

Collaborative Planning in Customer-Oriented Supplier Networks – The CoReNet Approach

João Bastos¹, Américo Azevedo¹, Ricardo Almeida¹

¹ *INESC TEC (formerly INESC Porto) & Faculdade de Engenharia da Universidade do Porto*
Rua Dr. Roberto Frias S/N, 4200-465 Porto, Portugal {joao.bastos, ala, ralmeida}@fe.up.pt

Abstract

Due to the dramatic change of the market competition for industrial manufacturers, especially in TCFI (Textile, Clothing and Footwear Industry), in the recent past due to the globalization and consequent openness of the markets together with the financial crisis, there is an increased need of networked collaborative approaches and tools. This pressing need of collaboration allows SMEs (small medium enterprises) to compete in open markets with increased responsiveness in developing and providing new complex and high configurable products and services. This paper presents a new collaborative aggregated planning approach for supplier networks, where groups of SMEs collaborate in the formation of the network, the definition of the operations plan, reply to customer inquiries and release of individual production orders for each unit in the network. The proposed approach promotes the production plan definition through collaborative negotiation and rough capacity checking validation.

Keywords

Collaborative Planning, Collaborative Networks, Negotiation, Supplier Networks

1 Introduction

The emergence of global markets has forced the European Manufacturing Industry, SMEs in particular, to adapt to a new competitive environment in order to proactively respond to challenging market requirements with increased responsiveness and flexibility. This reality is intensified by the fact that consumer goods, in particular fashion products as clothing and footwear have in the last years been facing an increased number of seasonal collections. Moreover the mass customization paradigm requires that companies are ready to produce small batches (till one-of-a-kind product for mass market) to satisfy customer requirements, leaving best opportunities only for companies that produce value added and wide range of products [Azevedo, Bastos et al. 2011].

Other related aspects are not only connected with social phenomena's such as ageing, increased obesity and disabled people but also with the growing sensitivity towards eco-friendly products. All these issues pose a challenges for TCFI (textile, clothing and footwear industry) manufacturers: How they can address consumers demand for personalization and value adding of harmonized products not only in terms of aesthetics, but also in terms of health, innovative functionalities and environmental impact.

Nowadays there is a clear need for health fashionable consumer goods, since customers want to be fully satisfied both under the point of view of their look and their health. This need generates a very distinctive type of demand, based on small lot series and fast delivery, forcing companies to change there manufacturing philosophy. It is no longer possible to deal with long transportation times of materials and components or extended lead times in manufacturing services to face this new demand paradigm.

Indeed, addressing this new type of customer demand groups as main target, it is necessary to develop new collaborative supply chain solutions based on cost effective, social compliant and

eco-efficient design and production of customized products that fully satisfy the customers considering their health issues as well as their desire for fashionable products.

In order to accomplish this pressing need of collaborative supply chain solutions, managers are increasingly seeking for supporting tools that allow: the creation of collaborative networks, the support for collaborative negotiation and the creation of collaborative supply network plans.

This document details specifically the Collaborative Planning approach embedded in the CoReNet's framework for supply networks management. Namely, it specifies the functional and technological requirements of the collaborative planning tool within the CoReNet framework. Also describes the methods and a technology used in this approach and details its integration with the overall CoReNet solution for supply chain management [Fornasiero, Chiodi et al. 2010].

2 Background

The uncertainty of demand (in quantities and seasonality) has been one of the most difficult trends in nowadays-competitive markets. It becomes quite difficult to develop manufacturing strategies that promote mass production to achieve reduced industrial costs in order to remain competitive. Additionally, customers ask for innovative products which demand a high level of technology development, most of the times unachievable for companies (specially, for SMEs). Market's globalization also raised competition to a complex dimension never been though before, increasing the need of flexibility on the development of new products and services.

In order to follow the trends of the last decades, operation management has become characterized by complex supply chains, which increased the need to control information and materials flows. Due to the need of creating innovative products in shorter periods of time and with reduced costs, a new concept of cooperation between companies has arisen. A new concept of CNs (Collaborative Networks) appeared to enhance a stronger commitment between companies to achieve a common business opportunity. In order to integrate these CNs, companies were obliged to organize their internal business processes in an efficient way as well acquiring advanced logistic and production planning systems to promote integration and response on the new levels of collaboration with other partners.

The concept of Collaborative Planning rose from the need of synchronization of company's productions plans, in order to manage the allocation of resources in an effective way to achieve the desired performance (price, delivery time, quality level, etc). This new trend of negotiation and overall achievement (instead of working only on a local basis) has revealed several weaknesses on the most part of the companies; one of the issues revealed concerned a major culture restriction, since companies were not used to work collaboratively. Another issue that was detected was the lack of software applications on IT market to provide a solution for this new challenge. Most of the existing software is prepared to manage internal business processes but do not provide the desired support on strategic decisions for a group of isolated companies, which desire to work together to a same objective. The usage historical data on sales of collection items and seasonal trends assume a major importance to help on the build of new strategies to remain competitive on market, especially on cases of the reduction of order's quantities which demand smaller production lots.

The type of supply chains for which the CoReNet project is focused, includes small series industrial production and manufacturing customer-oriented mechanisms for which the classical approach of the CPFR concept is based on the usage of historical data to make forecasting and support replenishment [Bastos, Azevedo et al. 2011]. Such approach is hard to be implemented for the production of small series or single customised items and the produced results have a very limited value. Henceforth, this research work emphasizes the features of an agile collaborative planning tool, monitoring and controlling production in this kind of supply networks.

3 Collaborative Planning Approaches

As referred previously, Collaborative Planning assumes a major importance on CNs. The major challenge of production planning on CNs arises of how to link and coordinate planning between the different companies that belong to the network. Other authors studied several approaches. One of the approaches focused on the existence of a negotiation process (coordination scheme between two or more companies), to ensure the synchronization between production plans from distinct organizations. This concept requires all partners to adapt their local product plans in order to developed an overall planning, acceptable by all supply chain members; assuming a decentralized planning approach. This collaboration environment is achieved through an exchange of relevant information (actual and past) and, dependant on its availability' speed, planning results become more accurate. Collaborative planning involves activities by means of which individuals coordinate their planning processes [Camarinha-Matos and Afsarmanesh 2006]. Individuals predominantly plan according to the objectives of company but, in CNs, they additionally try to create possibilities for the optimization of others' planning. Thus, Collaborative Planning must include aspects that enable partners to recognize how individual plans should be adapted, according to which criteria the planning can be optimized, and which restrictions in the common planning must be accepted.

3.1 Challenges of business collaboration

Applying for a collaborative approach has turned a difficult challenge for many organizations. The traditional approach assumes a centralized approach, which present some restrictions. One of the most known is a culture constraint of willingness on sharing data and working on a multi-environment with other supply chain partners. Companies must be able to share strategic information, resources and capabilities with other companies to provide a common “strength”. Many companies avoid centralized approaches, with the belief of losing their local autonomy. On the other hand, decentralized approaches will not provide optimal solutions if not coordinated efficiently.

The solution might be raised from a consistent coordination scheme, which ensures information privacy, autonomy of local decisions and trust enhancement on supply chain partners. Stadler [2009] referred that bilateral agreements between supply chain parties would ensure that partners wouldn't have profitable unilateral deviations.

3.2 Centralized and decentralized planning approaches

In centralized planning approaches, all decisions lead to an optimal solution at a first try, since the calculation is provided by a single company, and assumes the theoretical capacity of each partner. A lack of transparency of the overall decision-situation leads to poor coordination in decisions involving several of these intra-organizational planning domains [Kovács and Paganelli 2003]. In such environments the delivery time calculation is performed using sequence algorithms, assuming that each partner has informed about their local capacity (and that is 100% available). Such approaches are only feasible when companies work a dedicated capacity to others.

On business scenarios characterized by an increased complexity of their products, the centralized approaches do not response accurately. Constraints like the loss of local autonomy are rejected by most part of the companies. As referred previously, a decentralized approach might be taken based on bilateral negotiations to achieve the best planning solution, in order to reduce conflicts.

3.3 Flexibility on collaborative models

Collaborative planning desires for a high level of flexibility due to the need of a dynamic and fairness integration of contributions from several individual planning. Gunter identified two important requirements to promote flexibility on collaborative planning scenarios:

- Explicit planning based on truthful information sharing between partners about the actions to be performed concerning the planning process. Such strong communication of anticipated events allow companies to react quickly and adapt their planning;
- The level of details (in planning) should be adequate to allow others actors to modify the plan, enhancing autonomy in the decision process. According to the author, each company should be aware of relevant conditions, intermediate goals, and availability of alternatives to develop successfully plans.

As referred previously, an important issue on the creation of collaborative plans is the ability to formulate lateral agreements. Each company must define its own management objectives, which must be aligned in common goals for the collaborative planning. The use of “frozen” periods and alternative scenarios can help on the definition on a stable planning.

Also monitoring assumes a major importance on collaborative plan executions, to promote quick revisions from partners and, jointly, evaluate the appropriateness of new possible solutions.

4 CoReNet Framework

The proposed CoReNet approach [Fornasiero, Chiodi et al. 2010], intends to support textile, clothing and footwear companies in the implementation of new models for small series production for health and fashionable goods following the Competitive Sustainable Manufacturing (CSM) paradigm [FoF-PPP 2009] and current initiatives of European Technological Platforms like Manufuture [Jovane, Westkämper et al. 2009] and Footwear. The project intends to support the whole value chain to get and manage consumer data to investigate its needs; involve consumer into design and product configuration phases; exchange consumer data through adequate data models and secure systems; manage the collaboration with suppliers in order to plan and distribute on time; implement innovative manufacturing technologies; deliver timely the product to the final customer; and monitor the quality and sustainability of products.

Small series and customized products require totally different supply networks structures, where each company should be able to produce the complete product (all or most of the operations) and be specialized by the type of product or market segment. In this context, and following the approach described, a supply network should be configured for each customer order and tend to include a small number of skilled companies. The key selection criteria should be the ability to perform the required operations for the desired delivery date, with the expected cost. In practice these scenarios will be characterized by a very large number of small orders, each of them having different partner companies, based on their availability and capabilities. In this context co-planning and control will be required to optimize the production plans that result, on a first iteration, from the configuration (or set up) of the supply network for each order.

Beside the early phases for the design and development of the collection, once the sales have been closed and the product completely defined and configured, along with the measures, quantities and due dates, all the complete set of information required for the actual production can be finally defined (final BOM, accessories, etc.) and the Production Orders (PO) can be generated for a specific customer order. During this phase it is possible to identify the Supply Chain specification (design and formation) for a specific customer order, that implies to have identified all the suppliers and partners in charge of carry out all the external activities, assigned

the whole set of operations associated to a specific product and finally obtained all the information and data needed for the planning activities. In order to implement these new models for small series production for health and fashionable goods the CoReNet project is organized in five main pillars as represented in Figure 1. Namely, the third pillar addresses the sustainable methods and tools for production and distributed planning and includes the collaborative planning tool.

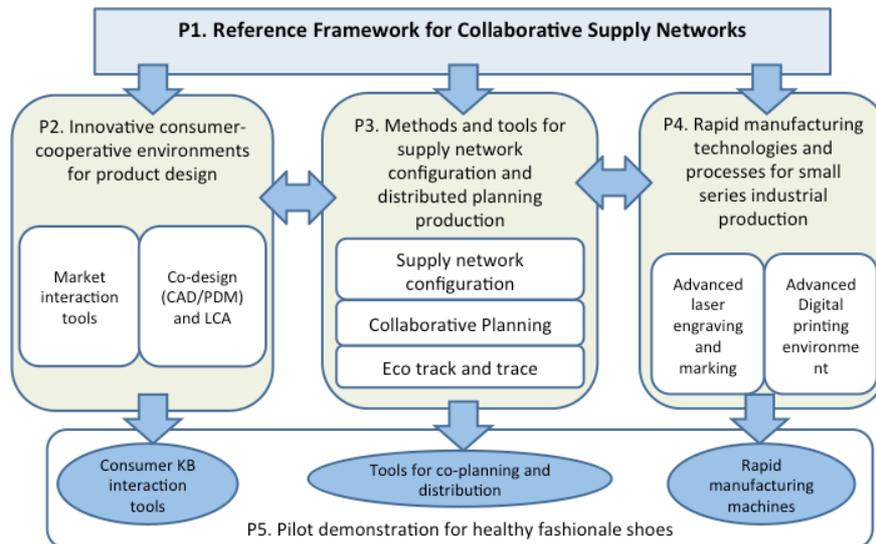


Figure 1 – CoReNet reference framework for collaborative supply networks

One of the most critical aspects during the PO planning, execution and control is the management of the external activities that may be strongly different for each product. Therefore, during the PO execution is strongly required that manufacturer and partners could interact and share information, exchange documents and take decisions. In order to the CoReNet framework defines in this third pillar a set of services as represented in Figure 2. These services are responsible to provide the tools and services required to the establishment of customer-oriented collaborative networks.

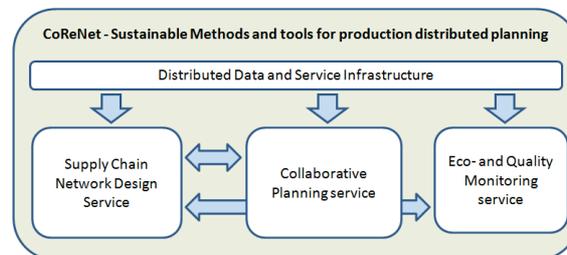


Figure 2 – CoReNet supply networks setoff tools for co-planning and distribution

For this specific purpose, this paper addresses the importance of flexible IT services supporting collaborative planning that should engage the manufacturer and any partner to be involved on specific order basis. The main objective is to enable the planning of POs assigned to any partner and support the related info and document management.

5 CoReNet Collaborative Planning Solution

CoReNet’s project designed a collaborative aggregate planning based on a negotiation process, as a response to the needs of the first phase of the production planning (described on the previous chapter). The term “aggregate” as defined previously is used to express the definition and planning of major operations (and not detailed operations planning for shop floor control) which

are assigned to partners in the supply network being formed, leaving the operation's details for partner's own management. This approach is based on a decentralized negotiation model, which allows partners to propose new delivery dates and costs, represented graphically at Figure 3.

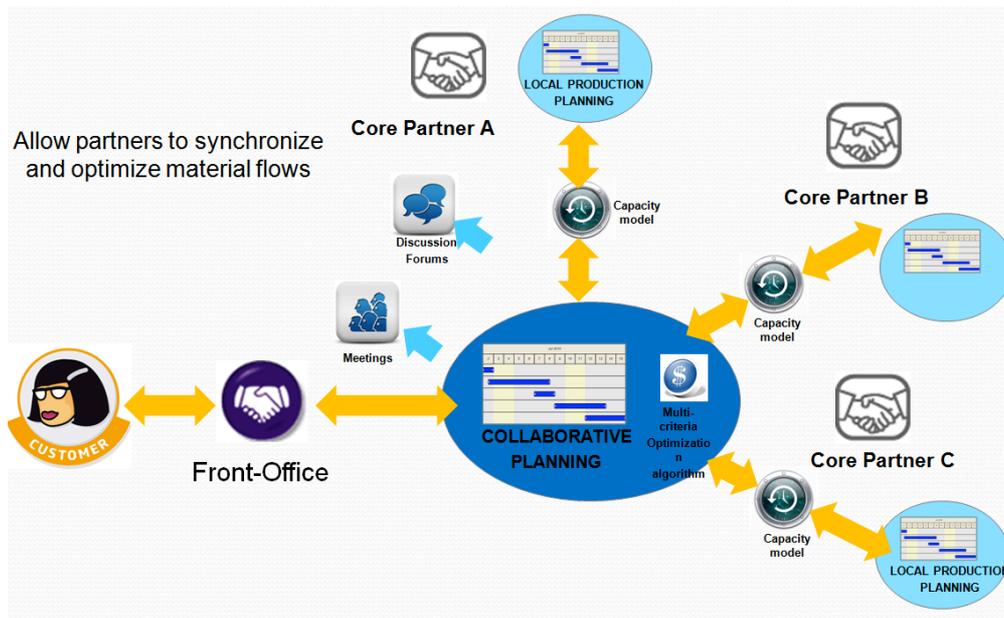


Figure 3 – Collaborative planning approach

This approach, although centralized when considering the supporting ICT architecture (for the graphical view and management of requests and quotations), promotes a decentralized approach on the definition of the supply networking planning, since each partner is capable of proposing and participating actively on the characterization of each required operation and to request from any other partner a change on the plan (through the creation of a request for quotation).

The major characteristic is the inexistence of a major partner imposing a plan to the others; every core partner has the same “weight” on the decision process over the operations planning of the network (major condition for non-hierarchical networks). The front-office has the responsibility to coordinate this process and promote the resolution of any conflicts. Major advantages can be resumed as follows: reduction of the “traditional” communication, like e-mails and phone calls, between partners (since the planning is shared and available for any partner in the supply network); accurate control of any change and evaluation of the associated impact, with the ability to apply the necessary events to handle those changes; enhancement of trust, due to the increased visibility and to the fact that core partners have the same weight on the decision process. Each change proposed by any member in the supply network will create new possible plan which, after been analyzed and accepted by the involved partners, will create a new (accepted) plan which will be evaluated following common criteria (defined in the very beginning of the process).

5.1 Requirements

The proposed approach for aggregate collaborative planning includes two steps:

- The customer presents the business opportunity requirements to the company Front-office (company that identified the business opportunity and is responsible for the interaction with the customer). After the elicitation of the major requirements on the required custom made product, the product concept/design is defined by the Front-office and by the new partners that are invited to join the supply network, based on their

specific competencies and availability . These partners are called “core partners” since they integrate Product Design activities and share some risk in responding to the overall business opportunity. In this context, the necessary main operations of the supply network are defined by the company front-office and core partners, with its sequence and timing restrictions (start, finish and leading times), taking into account the due date specified or expected by the customer and theoretical capacities defined on each partner’s profile.

- In the beginning of the planning process the criteria for partner selection are defined and agreed by core partners. These criteria may be imported from the Partner Search module which is based on Partner Profile.
- Additional partners (called “potential partners”) are invited to participate on several operations. Their selection is performed according a criteria (for example, certification or feedback from previous negotiations) previously defined by the company front-office and core partners. This gives rise to a first operations “rough” plan that the company front-office proposes to all the members in the supply network;
- Partners receive the first “rough” plan and a set of requests for quotations, one for each operation allocated to him. Each partner proceeds then to a local analysis of their local production capacity to evaluate if it is possible to accept the proposed dates and lead time for the indicated quantity. A quotation is then formulated, accepting the proposed plan or proposing an alternative for the request.

5.2 Multi-criteria Planning Evaluation

A critical issue in Collaborative Networks is the level of confidence and fairness presented on major business processes, like Collaborative Planning and quotations' selection (to enhance the trust between partners). Partners will only participate if they feel that their quotations will be impartially evaluated, according to know criteria (defined at an earlier stage of the negotiation process). In order to guarantee a truthful collaboration environment, Core-Net project proposed a multi-criteria algorithm to evaluate partners' quotations, enabling a fair negotiation process.

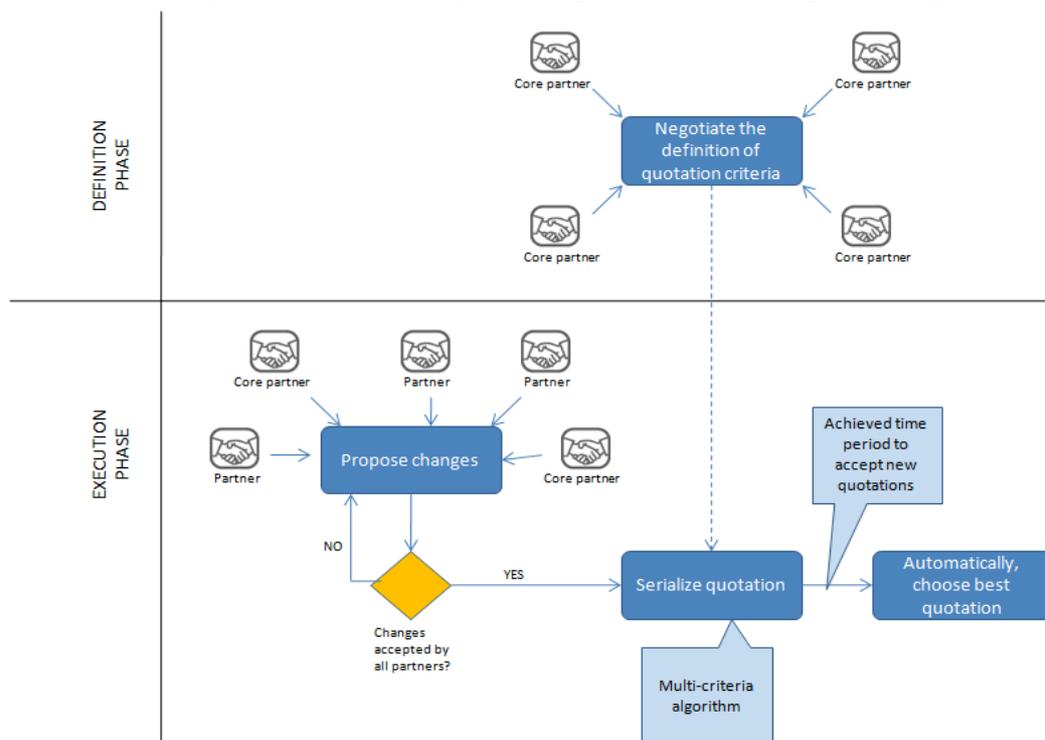


Figure 4 – Stages of the negotiation process and multi-criteria evaluation

Figure 4 presents the two stages of the negotiation process. A first phase is related on the definition of the variables to serialize a quotation. A clear description over calculations variables and information distribution (to all involved partners) assume a major importance on this process, in order to allow a correct evaluation of the impact of each quotation in the overall solutions. To promote fairness between partners, this definition should be performed at the earlier stages of the Collaborative Network's creation. The second phase occurs during the planning process, when each partner suggests any change to a proposed plan (by other partner). Each quotation process has a time limit to accept new changes, and each proposed change must be validated and accepted by all partners (otherwise, it won't be serialized as a possible plan). Such approach enhance trust between partners since ensures that any proposed change will only be considered (and serialized by the multi-criteria algorithm) in case everyone accepts.

The multi-criteria algorithm promotes a calculation of the best solution using a linear normalization algorithm based on several criteria (for example, lead time, price, quality level, etc), defined previously by the core partners. For each variable is defined a weight (in percentage) to characterize its level of importance, a minimum and maximum values allowed. This method enables the evaluation of the quotation following variables' maximization or minimization, according to partner's objectives.

5.3 Implementation Issues

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5.4 Collaborative Planning tool Architecture

This section briefly characterizes the main aspects of the module architecture to be used in the development of the Collaborative Planning Tool.

The specification of the foreseen functional elements to support the collaborative planning module defined a web-approach supported in the Liferay web platform. With this content management framework or web application framework is possible to embed the collaborative planner server portlet module.

The collaborative planner server offers for the different users specific web-based views through simple browsers the necessary support for their interaction with planning tool.

The integration of the collaborative planner module with the CoReNet's Service Infrastructure is achieved through the web service link with the Enterprise Service Bus. By this interface the

collaborative planning module exchanges documents with the Partner Search, Process Planning and other modules present in the CoReNet's IT infrastructure.

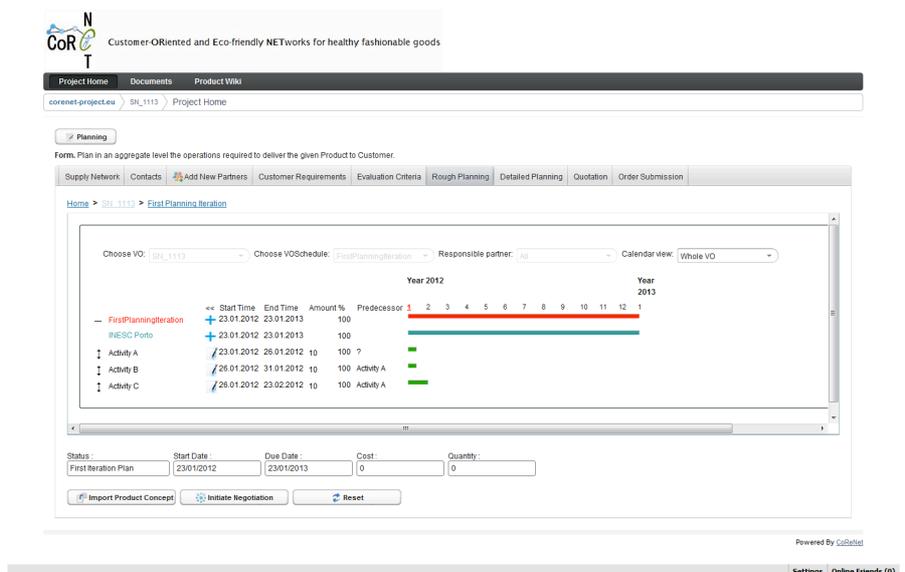
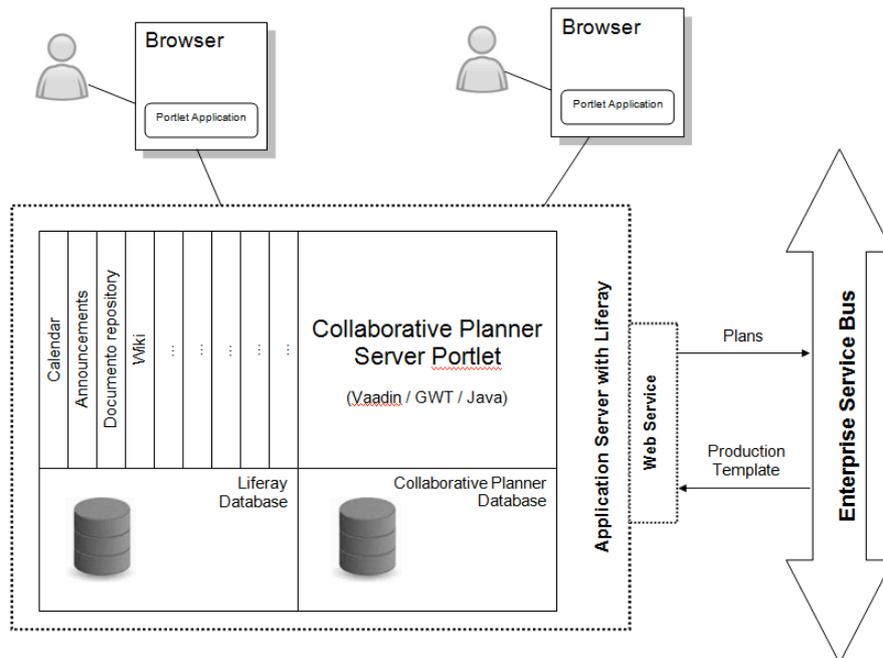


Figure 6 – User Interface of the Collaborative Planner tool.

Figure 5 - Module architecture diagram for the Collaborative Planner tool.

Presently, the proposed concept and collaborative planning approach is under assessment and evaluation inside of the CoReNet consortium through a software prototype implemented through a Web-based application embedded on a Liferay application server. Figure 6 presents the graphical user interface of the collaborative planner tool prototype of the current release version.

The present version supports most of the features intended for the collaborative planning inside the CoReNet sustainable methods and tools for production distributed planning pillar. The following development phase intends to fully integrate this development with the remaining set of CoReNet supply chain management toolset.

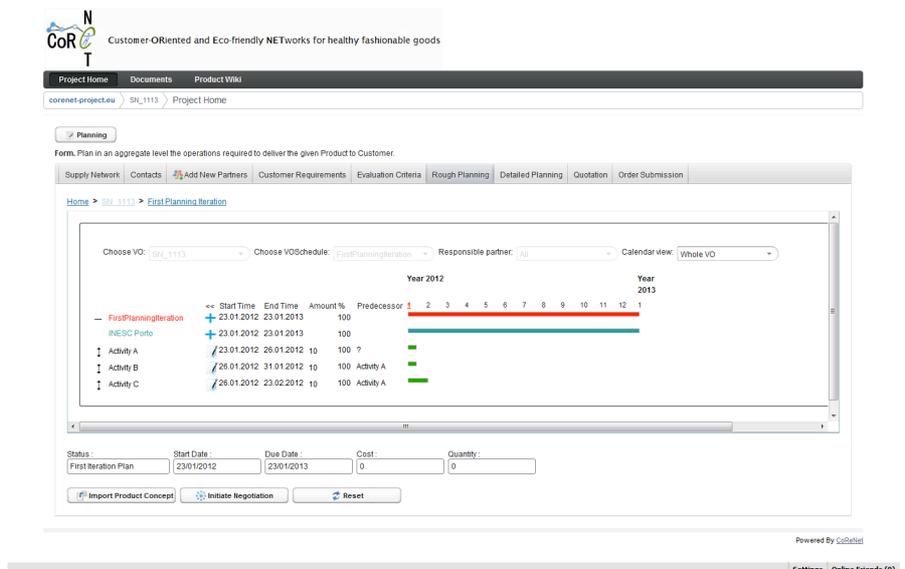


Figure 6 – User Interface of the Collaborative Planner tool.

6 Conclusions and Further Work

In this research, it has been studied a conceptual approach for collaborative planning processes among TCFI supply networks framed on the CoReNet European project. This innovative approach presents a truthful framework for collaborative negotiation among partners in the TCFI supply networks, providing support for the definition and organization of operations and activities relevant to fulfil customer orders of high customizable products and services.

The proposed approach presents several major advantages as compared with traditional solutions, such as: a centralized repository of shared information for collaborative planning generation; ability of partners do suggest new delivery dates, delivery conditions and quantities in a collaborative negotiation model; evaluation of alternative plans based in a multi-criteria approach. Presently, this approach is under development and refinement inside the consortium of the CoReNet project and will be tested in the different business cases applicable to the TCFI sector.

As further work, it is planned to validate the proposed approach on several industrial clothing and footwear networks and evaluate the integration of this tool with local company information systems in order to allow an automated production capacity validation for local production planning.

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