL [27] or CMQF [12]). In future work, we intend to fill the gaps that still persevere in the research field with a new set of pragmatic guidelines that allows improvement of all desirable characteristics in the business process models. This could be seen as a contribution to the body of knowledge on the quality of business process models at a conceptual level.

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