The Goal-Based Selection of the Business Process Modeling Language

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Abstract. Business process models are an essential issue of enterprise modeling because business process modeling is the means for performing a wide range of tasks, such as documentation, communication, business improvement, and capturing requirements for software design up to creation of executable process descriptions. Nowadays a wide range of general purpose business process modeling languages are used for handling these tasks. Constantly also a number of the general purpose modeling language extensions and domain specific modeling languages (DSL) are being developed. Thus, obviously, the universal business process modeling language that would be suitable for all the modeling purposes does not (yet) exist. In such a situation the modeler is faced with the problem of choosing a business process modeling language suitable for a certain modeling purpose. This paper proposes to base the choice of the language on a formalized business process modeling goal and a three dimensional business process modeling framework. The paper also describes how to use the proposed framework to measure the modeling language conformity to a certain modeling goal using a general business process element taxonomy and metrics.

Keywords: business process modeling goal, business process modeling framework, business process element taxonomy, business process modeling language metrics

1 Introduction

The scope of the business process modeling is wide and is continuously increasing. Business process models are used for business process reengineering and management, business process aware system development, e-commerce solutions, enterprise regulation modeling, business process orchestration and choreography modeling, knowledge management, requirement specification, and other purposes.

Such wide applicability of business process models could be explained by the facts that business process modeling is used as the means for handling a wide range of tasks; and that it is supported by the business process modeling tools with constantly evolving functionality. However, the wide applicability of the business process modeling leads to certain problems. Almost in each area of use a number of appropriate business process modeling languages are available (e.g., formal modeling languages). Constantly also extensions of general purpose modeling languages are being developed. For instance, BPMN is already acknowledged as a *de facto* standard for business process modeling and has been recognized as an inter-organizational standard [1] that covers all necessary business process aspects and is suitable for a wide range of users, from business analysts and developers to managers and external partners and clients. However, the applications of this notation have many subsets of elements and a multitude of extensions, and it still coincides with many other modeling languages, forming a large set of available options for business process modeling languages and dialects [2]. Thus, we can conclude that there is no universal business process modeling language that would be suitable for all modeling goals.

Enterprises are faced with situations where the same business processes are modeled for different purposes [3]. On the other hand, particular business process modeling languages are appropriate for certain business process modeling goals. The question arises, how to find a modeling language that is suitable for a certain modeling goal. While, in general, the goal of modeling is a central notion in the choice of modeling languages, in the most of researches, which propose guidelines, techniques, and methods for business process modeling language evaluation or/and selection, the business process modeling goal is not formalized and respectively not transparently taken into account. To overcome this gap, and to explicate and help to handle the business process modeling complexity, the approach to formalize the business process modeling goal and the supporting three dimensional business process modeling framework were proposed [4].

The way how to formalize the business process modeling goal was discussed in detail in [4], specifying what parameters the desirable business process abstraction should have. On the basis of the formalized modeling goal, business process modeling languages can be evaluated according to the values of the modeling goal parameters. In order to identify the values of the modeling goal parameters this paper describes appropriate metrics and algorithms for evaluating modeling language conformance to selected values of modeling goal parameters.

The remainder of the paper is organized as follows. In Section 2 the approach for formalization of business process modeling goal and the supporting Business Process Modeling Framework are described. Section 3 illustrates how the Business Process Modeling Framework can be used for evaluation of business process modeling languages. In Section 4 the related work is outlined. Brief conclusions are presented in Section 5.

2 Formalization of the Business Process Modeling Goal

A natural way to learn about the world around us is its modeling. When we create models, the object under the research is replaced by another mental or physical object, which is more convenient, safer, or cheaper to use than the original. According to such general explanation of the model, any kind of modeling requires the creation of the abstraction of the research object. In a general sense, abstraction is understood as highlighting of the important properties of the research object and ignoring unimportant properties; or creating the general concepts or ideas from the set of objects or facts [5]. By analyzing the business process modeling language specifications (BPMN, DFD, IDEF0, EPC, UML AD, etc.) and business process modeling framework documentations [6,7,8,9,10], we have found that, in order to create the business process model for a particular goal, the following three types of abstractions are to be used:

- Filtration of the business process elements according to the certain modeling perspective
- Generalization from the details about the business process execution according to the selected level of the uncertainty
- Reducing the complexity by "hiding" the part of the business process in the lower level of the decomposition.

In order to identify the values of a modeling goal parameters we propose the Business Process Modeling Framework that is shown in Figure 1. This framework is developed by amalgamating business process modeling knowledge available in resources of IEEE, ACM, Elsevier, Springer, and other sources. The framework has three dimensions that are defined according to the modeling goal's parameters. Each framework dimension has appropriate "scale" of "values" shown with the abbreviation GL_i – for generalization, DL_i – for decomposition, and P_i – for perspectives. The detailed description of each dimension with appropriate values of the scale is available from [4].

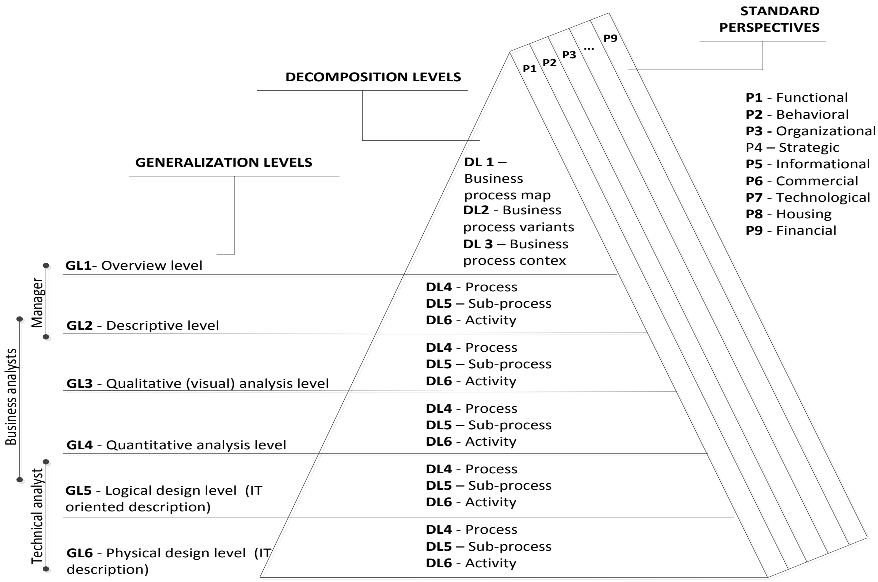


Fig. 1. Business Process Modeling Framework

By modeling the business process at certain generalization and decomposition levels and from a certain perspective, the modeling language that meets the requirements of the modeling goal should be selected. For instance, when creating the business process models at the description level, the attention should be focused at the understanding of the reality, and it is not desirable to spend the time to understand how to use the modeling language. Thus, the modeling language should be intuitively understandable and easy to use. In contrast, when creating a business process models at the logical and physical design levels, there is no need to spend time to create readable and easy understandable for business executive models, i.e., the modeling language should be formal and executable.

3 Goal-based Selection of the Business Process Modeling Language

This section describes how to use the Business Process Modeling Framework to evaluate the business process modeling language appropriateness to the modeling goal. First, according to the Business Process Modeling Framework, a modeler chooses the perspective and generalization and decomposition levels. Next, it is necessary to evaluate the modeling language with the quantitative metrics, by identifying those languages that are most relevant to the modeling goal parameters. In order to formalize the modeling language notation we propose the General Business Process Modeling Language Taxonomy and the General Business Process Taxonomy.

3.1 The Business Process Modeling Language Taxonomy

The business process modeling language, as any artificial language, could be characterized by semantics and syntax. Some sources, such as [11,12] separately distinguish a concrete syntax and abstract syntax. For evaluating modeling language appropriateness for a certain modeling goal, we propose to consider only the concrete syntax. For this purpose concrete syntax taxonomy is created for each language that is the set of the language elements arranged in accordance with the General Taxonomy (described in the next section). The modeling language symbols may conform to the General Taxonomy in the following way: the modeling language element corresponds to the appropriate *class of the General Taxonomy* or the modeling language element corresponds to the appropriate *attribute of the General Taxonomy class*. In addition each business process taxonomy element is described using such indicators: G – graphical or T – textual, Vr – vertex, L – link or Gp – Group, Vs – visible or $\overline{Vs}$ – invisible. Vr, L and Gp are defined only for graphical elements.

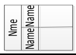
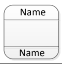
In this paper only graphical business process modeling languages are considered. Further studies are required to incorporate the textual modeling languages (e.g., formal and executable modeling languages).

To illustrate the Business Process Modeling Language Taxonomy, we demonstrate the part of the BPMN taxonomy that reflects the organizational perspective (Table 1).

3.2 The General Business Process Taxonomy

The General Business Process Taxonomy (or simply the General Taxonomy) is a hierarchical classification structure that allows classifying the normalized set of the business process elements taking into account the degree of the business process elements similarity. The General Taxonomy is obtained by generalizing and normalizing the developed business process modeling language taxonomies. For this research several modeling languages, which have gained wide recognition among both practitioners and scientists, were selected, i.e., BPMN, EPC, UML AD, IDEF0, IDEF3, and KMDL. The General Taxonomy is divided into several levels according to the generalization levels in the Business Process Modeling Framework. The third level of the taxonomy is shown in Figure 2.

Table 1. A part of the BPMN taxonomy (organizational perspective)

General taxonomy element	BPMN element name	BPMN element	Indicators
Active Resource	Pool		*Gp, G, Vs*
Active Resource:: Hierarchy:: Group	Pool		*Gp, G, Vs*
Active Resource:: Hierarchy: Subgroup	Lane		*Gp, G, Vs*
Active Resource:: Dimension:: Horizontal	Horizontal pool		*Gp, G, Vs*
Active Resource:: Dimension:: Vertical	Vertical pool		*Gp, G, Vs*
Active Resource:: Number:: Indefinite	Multiple pool		*Gp, G, Vs*
Active Resource:: Transparency:: Closed	Closed pool		*Gp, G, Vs*
Active Resource:: Transparency:: Extended	Extended pool		*Gp r, G, Vs*
Active Resource	Choreography task performer		*V, G, Vs*

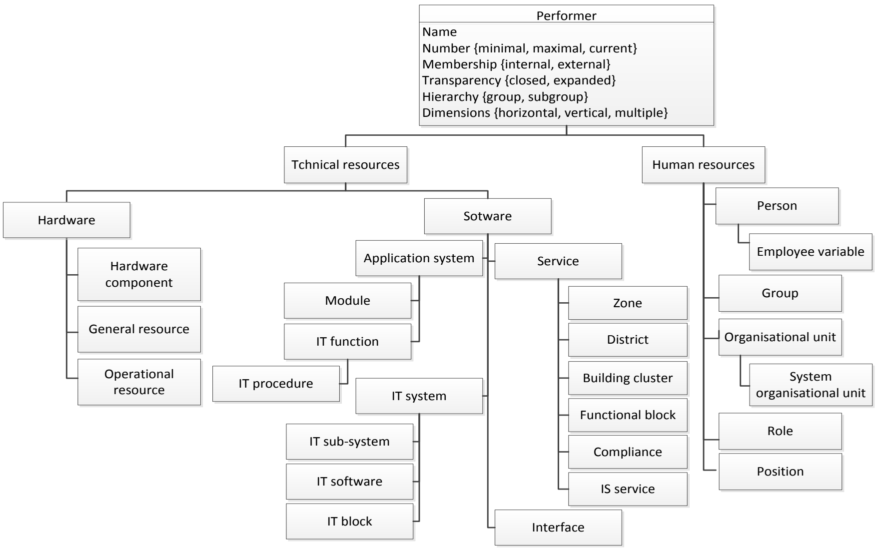


Fig. 2. The third level of the General Taxonomy

In the next subsection it is described how the General Taxonomy can be used to evaluate the modeling language appropriateness to the modeling goal.

3.3. Metrics for Business Process Modeling Language Evaluation

In order to evaluate compliance with the modeling goal parameters we propose to adopt ideas from approaches based on *Bunge–Wand–Weber* (BWW) ontology [13,14,15,16]. However, we have introduced some essential differences. First, the modeling language constructs should be compared with the constructs of the General Taxonomy instead of BWW representation model. Second, it is not always necessary to evaluate the whole General Taxonomy. For instance, when determining compliance with the required perspective, the subset of the General Taxonomy should be built that includes only those elements that are relevant to this perspective. When determining compliance with the generalization level, full General Taxonomy should be estimated. Finally, to estimate the modeling language conformity to the generalization level, the obtained results should be correctly interpreted, i.e., in the highest generalization levels the redundancy (or degree of the construct multiplicity) should be minimized, but overload (or degree of the construct flexibility) should be maximized (see also Figure 3). On the other hand, in the lowest generalization levels the results should be interpreted inversely, i.e., in the highest generalization levels the redundancy should be maximized, but overload should be minimized.

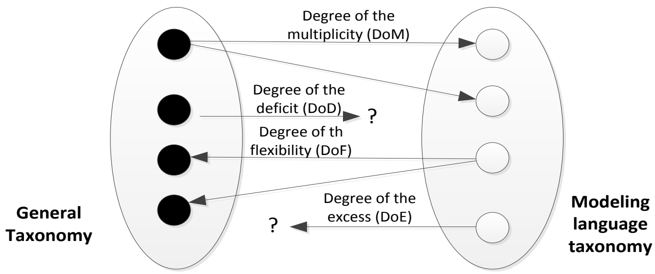


Fig. 3. Metrics for evaluation of the modeling languages

Thus, the following metrics are proposed for business process modeling language evaluation (Figure 3):

- Degree of the construct deficit (DoD) – is the ratio between the number of constructs (in the subset of the General Taxonomy that reflects certain perspective) found to have a mapping to language constructs divided by the total number of constructs defined in the subset of the General Taxonomy that reflects certain perspective.
- Degree of the construct multiplicity (DoM) – is the ratio between the number of language constructs found to have a mapping to the same General Taxonomy construct divided by the total number of constructs in the modeling language.

- Degree of the construct flexibility (DoF) – is the ratio between the number of language constructs found to have a mapping to the more than one General Taxonomy construct divided by the total number of constructs in the modeling language.
- Degree of the construct (DoE) – is the ratio between the number of language constructs found not to have a mapping to any General Taxonomy construct divided by the total number of constructs in the modeling language.

Thus, the modeling language evaluation consists of the following steps:

1. The modeler selects the desired generalization and decomposition levels and perspective. There are two ways how to specify the perspective: (a) choose one of the standard perspectives; (b) create user perspective, selecting required business process elements from the list of the General Taxonomy elements.
2. According to the selected perspective and generalization level a subset of the General Taxonomy is built (see example in Table 1).
3. Then each of selected modeling language taxonomies is evaluated indicating the degree of the deficit (DoD), the degree of the flexibility (DoF) and degree of multiplicity (DoM).
4. Modeling languages are ranked according to the degree of suitability for the abstraction level, the granularity level, and the perspective. If none of the languages provide complete coverage of the chosen perspective, a modeling language combination is offered. When creating such combinations, the priority is given to modeling languages that have a minimum coverage. In the case when the conflicting assessments are obtained, e.g., when one modeling language provides a better coverage of the perspective and is less appropriate for the chosen generalization level, and another modeling language has the opposite evaluation results; then the priority is given to the modeling language, which has already been used for other modeling goals. If no one of the modeling languages yet have been used, then the modeler makes the decision by himself.

4 Outline of Some Related Works

Analyzing different researches that propose guidelines, techniques, and methods for business process modeling language evaluation and/or selection, it is possible to classify proposed solutions into several groups. One group of solutions, such as [13,14,15,16], offers to estimate business process modeling language characteristics. However, it is not explained what are the characteristics the modeling language should have in order to be suitable for a particular modeling purpose. Others researches offer to use particular business process modeling languages for certain modeling purposes (e.g., [17,18]), but the choice of the modeling language is mostly based on the author's subjective opinion. Another category of solutions (e.g., [19,20,21]) offers to adapt business process model content to new modeling purpose, using various techniques such as changing the level of granularity, reducing unnecessary details, or generalizing the content of the model. Finally, there are solutions that provide transformations between different abstraction levels [22,23,24], for instance, the conceptual models are transformed to realization models according to Model Driven Approach (MDA) approach [25]. Each abstraction level is realized by certain modeling language, and the choice of this language is not clarified. Thus, we can conclude that the large part of the solutions do not support the selection of the modeling language according to the modeling goal. The modeler should decide which modeling language is more suitable for a particular goal or to use the offered modeling language without justification and estimation of the alternatives.

5 Conclusions

The paper suggests using the abstraction types (generalization, decomposition and modeling from a particular perspective) for formalizing the business process modeling goal. For better usage of the modeling goal's parameters the Business Process Modeling Framework is proposed. Using this framework, a modeler can choose the perspective and the levels of the generalization and decomposition. In addition, the paper offers appropriate metrics and algorithms for evaluating how modeling languages conform to the selected values of the modeling goal parameters. For instance, in order to evaluate to which extent the business process modeling language conforms to the desired perspective, it is measured whether the modeling language offers syntactical constructions for all necessary business process elements. But in order to evaluate the conformity to the required generalization level, the flexibility and multiplicity of the modeling language is evaluated. That is, for modeling at the highest generalization level, the modeling language should be the simplest and the most flexible and provide only one syntactical construction for each business process element. When modeling at the lower generalization levels, these features are not so relevant, but formality and executability of the language matters.

The proposed solution is the step forward to handling business process modeling complexity semi-automatically and is the first step towards development of a support system for evaluating conformity of the business process modeling languages to particular modeling goals.

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References

1. Shapiro, R., White, S.A., Bock, G., Palmer, N., Muehlen, M., Brambilla, M., Gagne, D. et al.: BPMN 2.0 Handbook Second Edition: Methods, Concepts, Case Studies and Standards in Business Process Modeling Notation. Future Strategies, USA (2012)
2. Braun, R., Esswein, W.: Classification of Domain-Specific BPMN Extensions. In: The Practice of Enterprise Modeling, pp. 42–57. Springer, Heidelberg (2014)
3. Garcia, H.D.D.: Evaluation of Data-Centric Process Modeling Approaches. Master thesis. Eindhoven: Eindhoven University of Technology (2011)

4. Businska, L., Kirikova, M.: The Formalization of the Business Process Modeling Goal: Extended Abstract. In: Joint Proceedings of the BIR 2016 Workshops and Doctoral Consortium co-located with 14th International- Conference on Perspectives in Business Informatics Research (2016) (in print)
5. Free Dictionary, http://www.thefreedictionary.com/
6. Weske, M.: Business Process Management: Concepts, Languages, Architectures. Springer, Heidelberg (2012)
7. Eid-Sabbagh, R.-H., Dijkman, R., Weske, M.: Business Process Architecture: Use and Correctness. In: Business Process Management, pp. 65–81. Springer: Heidelberg (2012)
8. Swenson, K.: The Difference Between Workflow and BPR, http://www.e-workflow.org/downloads/workflow-bpr_kswenson. pdf
9. McLeod, G.: The Difference between Process Architecture and Process Modeling/Design (and why you should care), http://grahammcleod.typepad.com/files/ processarchitecturevsprocessmodelingmcleod.pdf
10. van Nuffel D., de Backer M.: Multi-abstraction layered business process modeling. Computers in Industry. 63 (2), pp. 131–147 (2012)
11. Baar, T.: Correctly Defined Concrete Syntax for Visual Modeling Languages In: Model Driven Engineering Languages and Systems, pp. 111–125. Springer, Heidelberg (2006)
12. Brambilla, M., Cabot, J., Wimmer, M.: Model-Driven Software Engineering in Practice.- Morgan & Claypool Publishers, USA (2012)
13. Recker, J., Rosemann, M., Indulska, M., Green, P.: Business Process Modeling: A Maturing Discipline?, http://www.bpmi.org
14. Green, P., Rosemann, M., Indulska, M.: Ontological Evaluation of Enterprise Systems Interoperability Using ebXML. EEE Transactions on Knowledge and Data Engineering. 17 (5), pp. 713–725 (2005)
15. Green, P., Rosemann, M.: Integrated Process Modeling: an Ontological Evaluation. Information System. 25 (2), pp. 73–87 (2000)
16. zur Muehlen, M., Recker J., Indulska M.: Sometimes Less is More: Are Process Modeling Languages Overly Complex? In: EDOC Conference Workshop, pp. 197–204. IEEE Press (2007)
17. Lodhi, A., Koppen, V., Saake, G.: Business Process Modeling. In: Active Research Areas and Challenges: Technical Report, 34 p. (2011)
18. Burlton, R.: Perspectives on Process Modeling, http://www.bptrends. com/point-of-view-perspectives-on-process-modeling/
19. Polyvyanyy, A., Smirnov, S., Weske, M.: Process Model Abstraction: A Slider Approach. In: Enterprise Distributed Object Computing Conference, pp. 325–331. IEEE Press (2008)
20. Smirnov, S., Reijers, H.A., Weske, M., Nugteren, T.: Business Process Model Abstraction: A Definition, Catalog, and Survey. In: Distributed and Parallel Databases. 30 (1), pp. 63–99 (2012)
21. Rosa, M.L., Dumas, M., ter Hofstede, A.H.M., Mendling, J.: Configurable multi-perspective business process models. Information Systems. 36 (2), pp. 313–340 (2011)
22. Dehnert, J., van der Aalst, W.M.P.: Bridging the Gap between Business Models and Workflow Specifications International. Journal of Cooperative Information Systems. 13 (3), pp. 51–69 (2004)
23. Mendling, J., Ziemann, J.: Transformation of BPEL Processes to EPCs, http:// citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.90.2429
24. Dreiling, A., Rosemann, M., van der Aalst, W.M.P.: From Conceptual Process Models to Running Workflows: A Holistic Approach for the Configuration of Enterprise Systems, http://aisel.aisnet.org/pacis2005/30/
25. MDA - The Architecture of Choice for a Changing World, http://www.omg.org/ mda/