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A Collaborative planning process modelling methodology. An application to a real case[14]

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Abstract

Nowadays the business process modelling concepts are becoming a strong support to model the planning complexities in the supply chain. Moreover, under a collaborative context, consider an properly modelling methodology and choose as well the right modelling language will help to represent and understand the system in a simplest way. Therefore, in order to find the common patterns regarded to the business process modelling that are considered to support the problems related to the operational collaborative planning in the supply chain management context, a scientific literature review in carry out. Regarding to this, it is concluded that a methodology that support the operational collaborative planning modelling process must consider all the risk related to the business process modelling and the information technologies. In this context, a business process modelling notation (BPMN) is considered to develop the modelling methodology and to represent a real situation in this context also.

Key words: Collaborative planning (CP), business process modelling (BPM), modelling methodology, business process modelling notation (BPMN), supply chain (SC).

1. Introduction

From some time ago, the development of SC's are oriented to conform workgroups which, in a cooperative and collaborative manner, result a determinant key to create value in the SC (Mitra and Sanghal, 2008). Then, its seems to be clear that the collaboration among the SC partners give some advantages to the SC, mainly oriented to cycle times, service levels and costs (Manthou *et al*, 2004). Moreover, in a collaborative context, the business process that are carried out in isolated way (by each partner who conform the SC), must be executed in coordinated manner, but with new goals oriented to promote the collaboration in SC. Therefore, for that each business process can be executed by each partner, the business process must be upgraded to support the complexities related to the collaboration among the partners (Alarcón *et al*, 2007). Furthermore, those new upgraded business processes or collaborative processes are characterized by the following aspects: 1) the activities execution is shared among the partners and 2) their goals must be defined by the different collaborative partners. In addition, regarded to Olsson (2008), the collaboration necessarily implies new

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relationships among a broad group of partners that developed (in example) trust, a common understanding of issues, and an interest in finding solutions. Thereafter, in a SC context, Ming *et al* (2008) establish that one of the most important collaborative activities in collaborative product manufacturing in product lifecycle management is collaboration between process planning and manufacturing. Furthermore, based on the Alarcón *et al* (2007) work, a CP process modelling methodology in SC context is proposed, as well as application of it to a real case. This proposal, in the first place, present the corresponding background (regarding to a literature review) related to the scientific work in the area of CP process in the SC. Then, a study of the CP characteristics and their implications in the modelling process is carried out. Finally, considering the BPMN formalism, the methodology is applied to real SC case in order to see the main implication of the collaborative process in the modelling process.

2. Background

2.1. Characterization of the collaborative planning processes in the supply chain

Regarding to a collaborative planning approach, Chu-Carroll and Carberry (2000) establishes that the participants tends to be autonomous and heterogeneous, thereafter the conflicts that may arise among them are frequently unavoidable. That is why the dialogue process to support the collaborative planning turns a very important aspect to be considered. In this context, Sidner (1994) and Walker (1996) consider the collaborative planning dialogues as an important instrument in order to model proposal/acceptance and proposal/rejection sequences of a negotiation processes. Moreover, in a Internet large-scale distributed projects in manufacturing context, Lee and Kumara (2003) make certain that regarding to project group, each one of them tries to secure enough resources to achieve their goals with the higher probability, but due to the resource constrains present in the environment, is quite difficult to find a solution that fulfil the requirement of the members of the group. In this context, to support a modelling process, under a collaborative context, Lee and Kumara (2003) consider two main elements to be taken in to account, which are the product development and the functional division. The last element considers the conjunction of a set of organizational resources.

In addition, Abbid *et al* (2004), consider the collaboration process among responsible units as the decision-making driving element in a networked enterprise environment. Then, the study of Abbid *et al* (2004) shows that the overall performance of the firm is mostly likely to be improved, this regarded to the fact that the demand planning process is considered collaborative and sophisticated as well. Also, the study shows that when the integration among the resources utilization and costumer requirements is allowed the overall performance is improved too. Moreover, Berning *et al* (2004) comment that the collaborative planning concept allows the development a concurrent work among the each supply chain partner, therefore a higher transparency, greater flexibility and attenuation of the response time must be obtained. An example of this, is given by Berning *et al* (2004) who by considering a collaborative client-server network structure, establish that through local models the recover of information from a central database is possible. Hence, the coordination in the network must be present in order to support the organizational overcomes boundaries and constrains of the companies. In this context, Danese *et al* (2004) considers the theory of the network coordination in order to provide a theoretical basis that support the management of the business process across the supply chain network and also, regarded to a CPFR approach (VICS, 2008), considers coordination mechanisms to support the active supply chain trading partners who jointly plan key supply chain activities, which aid and cover the production and

delivery row materials processes and also helps the production and delivery of end-products to the end-customers.

Another point of view is given by Dudek (2004), who says that the collaborative planning is an attempt to achieve cooperative planning among business processes rather than centralized planning, trough a non-hierarchical negotiation based approach. Therefore, a scheme of a negotiated collaborative planning must consider feasible policies by taking in to account the compensation principle (Little, 1950). This means that, in the worst case, the loser supply chain partner must be rewarded. Besides, from a social point of view, Caridi et al (2005) considers that when a negotiation is used to solve an exception in a interaction process among supply chain partner, these partner can be considered as collaborative, so the are capable to re-establish the rules that they consider in order to support their operational and negotiation activities. What's more, under a CPFR context, from the study of Danese (2007) suggest that to support a collaboration process, the following aspects must be taken under consideration: (1) the number and type of business processes involved in the collaboration, (2) the level of integration and (3) the number of units with which a company collaborates.

Furthermore Dudek and Stadler (2007), under a negotiation context, consider how a supplier must negotiate with three different buyers in order to support its planning processes to favour the collaboration among them. In this context, the buyer must face three different planning situation to cover the three buyer situation, which considers a total, semi and non collaborative situation. These situations are regarded to the information sharing process. On the other hand, from a supplier point of view, the planning process must differentiate two aspects. The first one is related to the evaluation of the given order proposal, and the second one is associated to counter-proposal compromise generation. Obviously, the situation of the supplier is much complex than the buyer situation, this regarded to the fact that the supplier must collaborate with three entities (buyers) in a simultaneous manner (Dudek and Stadtler, 2007). In addition van der Vaart and Wijngaard (2007) considers the fact that, under a situation in where the resources management turns an important matters, focus the resources makes easy to tune the way in which each resource is used in order to fulfil the buyers preferences and helps to obtain an advanced collaboration and acquiring process in the context of the demand information sharing. But, van der Vaart and Wijngaard (2007) establish as well, that a disadvantage regarded to the resources focus is that it leads to loss the pooling synergy among the buyers.

Therefore, from a contract perspective, Frasctore and Mahmoodi (2008) establishes that in order to support a collaboration process, the demand must be realized first, then an effective contract must provide the necessary incentive to the suppliers in order to increase its capacity or, in the other hand, decrease the incentive in order comprise an underinvested process. Finally, Selim *et al* (2008) consider a collaborative production-distribution planning problem in a supply chain system. Their study shows that, under a fuzzy goal programming, mutual benefit plans can be obtained by considering various collaborative planning problems related to the supply chain environment such as location-routing, location-inventory control, inventory control-transportation and supplier selection-inventory control.

3. Study of the collaborative planning processes characteristics under a modelling context

Regarded to the background already presented in the last section, and also in order to support the collaborative planning methodology proposal, it is possible to say that the literature which deals with those matters is scarce. Therefore, in order to support the corresponding proposed

methodology, seven elements were identified in order to fill out those gaps in the literature under a modelling process context. Thereafter, the authors of this paper (regarding to the literature review) consider the following aspects, or characteristics, that must be considered in order to support the modelling of the collaborative planning process in the supply chain. Then, the Table 1 shows how the literature review contributes to those seven aspects.

- **A: Process definition.** The definition of the process is necessary in order to establish the framework which will support the corresponding modelling process. Regarding to this, it is possible to define the main problem under study.

- **B: Define the process behaviour through the objectives, parameters and variables identification.** From a scientific point of view, once the process is defined, the identification of the corresponding objectives helps to build a strong structure of the problem from a modelling point of view, supporting as well by the identification of the parameters and variables. Those two last aspects give, from a quantitative point of view, the chance to measure the behaviour of the corresponding process.

- **C: Establish the resources of the process.** From a whole process definition is important to detect which resources (physical or humans) gives to collect the right behaviour of the process. Then, establish the resources means detected those resources that are better related with the process definition.

- **D: Identification of the corresponding decisional levels.** The decional-making process is in the most of the cases characterized by the length of the horizon in where decision impact in to the process. Then, indentify the corresponding decisional levels helps to see if the decision oriented to be strategic, tactic or operative in the horizon plan.

- **E: Establish a sequential or parallel order to build the process model.** The sequence, or order, that a process follows can be classified in two types, the sequential and parallel process. A sequential process means that each activity depend on a previous activity (excepting the firs one, who initialize the process). A parallel process means that a conjunction of activities can be executed at the same time or that they don't depend on previous activities. Regarding to each type of order, the study of the process is different, mainly because the critical points are in different places (beginning. Middle or ending point).

- **F: Model Validation.** In order to prove the validity of the model, a validation process must be done. Thereafter, this checking process must be done both from the perspective of those who develop the model (modellers) and from who which provide the information of the system.

- **G: Modelling tool and language selection.** Regarding to the modellers experience, it is possible to chose the modelling tool and language which fits better the modelling process of the system, this in order to cover and support as whole the resources, parameters, variables and order of the process (sequential, parallel or both). A full study of this can be found in Kettinger *et al* (1997) and in Aguilar-Saven, (2004).

Table 1. Contribution of the authors to the collaborative planning model characteristics.

Authors	A	B	C	D	E	F	G
Abid et al. (2004)	■	■	■			■	■
Aguilar-Saven, (2004)			■		■		■
Alarcón, F. (2007)	■	■	■	■	■	■	■
Alarcón et al. (2007)	■	■			■		
Berning et al. (2004)	■	■	■		■	■	■
Caridi et al. (2005)	■	■	■	■	■	■	
Chu-Carroll and Carberry (2000)	■	■	■			■	■
Danese et al (2004)	■	■	■		■		
Danese (2007)	■		■				
Dudek and Stadtler (2007)	■	■	■	■	■	■	■
Lee and Kumara (2003)	■	■			■		
Little (1950)	■	■			■		
Manthou et al. (2004)	■		■	■	■		
Mitra and Sanghal (2008)	■	■	■		■	■	
Ming et al. (2008)	■	■	■	■	■	■	■
Olsson (2008)	■			■		■	
Selim et al. (2008)	■	■		■	■	■	
Sidner (1994)			■		■		
van der Vaart and Wijngaard (2007)		■	■		■	■	
VICS (2000)	■	■	■	■	■		
Walker (1996)			■		■	■	
	81%	71%	76%	38%	81%	57%	33%

From the Table 1 can be seen that the most important characteristic in order to support de modelling process under a collaborative context is regarded to the process definition (81%), establish the resources of the process (76%) and the establishment of a sequential or parallel order to build the model (81%). Then it is possible to see that the modelling process must, primary, consider those characteristics in order to fulfil the collaborative planning process requirements. On the other hand, the less characteristic considered are those related with the decisional level identification (38%) and the selection of a modelling tool and language (33%). This means that an important factor to be considered, in the methodology proposal, must be the detail level definition and their implications in the model, also the right tool in order to support de development of the modelling process. Finally, the process objectives, parameter and variables definition (71%) and the validation of the model (57%) seems to be to normal characteristics the studied authors take in to account in order to support their modelling process regarded to modelling of the collaborative planning process.

Therefore, the following section is to propose a modelling methodology, from a generic point of view, and also by supporting the gaps found in the literature review as well as enrich the current aspects that the scientific review has shown as important aspect to support the modelling process.

4. A collaborative planning modelling methodology proposal

Since the CP process is basically a decisional making process, which is supported by the functional, physical, organizational and informational aspects relative to the system, is necessary support de methodology by those point of vie as well. Therefore, is understood that the decisional-making process is carried out by decisional centres (DC) which are conformed by the corresponding decisional makers. Moreover, from a generic point of view, the proposed methodology (Figure 1) considers the following steps: **preparation** (in which everything is arranged before the next phases begins); **description** and valuing (in where the

aspects that may impact the modelling process are identified and described as well); **modelling** (oriented to develop CP process model); and **validation** (in where the model is review and fixed if proceed. In order to represent the methodology and the following real case application, regarding to the knowledge of the modellers and to the availability of the software licence as well, the BPMN modelling language and *iGrafx 2006 process for six sigma* modelling tool has been chosen. Moreover, the four steps are explained briefly as follows:

- **Preparation.** This phase is related with the establishment of the initial number of the detail levels. Furthermore, regarding to the decisional view two detail levels are considered, the macro and micro level. After that, the objectives and characteristic of each detail level are defined. Furthermore, the macro level is oriented to represent the interdependence relationships among the different DCs and the sequence as well in which the decisional-making process are carried out. Moreover, at this level, important aspects to be taken in account are: properties of the activities (functional view), DC involved in the process (decisional view) and necessary information to support the exchange of it (informational view). On the other hand, from a micro level point of view, the way in which each DC takes their inter decisions considering their interaction with the rest of DCs. Finally, the number of detail levels is validated

- **Description.** Before each element will be modelled, a description of each one of them is necessary. This in order to study and select the adequate modelling tool by considering how each element can be represented with this.

- **Modelling.** Regarding to the modelling phase two level must be defined: the macro and micro level. The macro level represent the interdependence relationships among the decisional centres and the sequence of the decision making process during the CP process. Therefore, this level considers the following aspects: temporal hierarchical modelling; decisional centre modelling regarded to the same temporal level and decisional maker; space hierarchical modelling; process modelling. On the other hand, the micro level represent the way in which each decisional centre takes their decisions from an internal perspective, but also don't forgetting their relationship with the other decisional centres.

- **Validation.** The validation is at same time a finale state and a way in order to improve the model. This improvement is regarded to the consistency that the model represents in front of the real system. In any case, the feedback process will may feed the beginning of whatever step, this mainly because the modelling of collaborative process is not a lineal process, but also is a concurrent process.

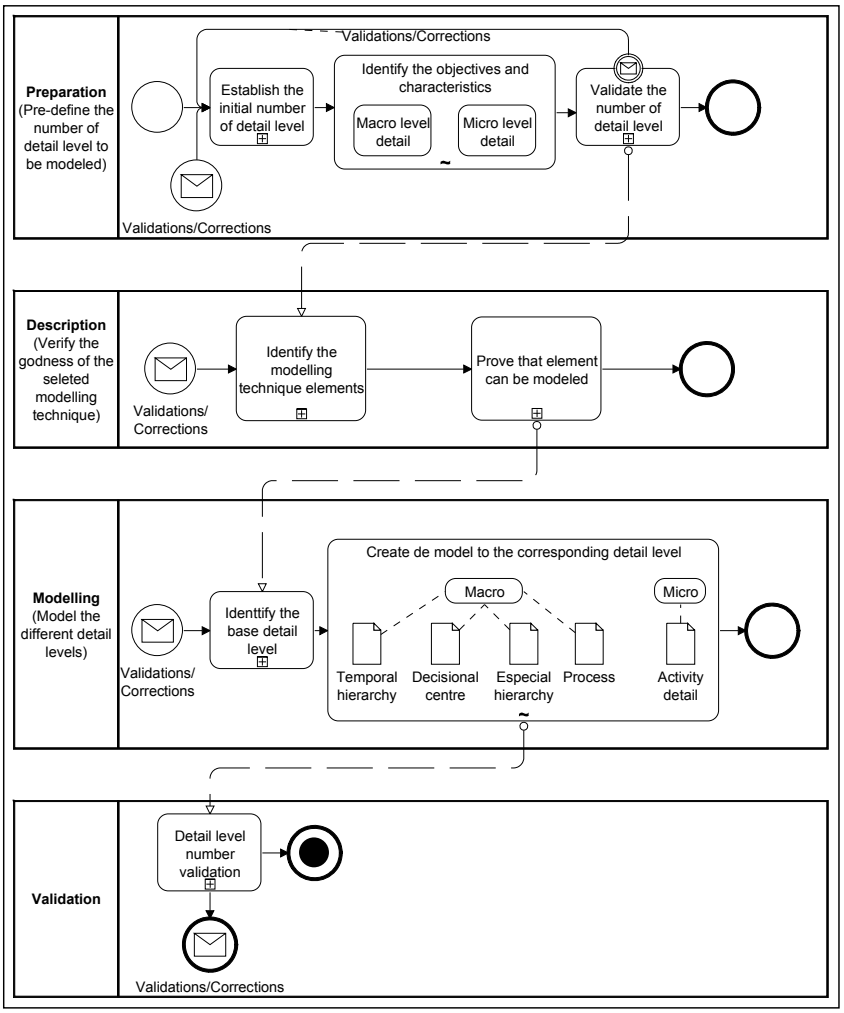

Figure 1. Collaborative planning modelling methodology proposal.

5. Application to a real case

It is a company dedicated to the design, manufacture and marketing of ceramic floor and wall tiles. The ceramic products include: traditional floor and wall red and white pasta, polished and sophisticated coatings rectified, porcelain enamel and technical high technical qualities. Then, this real case begins when the manufacturer informs (every three months) to the supplier the subcontracting capacity requirement plan at a pre-established price (later this plan will be confirmed). Once the supplier receive the requirement plan, he takes a series of decisions about the capacity size and will inform to the manufacturer the capacity that it will be possible to reserve him at the established price. Therefore, if the difference between the manufacturer required capacity and the supplier proposed capacity is less than a certain quantity, the negotiation process is over. On the other hand, a negotiation process is established over the capacity and price of it. Thereafter, the negotiation process will be carry out until the difference between the manufacturer required capacity and the proposed by the supplier will be less than the required quantity. Next, once the agreements at the tactical level are reached, decisional centres (DC) of the manufacturer exchange information from the tactical to the operative level. This information is related with the desired inventory level of the different product families for the next period and the number of turns that will be developed at the time that the physical system is implemented. In addition, each month, the tactical manufacturer DC take the corresponding decision related to the quantities to be produced of any article. To doing so use, as main information, the desired inventory levels

and the turns numbers at the tactical DC of the manufacturer, but at the same time anticipate in a explicit manner the behaviour of the supplier before sending him the short-term demand information. In this context, once the operative DC of the manufacturer make a decision respect to the short-term component demand, and also the time when they are needed, the manufacturer send this information to the supplier. At this time, the operative DC of the supplier executes his decisional model taking in account supplied information from the tactical DC of the supplier. Once the model has been executed, the operative DC of the supplier informs to the supplier the supply plan. This plan may imply therefore that manufacturer rebuild his replenishment plan. Therefore, the collaborative planning supported by BPMN is presented in the Figure 2.

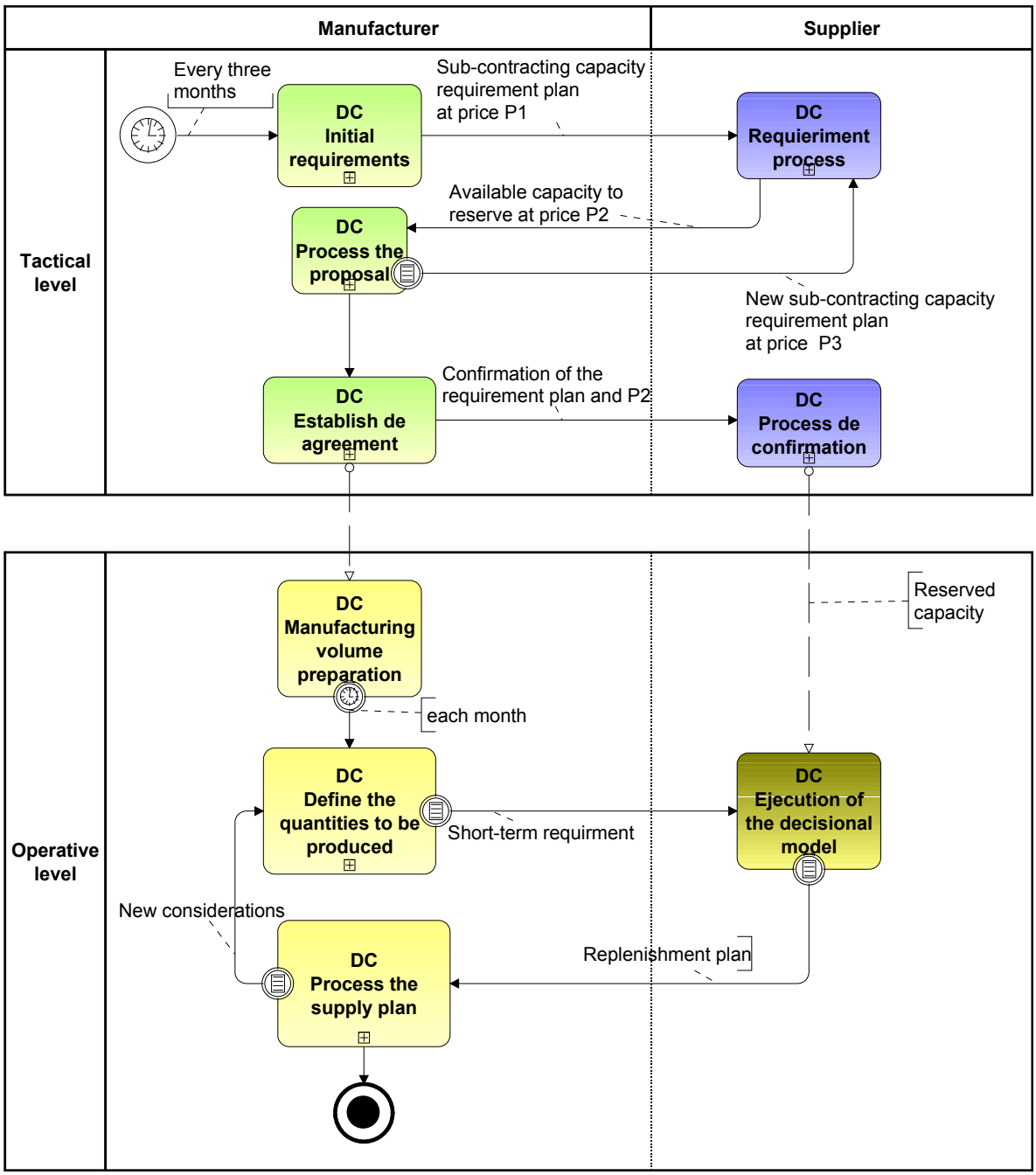

Figure 2. BPMN representation of the collaborative planning. A real case approach.

6. Conclusions

This paper has proposed a methodology to model the Collaborative Planning Process, which consist of a series of phases developed, defined and grouped into two levels of detail; a macro which allow the overall vision and understanding of the steps to follow, and micro level detail, which is intended for the use of the methodology and organized according to last phases in the past. Therefore, the proposed methodology is designed to create models of the process of planning operations which contain essentially three views or perspectives: functional, physical and informational, but by adding relevant stages in the process of modelling, it could be possible to include new perspectives.

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