

Choreographies in BPMN 2.0: New Challenges and Open Questions

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Abstract. The concept of choreography has emerged over the past years as a fundamental concept for capturing collaborative processes. The latest version of the Business Process Modeling Notation (BPMN 2.0) introduces the choreography diagram as a first-class citizen actor. After having evaluated BPMN 2.0 in a previous work, we discuss here the new challenges, future work and the open questions about the potential choreography standard language. We also describe the ameliorations that will be introduced in the evaluation framework.

Keywords: Choreography, Evaluation, BPMN 2.0, Quality Framework

1 Introduction

A choreography formalizes the way business *participants* coordinate their *interactions*. In a choreography, the focus is not on the work performed internally by each participant, but rather on the *exchange of information* (e.g. messages) between participants. Another way to look at choreography is to consider it as a type of *business contract* between two or more organizations.

Industry initiatives such as RosettaNet ¹ aim at standardizing business to business integration in a particular domain. However, these initiatives mostly turned to textual descriptions of the overall choreographies, centered in providing detailed message format descriptions [9]. W3C's efforts within the context of the *Web Service Choreography Description Language* proposal (WS-CDL [23]) did not achieve enough industry support and do not reach standardization. The WS-CDL's working work stopped the development of the language in July 2009. Previously, major lacks were detected in [2]. Over the past years, several research projects have proposed different languages for capturing choreographies such as *Lets's Dance* [24], *BPEL4Chor* [9] or *Multi-Agent Protocols (MAP)* [1]. However, these proposals remain far to be adopted by the industry. Popular languages as the *Message Sequence Charts* (MSC) [12] have also been used to capture cross-organizational interactions. But the latter is not rich enough to capture complex choreographies [8].

¹ <http://www.rosettanet.org/>

In early 2011 the OMG [18] released the latest version of the *Business Process Model and Notation* (BPMN version 2.0 [19]). Among other improvements, a choreography diagram is introduced. In previous versions of BPMN, the only way to represent choreographies was via *collaboration diagrams*. This new version allows modelers describing both choreography and collaboration approaches together or individually. Actually, a global view of interactions is represented in addition to the participants' view given by collaborations which enriches the expressiveness of the language [19].

In a previous work [7], we evaluate the adequacy of the constructs for choreography modeling introduced in BPMN 2.0. We also presented a catalogue of identified requirements that represents a clear overview of possible criteria for evaluating a choreography language as well as to better understand this increasingly used concept. After the evaluation, we detect some important drawbacks in the language.

The goal of this paper is to briefly resume the evaluation that we performed [7] and then discuss the major challenges and the research agenda to short out the problems detected. We also present several limitations that are identified in our evaluation framework, and the necessary improvements in order to complete it.

This paper is structured as follows. We resume our evaluation of choreographies in BPMN 2.0 in Section 2. A detailed discussion about major challenges and future work are presented in Section 3. Section 4 presents our research methodology. Finally, Section 5 concludes the paper.

2 The Evaluation of BPMN 2.0 for Choreographies

We based our evaluation of BPMN 2.0 on a semiotic quality framework proposed by Kogstie [14]. We extend it for the specific context of choreographies similarly to [17] for Business Processes. We look at three axes that are the *Domain Appropriateness (D)* (relates the language to the semantics of its domain), the *Comprehensibility Appropriateness (C)* (relates the language to the social actor) and the *Technical Actor Interpretation Appropriateness (T)* (relates the language to tools). In order to organize and categorize the identified choreography requirements, we placed the requirements in the different dimensions of the framework (Fig. 1). Most of this requirements were further refined in sub-requirements.

Domain requirements are mainly extracted from the *Service Interaction Patterns* [3] and from the service choreography requirements identified by Decker et al. in [9]. Looking at the refined notions of choreography presented in [21] that are *B2Bi Choreographies*, *Conceptual Choreographies* and *Service Choreographies* it could be argued that we are more focused in the two latter although we find many common requirements within the three of them. A detailed study about B2Bi requirements can be found in [20].

When analyzing *comprehensibility requirements* of the language, the major interest is given to the graphical notation principles described by Moody in [16]. We also analyzed other aspects such as the model and the meta-model

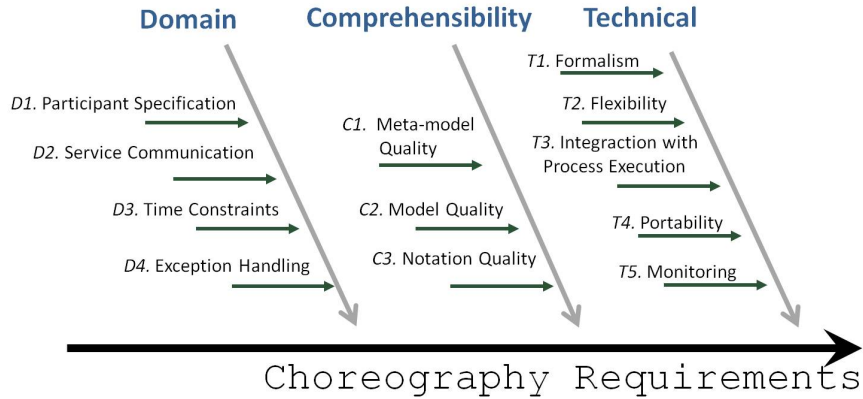


Fig. 1. The requirements axes extending the language quality framework

quality guided by researches as [22,10,4]. The necessity of taking into account comprehensibility aspects for a choreography language is already cited in [13]. *Technical requirements* were mostly induced by the analysis of previous choreography proposals. For further details about this evaluation, the reader can refer to [7].

3 Discussion about Future Work and Open Questions

3.1 Domain Requirements Analysis

Major Challenges. As we already mentioned, the domain requirements were mainly induced and based on the Service Interaction Patterns [3]. Lacks that will prevent BPMN 2.0 to support all the patterns were detected. Unlike *Participant Multiplicity* is supported in BPMN 2.0, *Message Multiplicity* (*Service Communication* sub-requirement), that is used to capture the definition of the number of messages sent from one (or more) participant(s) to other(s) is not supported. This lack will avoid fulfilling the so-called multi-transmission interaction patterns.

Another important detected problem is the weak support for *Reference Passing* (*Service Communication* sub-requirement) where participant A permits participant C to communicate with participant B by passing the reference of B to C. If the latter requirement is not supported, it will avoid fulfilling the so-called routing patterns. The major challenge here is to give support to all the interaction patterns. However one major issue for using BPMN 2.0 choreography is that its semantics are not well defined. The standard provides just an indicative idea of the semantics through local enforceability of different BPMN's choreography constructs and modeling situations. A preliminary work on clarifying the semantics should be done.

Future Work to Improve...

- ... **The Language.** Detecting major lacks within BPMN 2.0 for choreographies has been a first step in our work that might be completed by proposing an extension of the language. In [7], we suggest to recover the concept of channel introduced in WS-CDL to support reference passing. These channels could be explicitly captured with textual annotations in the diagram, following the principle of *Dual Coding* [16]. An extension of the concept of message to capture the *Message Multiplicity* is also suggested. These feature could be easily captured with a graphical construct in the diagram following the principle of *Semiotic Clarity* [16] that suggests one-to-one correspondence between symbols and semantic concepts. This will help avoiding ambiguities when defining it in a technical specification. However, these approach have to be matured and formalized.
- ... **The Evaluation.** A precise analysis of the support of the 13 patterns has to be considered as an important future work. The implementability of the patterns could be done analyzing separately the two possible ways of representing choreographies in BPMN 2.0 (i.e by means of collaboration diagrams and by the new choreography diagrams) but we could also think about evaluating BPMN 2.0 as a whole, considering that the two diagrams represent different views of choreography. Analyzing the service interaction patterns will give us a more precise idea of the limitations of BPMN 2.0 concerning choreographies. It will permit to perform an accurate comparison between the different choreography languages regarding the domain dimension.

3.2 Comprehensibility Requirements Analysis

Major Challenges. Regarding at comprehensibility requirements, the aim is to give more automation to our evaluation. Looking at the principles of graphical notation, a detailed analysis in the different principles is done. However, the great amount of graphical constructs difficult the work. Works like [11] where authors evaluate the cognitive effectiveness of BPMN 2.0's process models are a good reference to be applied to choreographies. If valuable metrics are defined, it will be much easier to compare the BPMN 2.0 features with other languages automatically. The challenge is to automate the evaluation of comprehensibility requirements.

We also detected a greater lack in the meta-model quality. A meta-model should be a useful tool for communication besides a technical description of a language. The way that meta-models are presented in BPMN 2.0 hinders the understanding of choreographies because they are presented in a very technical level. Therefore, another important challenge is to achieve a more comprehensible language.

We have also noted some underspecification and a lack of examples concerning choreographies that difficult an effective use of the language (e.g. the *ChoreographyLoopType*² construct).

² <http://www.omg.org/issues/bpmn2-rtf.open.html#Issue16554>

Future Work to Improve...

- ... **The Language.** In [6], the use of different levels of abstraction and the fact of clearly separate the structural and behavioral views in choreographies is recommended. This approach could also help to adapt graphical notation to different contexts similarly to Silver's proposal in [22] for business process models.
- ... **The Evaluation.** We consider essential to find concrete metrics to automate comprehensibility evaluation. Appropriate metrics could be found by conducting specific experimental studies for the different notation principles. In some cases as for example *Semantic Transparency* (visual representation appearance should suggest its meaning) it is difficult to find appropriate metrics that help evaluating this requirement. Although such evaluations provide valuable insights, they are time-consuming and only allow one to evaluate one or two specific aspects of a language (e.g. understandability or readability). It will also be interesting to work on indicators to better evaluate the meta-model readability and simplicity.
- ... **The Understanding of BPMN 2.0.** The standard should be illustrated to permit practitioners to easily know all the capabilities of the language. A set of examples, using the graphical constructors might be proposed. For example, the use of intermediate events attached to choreography activities are not clearly comprehensible as there are no examples in the standard. This might improve the language's pragmatic quality [15]. The introduction of abstraction layers similar to the ones proposed by Silver for business process models in [22] and the use of different views in the meta-model level will also help to understand the language in a more natural and progressive way.

3.3 Technical Requirements Analysis

Major Challenges. In the technical evaluation, the weakest point is concerning the underspecification of some requirements that leads to ambiguities in the evaluation. For example, terms such as *Formalism* or *Flexibility* lead to misunderstanding because there are not correctly defined.

It is also important to put forward the fact of having a completely new diagram integrated in the standard. This provoke that implementers had difficulties to support choreography conformance. Currently, there is an obvious preference besides process models and their execution rather than using the choreography approach. So we should still wait for implementers response to perform a detailed tool support analysis. The challenge is to find adequate requirements to guide proper tool support for choreographies.

Future Work to Improve...

- ... **The Evaluation.** An important limitation of our evaluation is the lack of technical requirements. To mitigate this lack, we turned to B2B integration requirements [20] and Rosetta Net project to complete this axis. Although

we do not target *B2Bi Choreographies*[21] but *Service Choreographies* and *Conceptual Choreographies* [21], many technical requirements are applicable to the different notions of choreographies. For example, we will have to introduce the *Message Formatting* requirement [9] as RosettaNet show that it is possible and fundamental to be considered. The detailed formatting of messages should be captured in the technical specification. However, different basic types of messages could be defined extending the notion of message. The analysis of orchestration requirements may also be helpful to infer critical choreography requirements.

We will also have to analyze carefully if all the the technical requirements are so well supported by BPMN 2.0 as currently considered. For example, in [13] authors argue that the choreography diagrams are tightly dependent on the technical configuration while we considered that the fact that choreographies do not need a technical configurations to be defined make them “flexible” and reusable.

4 Research Methodology

First, we identified the need of representing the choreography notion in a three-level multi-view approach to effectively bridge the Business-IT gap in [6,5]. These studies gave us an idea of the importance of abstraction levels and multi-views when managing choreographies. We gathered general requirements that should be supported by choreography languages basing our research on two main sources:

- Scientific studies dealing with choreography requirements such as [2,3,4,9].
- Choreography language proposals such as WS-CDL [23], Let’s Dance [24], BPEL4Chor [9] or MAP [1].

One of the most detailed prior evaluations of choreography definition languages is based on the *Service Interaction Patterns* [3], but these patterns only cover one perspective of the requirements for choreography definition languages. Accordingly, we complemented this patterns-based evaluation framework with other perspectives. Therefore, we categorized the choreography requirements with the three axes illustrated in Section 2 to evaluate *Domain*, *Comprehensibility* and *Technical* appropriateness for choreography languages. Special attention is given to graphical notation (*Comprehensibility* sub-requirement), since the graphical notation may be a key ingredient to bridge the gap between business world and technical specification.

Our goal now is to merge both works in a multi-leveled evaluation framework. It is obvious that we find different requirements depending on the level of abstraction that we are working on. For example, a graphical notation is essential in a higher level of abstraction (near the business world), while it might be less critical when a technical specification has to be implemented. On the other hand, message correlation is essential in a technical level while near the business level, it may not be essential to be captured. We want to analyze for each level of abstraction, what are the main requirements that have to be managed. Hence,

choreography requirements categorized in a three-leveled evaluation framework will be the foundation of a new service choreography language (sketched in [5]) or an extension proposal for choreographies in BPMN 2.0. It will also leads to a precise and useful guide for choreography language's evaluation.

5 Conclusion

We have summarized the evaluation carried out in [7] where we evaluated BPMN 2.0's constructs for choreographies using an extended quality framework. The major challenges are discussed and the main axis for future improvements are presented.

We conclude that in the domain dimension, important lacks such as *Reference Passing* and *Message Multiplicity* will prevent a fully support of all the requirements. A better evaluation of comprehensibility should be undertaken based on metrics or specific studies. The technical axis will be completed taking into account new requirements related to B2Bi requirements, industry initiatives as Rosetta Net, and orchestrations. However, our major efforts will be centered in *Service Choreographies* [21] and not B2B integration.

Having analyzing the necessity of defining the choreography notion in three different abstraction levels in previous works, we will propose a three-leveled evaluation framework keeping the *Domain*, *Comprehensibility* and *Technical* axes. A new choreography language or extensions of BPMN 2.0 for choreographies will be presented based on this updated framework.

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