Positioning Collaboration in Business Process Model Consolidation in VOs

Hodjat Soleimani Malekan[1(✉)], Mohammmad H. Rezazade Mehrizi[2], and Hamideh Afsarmanesh[1]

[1] Informatics Institute, University of Amsterdam,
P.O. Box 94323, 1090 GH Amsterdam, The Netherlands
{h.soleimanimalekan, h.afsarmanesh}@uva.nl
[2] Faculty of Economics and Business Administration,
VU University, Amsterdam, The Netherlands
m.rezazadehmehrizi@vu.nl

Abstract. Further to sharing their knowledge and information, organizations in a VO can also benefit from sharing and even combining/consolidating their Business Processes (BPs) in order to save costs, apply their best practices, and provide value-added services. A number of challenges are associated with the needed environment for BP consolidation. Our approach to tackle these challenges is two-fold. First part is addressed in this paper and deals with the human and procedural aspects of this problem and introduces an environment to support stakeholders of independent organizations with creating common understanding of each other's BPs and manually designing/testing consolidated BPs. The second part of our approach is however outside of the scope of this paper, which develops a semi-automated mechanism and algorithms to improve efficiency of defining and disambiguating consolidated BPs. Focused on first part, this paper presents results of an empirical study investigating performance and applicability of our approach, with about eighty participants.

Keywords: Business process consolidation · Merging organizations · Collaboration

1 Introduction

Companies select structured partnerships, such as Virtual Organization (VO) to reduce their costs, create innovative products, and provide optimized value-added services. The VO alliance represents a dynamic network, in which different companies share their knowledge, competences, and resources [1]. For instance, several travelling services can be integrated in a tourism VO, e.g. for buying the transportation tickets, reserving hotel rooms, reserving a rental car, purchasing travel insurance, etc., into a value-added service of a travel package.

A potential longer-term cooperation in VOs however, can create the base for partners to provide more efficiently a wider range of services and a wider scope of operation. When a set of companies intend to participate in a VO to operate for a long time, some of their Business Processes (BPs) can be merged/consolidated to deliver

H. Afsarmanesh et al. (Eds.): PRO-VE 2016, IFIP AICT 480, pp. 110–123, 2016.
DOI: 10.1007/978-3-319-45390-3_10

more efficient and optimized services. For example, the partners of the tourism VO mentioned above can standardize and run their reservation BPs on a cloud environment. As such, to save total cost of operation at the VO level, instead of each keeping a "reservation" or "purchasing" BP variants, they can start consolidating these BPs into two standard optimized BPs that all organizations can use. The consolidation procedure however must be performed by the people at these organizations, agreeing on intention, semantics, etc. of those BPS, which will then result in developing a merged BP.

Although, the VO partners usually may not tend to consolidate their BPs, they can benefit from it in several different ways. First, the BP model consolidation assists companies to standardize their BP models, use each other's experiences, and produce a high-quality BP model. Second, in the case of shared BP model repositories, the reduced size of merged BP models saves some maintenance costs. Third, knowing about the others companies BP models can underpin further future alliances among the VO members.

The main aims of supporting BP consolidation in VOs are twofold:

(1) Increasing the quality of the merged model that is the outcome of the consolidation process
(2) Increasing the efficiency and effectiveness of the consolidation procedure

However, because VO partners are highly heterogeneous, autonomous and usually geographically distributed, the BP model consolidation faces some difficulties and challenges: First, heterogeneities in the BP model representations, e.g. being graphically or textual, that can be found in different companies; Second, heterogeneities that can be found in the backgrounds and familiarity of the people who perform the consolidation job; Third, lack of a step-wise guideline for how to perform the consolidation. Consequently, a systematic approach is required to support and enhance the BP model consolidation procedure and products.

The existing approaches have mainly focused on merging graphical BP models, but lack the user centric perspectives [2, 3]. Therefore, the produced merged models are complicated to verify and difficult to understand by human users [4]. Additionally, the role of needed collaboration among organizations/agents in the BP model consolidation process is not addressed, while in practice, representatives from different companies typically gather together to decide how to combine their existing BP models and to develop merged models. Finally, no empirical study is performed to identify practical issues in the consolidation procedure, e.g. for identifying the importance of different business vocabularies used in the organizations for BP model consolidation in a VO context.

In this paper, we first describe and exemplify challenges in the BP model consolidation. We indicate the position of collaboration in increasing the efficiency of the consolidation procedure, as well as in enhancing the quality of the produced merged models. We then introduce a conceptual model with essential elements for successful establishment of collaboration in consolidating BP models in VOs. Then, we present the results so far achieved in our empirical experiment, which analyses our conceptual mode. Finally, the conclusions are addressed.

2 BP Model Consolidation in Practice

To develop an end-to-end business service, several BP models are used by VO members. This collection of BP models includes a number of BPs that are varied in different aspects, such as products they provide, purpose, locations, etc. For instance, two different insurance companies apply different "*claim handling*" BPs for *liability* or compensation cases. Thus, companies individually or collectively deal with their BP model variants [4]. Moreover, the proliferation of BP model variants in large collections and the need for developing inter-organizational BP models lead to an elimination of redundant and/or similar BP models through BP model consolidation.

In an inter-organizational BP model consolidation, the BP model variants of the involved companies are harmonized with their goals to produce added values. In other words, the BP model consolidation is about managing BP model variants [2]. However, reflecting to heterogeneities in the BP model variants makes the BP models consolidation a challenging task. To introduce the practical challenges in the consolidation procedure, an example is provided.

A set of companies, including the two insurance companies, called "ABC" and "MTTM", constitute a VO to produce insurance and financial services. The companies work to establish a long time collaboration, thus, they decide to consolidate some of their BP models. As a first step, *similar* and/or *equivalent* BPs must be identified. Suppose that one of these services, agreed to be consolidated, is the *claim handling service*, for which two variants exist in the pool of BPs from the two companies. A merger team is then formed of the representative of the ABC and MTTM companies to follow the consolidation procedure and develop a merged BP model for the *claim handling service*. The members of the merger team play the role of BP modelers. A set of potential challenges posed in this BP model consolidation process are addressed below.

Different representation modes. Companies document their BP models in different representation modes. They use textual descriptions or graphical depictions to represent their BP models. The two textual descriptions for this BP from the two companies are showed in Table 1. Moreover, in Fig. 1, the graphical representations of BP models from the ABC and MTTM companies are illustrated in Business Process Model and Notation (BPMN) language [5]. Selecting an appropriate modeling language for representing BP models requires a systematic method [6]. The BP modeling language used by different companies involved in a VO might be different. Thus, frequently we face with the challenge of different representation modes when consolidating BPs from different organizations.

Beyond the representation modes, some other model related challenges can emerge during the consolidation procedure. Here, we explain some of these other challenges in the following subsections, as they are also exemplified by "a" to "e" in Fig. 1.

a. Different modeling conventions: The modeling conventions, including modeling methods and modeling styles, (i.e. the combination of the modeling language's constructs) are diverse. This is considered by merger teams, when two similar tasks are modeled in two different forms. In Fig. 1(a), claim assessment and customer registration tasks are represented through a structured loop of exclusive gateways by the

ABC company, while a parallel construct comprised of two inclusive gateways is applied by MTTM for illustrating the same tasks. Additionally, the steps followed by the merger teams that start to design (or redesign) a BP model are often *emergent*, i.e. decided between modelers rather than conducted by any instruction or guidelines.

b. Similar business rules: The business rules are business decisions that lead the flow of a BP through different alternatives [5]. For instance, in Fig. 1(b) both BP models follow same decision of either *accepting* or *rejecting* a claim that are preceded by *assessing the claim*. Although identifying similar business rules in the current BP models of companies may seem to be trivial, determining whether they are and to what extent they are similar is difficult [2]. For instance, a business rule for accepting claims related to *car* compensation may differ from those for *personal* claims. This challenge further escalates when some modeling languages, such as the BPMN, have not provided efficient standard to accurately represent the business rules [7].

c. Conflicted Business Rules: In several cases the logical and temporal steps of performing a task is different, while the goals of tasks are the same. For example, in Fig. 1(c) the activities that succeed rejecting claims are executed sequentially in the MTTM Company. However, ABC synchronizes both activities of "*Updating customer's information*" and "*Inform customer*", in order to perform the same task.

d. Different level of granularity: Some tasks are provided in more and some in less details, corresponding to the modeler's opinion. Different levels of granularity represent the specific way of performing a task in a company. In Fig. 1(d), the compensation payment in the MTTM Company is depicted in one activity of "*Initiate payment*", however, the compensation payment task for ABC includes both "*pay out*" and "*Issue financial documents*" activities in parallel. The challenge here is to find the similarity threshold that specifies to what extent a BP model fragment, including one or more activities, are identical to the other one, in terms of fulfilling the same goal.

e. Different terminologies: Companies are communicating with their own business terminologies. Different companies need to converge their terms, business vocabularies, and semantics during the consolidation. In the represented BP models in Fig. 1(e), both companies run their service satisfaction evaluation activities, called "*customer satisfaction*" and "*quality of service assessment*" in ABC and MTTM, respectively. Since BP models, and particularly the graphical models, are commonly understood from the labelling in the models, selecting a correct, concise, and unambiguous terminology is necessary for successful consolidation of BPs.

In a similar manner, using different linguistic structures, such as words, verbs, sentences, and adverbs in a textual description imitates some of the same challenges as mentioned above. For example, the word "temporary customer" is used for new customers in the MTTM Company (step 4 of Table 1), while no specific word is used in the ABC company to address the customers.

In addition to the issues mentioned above, merger teams face another challenge, which is the heterogeneities among domain experts in practice. These are company representatives, with different backgrounds in modeling knowledge. Moreover, other roles such as consultant and mediator may be assumed to assist in BP consolidation procedure. Thus, the interactions and coordination of them are of importance to achieve best quality of consolidated BP model and efficient consolidation procedure. In brief,

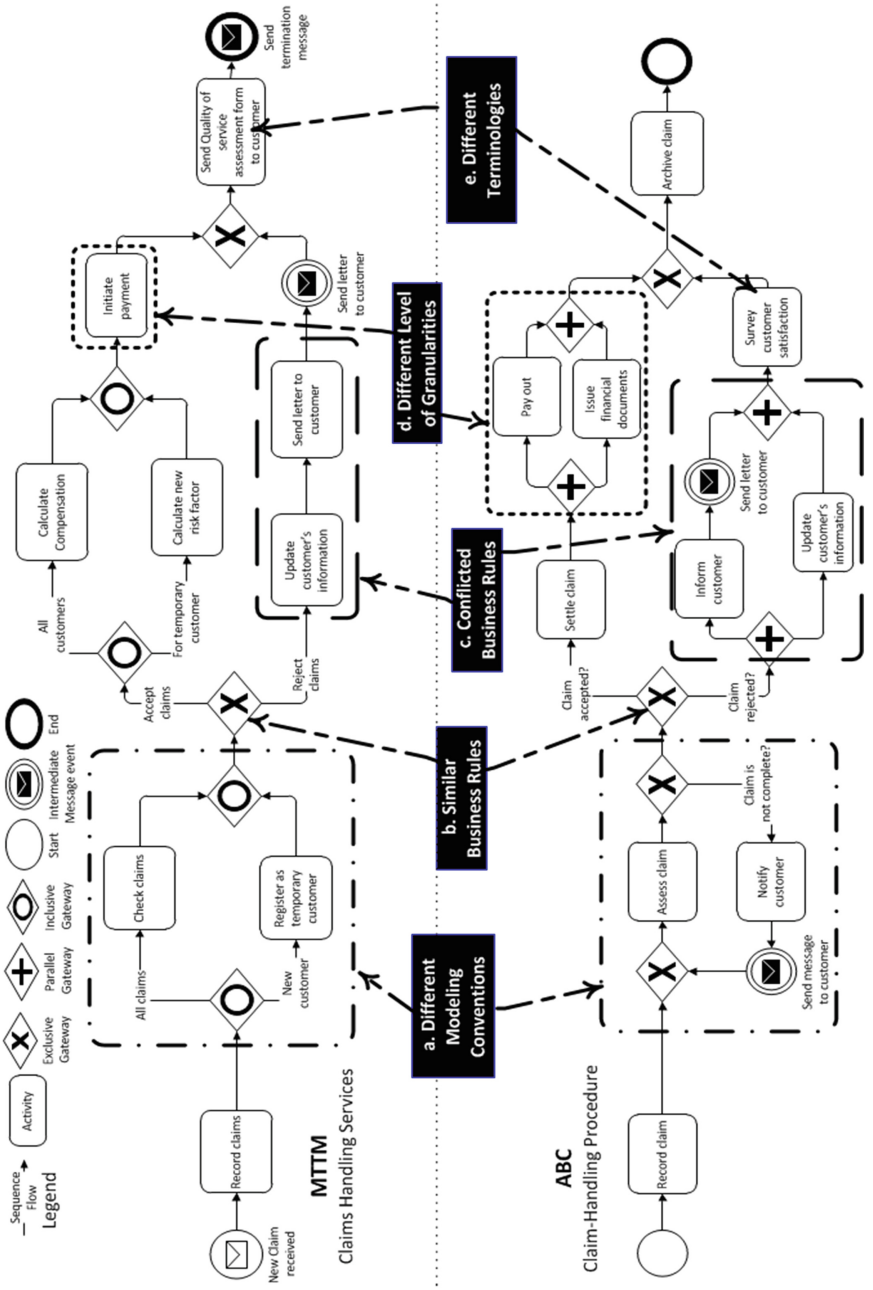

Fig. 1. Example of the graphical BP models in BPMN

Table 1. Example of textual description for two BP models in Fig. 1.

ABC company	MTTM company
Claim-handling procedure:	Claims handling services
1- Recording the claim is the first step in the ABC Company 2- Then, the claim is assessed. If the claim needs more information, such as new customer's information, a message is sent to notify the customer for more complete information. If the claim is assessed completely then it could be accepted or rejected 3- The accepted claims are settled to pay. Afterward, both the pay out and issuing the related financial documents are done by ABC 4- In case of rejected claims, the customer would be informed through sending a letter and the customer's information are updated in the system, at the same time. Afterwards, a survey is conducted to assess the satisfaction of the customer with rejected claim 5- The process finishes after archiving the claim	1- In MTTM Company, the process starts when a new claim is received. Each claim has to be recorded with enough details 2- All claims are checked accurately. Simultaneously, the claims and information of customers are checked. If it is a claim from an existing customer, its information already exists in the system. Otherwise, the information about the new customer will be registered as the temporary customer 3- Based on the claim's checking results, it would be either rejected or accepted 4- For the accepted claims, the compensation is calculated for all customers besides, if the claim is from a temporary customer, then a new risk factor is also calculated. After the calculations, the payment is initiated 5- While, if the claim is rejected, only the customer information gets updated accordingly, and afterward a letter will be sent to the customer 6- The process ends by sending "quality of service" form to the customer

several challenges of BP model consolidation for companies involved in a VO are tackled in our research. To address the mentioned challenges, we introduce a conceptual model to be delineated in regard to the VO specifications.

3 A Conceptual Model for Positioning Collaboration in BP Model Consolidation

The BP model consolidation is a collaborative-based procedure *per se*. In other words, various participants work together on achieving a shared understanding and developing a consolidated BP model. To show the collaboration position in our research, a conceptual model is illustrated in Fig. 2. This model visually describes essential elements that have influence on consolidating the two heterogeneous BP input models (i.e., graphically depicted or textually described), collaboratively in a VO context.

In this regards, we address both the consolidation procedure (i.e., certain steps to consolidate BP models) and the consolidation product (e.g., a merged BP model). Meanwhile, other elements which are essential to be incorporated in the consolidation

procedure, in order to achieve a high quality consolidated BP model, are delineated. Additionally, their kind of relations such as *lead*, *support*, *enhance*, and *increase/decrease* are specified in Fig 2. Please note that the width of the arrow illustrates the strength of the relations, which we specifically address in this paper. Also, certain elements are specified from the insight we have gained from literature.

- *Consolidation procedure:*

The BP model consolidation is concerned with managing BP model variants. Depending on the number of BP model variants, five steps are often followed to consolidate BP models. First, step is *devising* the consolidation procedure, which specifies "*what to do"* and "*how to do it*". For instance, in the devise step, VO members decide on whether combining, synchronizing, or keeping their existing BP models. *Formalizing* of the existing BP models is the second step. Although the VO members work autonomously, the formalization is necessary to establish the communication among involved VO partners. However, the heterogeneities of the existing BP models are challenging for consolidation of BP models. The *merging* is the third step. In this step VO members, for instance combine their BP models into one merged model by identifying the similarities and resolving the conflicts. The fourth step is *correcting* the merged BP models, to assure that the merged BP model is in compliance with all syntax rules. Since during the merge steps, the BP models are restructured, there is a risk of some anomalies occurring, such as the deadlock and livelock, in the merged BP model. The last but not the least step is the *coevolving* step. This step is of great importance, because the BP merged models can be complex and large, therefore,

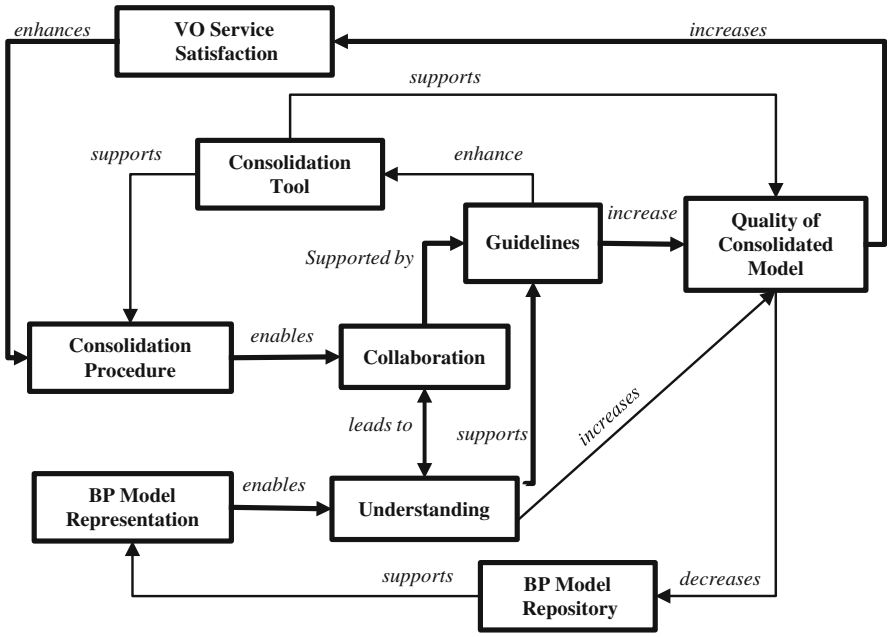

Fig. 2. Positioning collaboration in BP consolidation model

managing their changes are critical in the shared repositories or even the individual collections of the companies' BP models.

The above recommended steps have to be considered by the involved companies, in order to avoid inconsistencies and to increase efficiency and effectiveness in consolidation procedure. This steps primarily enable collaboration among VO members during the consolidation of their BP models.

- *BP model representation*:

BP model representation modes, e.g. the graphical depiction, enable knowledge acquisition from the BP models. Nevertheless, heterogeneities in the representation modes of the current BP models in companies, pose challenges for BP consolidation projects. Several of these challenges are already addressed in Sect. 2.

Today, different BP modeling languages are used to formalize BPs. The selection of a BP modeling language highly determines its capabilities and context. The *textual descriptions* and *graphical depictions* are identified as the two main representation modes used for BPs.

The textual documents, including reports, spreadsheets, and work instructions are the most dominant source of the business information. Additionally, the textual descriptions of BPs are easier for understanding by domain experts, since they usually do not require particular trainings or skills for their understanding by stakeholders. The textual representation can be (i) free-format, such as an English description of a BP, (ii) semi-structured, e.g. delineating a process steps in order of sequence, or (iii) structured texts, such as UML Use case descriptions. The textual descriptions of the two *claim handling* BPs are illustrated as examples in Table 1.

On the other hand the graphical depiction is preferred by modeling experts, due to the ease of communication and execution. Nevertheless, using graphical languages needs training and understanding the modeling languages. The BPMN language is the de facto standard for graphical depiction of BPs. Despite the suitability of BPMN for specific contexts [6], it still has certain problems, such as how it deals with ambiguities in some constructs, lack of formal semantics in its definition, and the arbitrary conventions that can be applied in modeling [7]. Two example BPMN Diagrams for the *claim handling* process are also depicted in Fig. 1.

- *Quality of consolidated BP Model*

In a consolidation project, the involved companies aim at producing high quality consolidated BP models. For this purpose, three aspects of BP model quality are addressed: "*syntactic*" [8], "*semantic*" [8] and "*innovativeness*" [9]. The syntactic quality aspect specifies to which extent a BP model adheres to the modeling language rules and grammar [8]. The semantic aspect of a BP model determines whether the existing model is consistent with what it intends to be in a real world context. In other words, it addresses how "good" the merged model is, in the existing context [8]. The innovativeness aspect however, reflects how well the model has chosen a convenient new way to express a BP model concept [9].

The selection of above mentioned three aspects are due to the following reasons: (i) Achieving a correct merged model is challenging [10] because the merged model is comprised of fragments of heterogeneous input BP models from different companies.

Thus, there is the risk of using incorrect BP model fragments from the existing input models, as well as the error-prone configuration of the consolidated BP models, e.g., the threat of deadlocks occurring [8]. (ii) Having errors in a BP model makes the model difficult to understand and therefore difficult to share and reuse [4]. (iii) Fostering innovativeness directly enhances the quality of the consolidated BP models. However, introducing innovativeness can also cause the consolidated model to have more errors [9], since creating new constructs beyond the existing structures pose the challenge of making mistakes or anomalies in the merged BP models. Consequently, discussing the quality assurance aspects of the consolidated model are necessary for producing innovative and valid outcome in the consolidation procedure.

Producing high-quality consolidated BP models however is not the only challenging objective of the consolidation projects, but also reaching high impacts on two other desired effects in the VO context, i.e. producing reduced size of the pool of consolidated BP models, as well as increasing the satisfaction of VO members.

- *BP model repository*

Managing a collection/pool of consolidated BP models itself brings new challenges, regardless of the size of the collections. For instance, a company, which is involved in the consolidation procedure, may demand for tractability of its BP model in the consolidated pool of BP models, for the sake of applying its internal changes in that model. The BP model consolidation, particularly by merging BP models, facilitates the maintainability of the BP model collections. Developing the consolidated BP model eliminates the collections redundancies. This is mainly because instead of the two BP model variants, one consolidated BP model is substituted and sustained/maintained.

It is noteworthy that consolidation, by focusing on similarities and reducing the differences, develops standardized BP models that impact on representation quality of the BP models in the VO.

- *VO service satisfaction*

The satisfaction of user is one aspect that is usually neglected in modeling tasks. The satisfaction of participants involved in consolidation procedures is defined as their attitudes toward factors that affect the consolidation procedure [11]. User satisfaction is triggered by the system quality and information quality. In our proposed approach, we follow the satisfaction triggered by the quality of the consolidated BP model.

- *Collaboration*

In theory, Malone and Crowston have introduced a multi-level collaboration on modeling tasks in [12]. At the base level of collaboration, especially through social interactions, “perception of common objects” is achieved by various actors. For example, defining shared tasks to achieve a common goal. At the next level, “communication” is established by a common language to facilitate sending and receiving common messages among the actors. Making “decision by group” is the next level, where actors in a collaboration have a set of alternatives aligned with their goal and make explicit choices, e.g. by voting or making a consensus. When a group of actors identifies their goals, schedule activities and allocate resources, they accomplish the “coordination” level. Through addressing collaboration in BP modeling, all levels

mentioned above get behind the collaboration process in developing consolidated BP models, nevertheless organizing the collaborative tasks, such as "making consensus" is of critical importance

We distinguish between "*emergent*" and "*systematic*" collaboration procedures, more specifically, in the BP merging step. Systematic collaboration is associated with two or more individuals that are involved in a coordinated consolidation of BP models, when it is predefined beforehand. But emergent collaboration describes the situation when two or more individuals from different companies themselves define and follow their merge efforts process while it is happening [30]. More specifically, the systematic approach aims at drawing the consolidation team's attention into predefined important issues, by which the collaboration can be facilitated; whereas in the emergent approach, the consolidation process is led by the emerging consensus of the team members. Moreover, collaboration in either of its forms, facilitates the innovativeness due to asymmetry in the knowledge of the members of the merger team [9].

- *Understanding*

Understanding in the modeling process generally, and in the BP model consolidation specifically, refers to ability of knowledge acquisition from a BP model. The grammar of BP modeling assists modelers to better understand the content of a BP. In principal, modelers perform two major tasks: "*reading*" and "*writing*" [2]. When modelers read a model, they obtain information about its BP domain, while during the writing stage, a BP model is created to represent a real-world BP. Moreover, the collaboration and understanding of the BP models bilateral affect each other [13]. Furthermore, the quality of the merged model is increased, when the understanding of its modelers increases [8].

- *Guidelines*

At the heart of the BP consolidation approach there is a set of guidelines that support and enhance its different elements. The guidelines specify certain configurations that facilitate the collaboration positioning in a consolidation procedure.

The guidelines suggest solutions in regard to the type of collaborations and the modes of input. Further, it investigates the role of the outcome representation modes, e.g. producing a graphical or textual merged BP model.

These guidelines are not only applicable to companies for setting up their consolidation procedures, but also assist companies with increasing the quality of their consolidated BP models.

- *Consolidation tool*

Considering the correctness aspect of consolidation, a semi-automated tool is required to assure their correctness and generating anomaly-free merged BP models. The BP model anomalies, such as deadlocks and/or ambiguous constructs (e.g. OR-join patterns) cause difficulties in executability of the consolidated BP models [16]. Thus, the consolidation tool addresses the deficiencies and corresponding solutions, in order to provide a robust execution infrastructure for the consolidated BP models.

4 Experiment

In order to validate the inter-relations defined in the conceptual model described in Sect. 3, we have performed an empirical experiment with a group of students. The entire experiment is also recorded on videos.

The experiment was designed to study the following two main aspects:

(a) The joint effect that the "*consolidation procedures*" (i.e., systematic collaboration versus emergent collaboration) as well as the "*input representation modes*" (i.e., the textual BP model description or graphical BP model depiction) can have on increasing the quality of the produced merged BP models.
(b) The importance of the role played by the BP modeling knowledge of the collaborating partners, as the moderators from the two companies, in the consolidation procedure.

For the purposes of empirically investigating the two main issues mentioned above, 78 participants were recruited. The participants were students from the Faculty of Economics and Business Administration at the VU University. These were selected since in real-world companies, typically the staff with business administration degrees are assigned by companies to perform the tasks of BP modeling and/or BP merge. Moreover, short training in BP modelling is a part of the procedure that we apply for BP model consolidation, and using background expertise is not recommended in our experiment, e.g. for transferring between graphical and textual BP model representations [15], since the experiment could then be biased by the background knowledge.

The participants formed teams of two. Each set of two members worked together, each as the representative of one of the two companies in a merger team. We also divided the participants into four separate conceptual study groups, and assigned some of the teams into each of the following study groups.

- Study Group A: Systematic collaboration- graphical BP model inputs
- Study Group B: Emergent collaboration - graphical BP model inputs
- Study Group C: Systematic collaboration - textual BP model inputs
- Study Group D: Emergent collaboration - textual BP model inputs

For the systematic collaboration, the study groups "A" and "C" were suggested to fully adopt the following set of guideline steps:

(i) Reaching a mutual understanding of both input BP models.
(ii) Finding any and all similar fragments in the two input BP models.
(iii) Resolving any and all differences/conflicts over dissimilar parts of the merged BP model, with the original two BP models.
(iv) Verifying the correctness of the merged BP models.

On the contrary, the teams in the emergent study groups "B" and "D" did not receive any guidelines.

Additionally, two graphically depicted BP models from the two different companies were provided to the participants in study group "A" and "B" (See Fig. 1). Similarly,

the equivalent textual descriptions of BP models were provided to the participants of the study Group "C" and "D" (See Table 1).

Then, all teams were asked to develop two consolidated BP models, including one graphical and one textual merged BP model. In total, we have received 60 merged BP models, half graphical and half textual.

This experiment has produced a valuable large set of data, which we have so far partially analysed applying the fuzzy set Qualitative Comparison Analysis (fsQCA) method. A set of promising results related to the BP consolidation approach in VOs are already induced and being gradually represented in a format similar to Fig. 3.

The presented results are used to evaluate the success and failure in achieving our desired outcomes. For instance, Fig. 3 represents some statistics about the results related to *Syntax Structural Correctness* of the produced merged BP models by teams.

Please note that the headers in the first 4 rows in Fig. 3 indicate the four criteria considered in this analysis. Also for each row, two values are considered, as mentioned in the header, and the solid circle and crossed circle respectively indicate these values for that row. The fifth row indicates the success or failure of the produced results in relation to the *Syntax Structural Correctness*. Please also note that each column represents one combination of cases that with a high percentage has produced either a success or a failure result.

Achieving the syntax correctness – as a quality aspect of – a merged BP is represented by SSCS1, and the syntax failure by SSCS2. Each of these solutions may

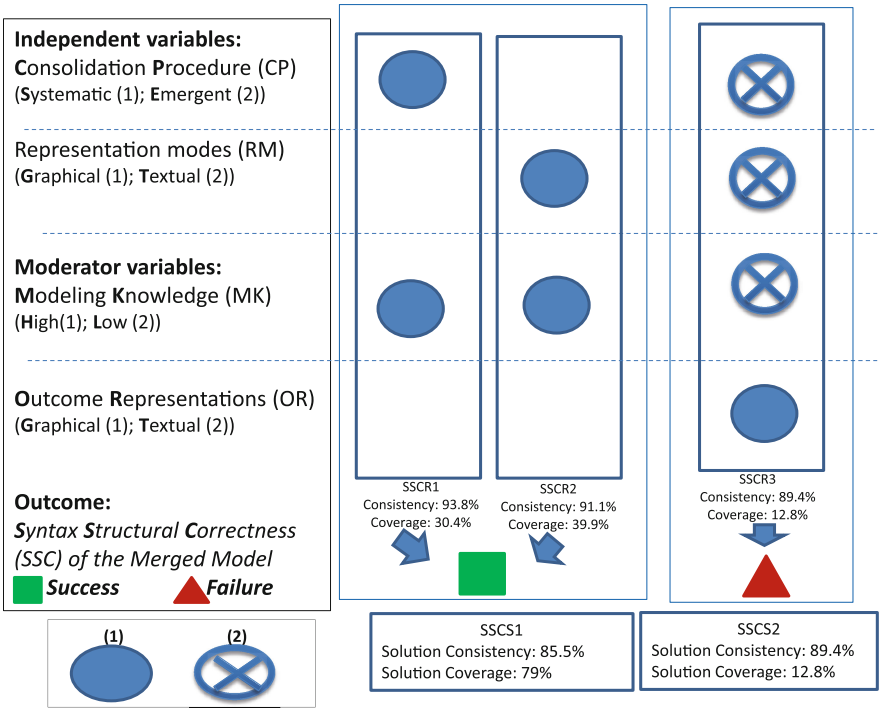

Fig. 3. The fsQCA analysis solutions for having syntactical correctness in the merged models

include a number of partial solutions. For instance, SSCR1 and SSCR2 are two partial solutions for having merged models with high level of syntactical correctness, i.e. the SSCS1 solution. Each of these solutions, as indicated by its respective column is due to a configuration of values for the four criteria represented by the rows.

For example, in the configuration of the SSCR3 partial solution, (i) given textual input BP models, (ii) while requiring the team to produce a graphical outcome, (iii) having low modeling knowledge of the participants, and (iv) applying an emergent consolidation procedure, while the produced result is highly consistent, it represents an 89.4 % of failures to achieve high quality merged BP model. Moreover, this configuration covers 12.8 % of solutions that results in having syntactical errors in their merged BP model.

Similarly in SSCR2, we observe that if (i) the input is graphical, (ii) the team members have high modeling knowledge, (iii) regardless of the type of outcome (i.e., graphical or textual merged BP model) and (iv) regardless of consolidation procedures (i.e., systematic or emergent) the syntactical quality correctness have high consistency and acceptable coverage. It is noteworthy that, the fsQCA is not symmetric, e.g. in case of the SSCR2, having textual input BP model and low modeling knowledge, does not necessarily ends in merged BP model with low syntactical quality.

5 Conclusion and Future Works

The presented research addresses the main challenging practical aspects of the BP consolidation in a VO context. Moreover, it positions and further conceptualizes the role of collaboration in the BP merge process. An empirical study is presented to investigate and validate the consistency of the introduced conceptual model, which can be used to provide a set of solutions for the VO partners involved in BP consolidation.

The results of this experiment will be applied to developing a set of guidelines for the process of for BP consolidation among companies, aimed both to increase the quality of the merged BP models, as well as for automating a part of the consolidation procedure in the VO context. At present we are in the process of analysing results from the empirical experiment. In the next step, we aim to study the quality aspects of the consolidated BP models, i.e. the syntactic, semantic, and innovativeness aspects.

References

1. Afsarmanesh, H., Camarinha-Matos, L.: A framework for management of virtual organization breeding environments. In: Camarinha-Matos, L.M., Afsarmanesh, H., Ortiz, A. (eds.) Collaborative Networks and Their Breeding Environments. IFIP, vol. 186, pp. 35–48. Springer, Heidelberg (2005)
2. La Rosa, M., Dumas, M., Uba, R., Dijkman, R.: Business process model merging: an approach to business process consolidation. ACM Trans. Softw. Eng. Methodol. (TOSEM) **22**(2), 11 (2013)
3. Gerth, C.: Introduction. In: Gerth, C. (ed.) Business Process Models. Change Management. LNCS, vol. 7849, pp. 1–12. Springer, Heidelberg (2013)

4. Dijkman, R.M., La Rosa, M., Reijers, H.A.: Managing large collections of business process models-current techniques and challenges. Comput. Ind. **63**(2), 91–97 (2012)
5. OMG: Business Process Model and Notation (BPMN), Version 2.0.2, December 2013. Last seen http://www.omg.org/spec/BPMN/2.0.2/
6. Soleimani Malekan, H., Afsarmanesh, H.: Overview of business process modeling languages supporting enterprise collaboration. In: Shishkov, B. (ed.) BMSD 2013. LNBIP, vol. 173, pp. 24–45. Springer, Heidelberg (2014)
7. Recker, J.: Opportunities and constraints: the current struggle with BPMN. Bus. Process Manag. J. **16**(1), 181–201 (2010)
8. Dumas, M., La Rosa, M., Mendling, J., Reijers, H.A.: Fundamentals of Business Process Management, pp. I–XXVII. Springer, Heidelberg (2013)
9. Figl, K., Weber, B.: Individual creativity in designing business processes. In: Bajec, M., Eder, J. (eds.) CAiSE Workshops 2012. LNBIP, vol. 112, pp. 294–306. Springer, Heidelberg (2012)
10. Schunselaar, D.M., Verbeek, E., van der Aalst, W.M., Raijers, H.A.: Creating sound and reversible configurable process models using CoSeNets. In: Abramowicz, W., Kriksciuniene, D., Sakalauskas, V. (eds.) BIS 2012. LNBIP, vol. 117, pp. 24–35. Springer, Heidelberg (2012)
11. Wixom, B.H., Todd, P.A.: A theoretical integration of user satisfaction and technology acceptance. Inf. Syst. Res. **16**(1), 85–102 (2005)
12. Malone, T.W., Crowston, K.: The interdisciplinary study of coordination. ACM Comput. Surv. (CSUR) **26**(1), 87–119 (1994)
13. Bernhard, E., Recker, J.C.: Preliminary insights from a multiple case study on process modelling impact (2012)
14. Ragin, C.C.: Fuzzy-Set Social Science. University of Chicago Press, Chicago (2000)
15. Burton-Jones, A., Wand, Y., Weber, R.: Guidelines for empirical evaluations of conceptual modeling grammars. J. Assoc. Inf. Syst. **10**(6), 495 (2009)
16. van der Aalst, W.M.: Business process management: a comprehensive survey. ISRN Softw. Eng. **2013**, 1–37 (2013)