ABSTRACT
Customers are more and more demanding regarding firms’ services or products. In today’s highly competitive business environment, they need to go beyond order qualifiers such as price, delivery lead time and product quality, to develop order winners that are related to customer service. This can be achieved by developing and monitoring the performance of the "Customer and Commercial Logistics (C2L)" processes. C2L includes all the processes involved in managing customer relationships and flow of orders. We focus on the Order Management activity, which probably constitutes the main component of C2L. The first part of this paper will discuss it and present the issue of its integration in the Order Fulfilment Process (OFP). In order to enhance the accuracy of order promising and the reliability of order fulfilment, the advanced ATP (AATP) function has increasingly attracted the attention of the supply chain management research community. The interaction between entities is crucial to the success of the OFP. The aim of this paper is to present a methodology, based on existing research, to manage bulk orders. This preliminary research should lead to the development of a specific AATP based on a multi-criteria analysis.

KEY WORDS
Supply Chain Management, Advanced Available To Promise, Order Fulfilment, Business Process, Integration, Continuous Improvement

1. Introduction

Many authors have highlighted gaps at the interfaces between Supply Chains (SC) and Demand Chains (DC). The Demand Chain focuses on the product from the point of view of the customer, what the customer wants and needs [1]. The traditional process propagates demand by sending purchase orders to the supplier. In the same manner, supply is propagated by the acceptance of the orders and the assignment of a due date by the supplier [2].
2. Customer & Commercial Logistics (C2L) Processes and Integration

“Customer and Commercial Logistics” (C2L) encompasses all the processes which enable to manage the flow of orders as well as customer relationship [3]. In this section we will first present the key processes that compose C2L. Then, the problem of integrating these processes inside the OFP is discussed. And finally, we will look at the complexity of the Order Management activity (the principal component of the OFP and hence, of the C2L) and the main problems to be solved in order to efficiently manage orders.

2.1 The C2L Processes

Customer satisfaction constitutes the heart of the performance of a SC [4]. However, in a highly competitive environment, customers can change their supplier very easily and quickly. Their selection criteria are based not only on finance and reactivity, but also on service and sometimes on feelings (need for recognition, listening...).

So, SCs have to increase their performance by working on four axes: satisfy customer requests; manage the supply chain’s uncertain events with respect to customers; coordinate the customers’ risks with respect to the whole supply chain; develop customer loyalty. Such a step is naturally articulated around C2L. In fact, C2L constitutes, for the customer, the single operational interface with the SC, from the expression of its needs (orders) to invoicing and problem-solving related to possible complaints.

Lauras et al. [5], inspired by the work of Croxton et al. [6], have identified the key processes of C2L and split them into 5 main fields: Demand Management, Order Management, Credit Management, Customer Service Management and System Administration (see Table 1.).

2.2 The Problem of Integration

Freeland [7] estimates that it is not possible to act effectively on the SC added value produced for customers if the Marketing, Sales, Manufacturing and Distribution processes are not coordinated with C2L processes. To do that, SCs have to develop their communication, cooperation and coordination capabilities. This characterizes the integration concept [8]. So in practice, it is a question of developing integration of processes in the SC, which are associated with customer service [9].

Integrated supply chain management focuses on the coordination of all logistics activities in a system that simultaneously attempt to minimize total distribution costs and maintain desired customer service levels [10]. So a first stake for a SC consists in supporting the integration of the C2L processes [3] by optimizing coordination with other nodes of the SC: Manufacturing, Distribution, Sales, Procurement, Marketing and, of course, Customer. Actually, C2L is in close relationship with these functions and has to ensure coordination and synchronisation with them.

Table 1: Key Processes of C2L

<table>
<thead>
<tr>
<th>FIELDS of C2L</th>
<th>KEY PROCESSES</th>
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<tr>
<td>Demand Management</td>
<td>Animation of sales forecast and administration, Available To Promise process, Stocks Deployment process, Coordination with other SC Planning processes (marketing, procurement, manufacturing, distribution)</td>
</tr>
<tr>
<td>Order Management</td>
<td>Analyse, modify and execute orders and orders’ portfolios, Coordination with other SC Execution processes (sales, distribution)</td>
</tr>
<tr>
<td>Credit Management</td>
<td>Edition and billing control, Cashing management, Customer risk</td>
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<tr>
<td>Customer Service Management</td>
<td>After sales process, Return process, Contact Management</td>
</tr>
<tr>
<td>System Administration</td>
<td>Management of the Data Base (Customer, Products), Administration of the C2L IT</td>
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To represent these interactions, we have used the BPMN (Business Process Model Notation) formalism. BPMN presents a relevant graphical projection of the studied processes: this is the Activity’s point of view. In addition, BPMN introduces, particularly, the concepts of “messages” and “information flows” that were not in the traditional Business Process representations (IDEF-0, SADT, etc.): this is the Event’s point of view.

Figure 1 describes the Order Fulfilment Process (OFP), from the order to the delivery of finish goods and, the treatment of complaints. It distinguishes the role of each entity (through the different lanes) and pumps up the volume on the different links between them. The flow chart shows clearly that two activities of C2L encompass a majority of the interactions within the different functional entities: Customer Service and Order Management. Consequently, these activities must be reliable to generate a good “on time delivery KPI” and to guarantee customer satisfaction. This is the aim of our research. In this paper, we study only the case of the Order Management integration. The Customer Service Management has already been studied through specific research works [11][12].
2.3 Order Management: Governance and Uncertainties

The Order Fulfilment Process (OFP) is complex because it is composed of several activities executed by different functional entities, and it is heavily interdependent between tasks, resources and agents involved in the process [3]. OFP is difficult to manage because each entity, which intervenes in the process, has its own objectives. Croxton et al. [6] add that effective OFP requires integration of the firm’s manufacturing, logistics and marketing plans. Thus, they should develop partnership with key members of the SC to meet customer requirements and reduce total delivered cost to customers.

As an evidence, C2L is the central entity of the OFP and the Order Management (OM) activity constitutes probably the most important part of this process (and encompasses a majority of the problems…). The aim of the OM activity is to receive orders from customers and to commit order requests. The main objectives can be summarized into two dimensions [3]:

- delivering qualified products to fulfil customer orders at the right time and right place;
- achieving agility to handle uncertainties from internal or external environments.

Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace [13]. Agility can be expressed as having four underlying principles: delivering value to the customer, cooperating to enhance competitiveness, organizing to
master change and uncertainty, and leveraging the impact of people and information. Four dimensions can be associated to the agility: efficiency, flexibility, robustness and adaptability.

The challenge seems to be able to propose methods and tools to support this agility. Two main difficulties arise:
- The uncertainty’s management within the OM activity;
- The problem of Governance.

In fact, the first step to satisfy customers begins with effectively responding to request for quotation, which is, in other words, to give Available-To-Promise (ATP) for the order quotation. The aim of the OM activity is to execute this ATP. But in many cases, order promising cannot be respected and order Fulfilment cannot be done properly. Stock-out, Non-quality or not envisaged Orders are some of the examples.

Question 1: How can orders be managed when promises cannot be executed?

Moreover, if the OFP gets a clear global objective (provide to the customer the right product, at the right price, at the right time), each entity that participates to this process tries to achieve also their own objectives. Of course, these objectives are generally contradictory (the problem of Governance then arises). Thus, in case of stock-out for example:
- Distribution wants to minimize the costs of transportation by delivering all the products of an order later but in one batch.
- Sales department must maximize the turnover of the current month by sending backorders separately (especially if the order is not complete at the end of the month…).
- Marketing does not want to sell some products individually. For example, an order with a solar cream and a booklet cannot be delivered if one of the two articles is not available (because they are linked).
- Manufacturing wants to minimize the impact of this problem on its planning (and probably also on its costs). Consequently, they do not want to change anything in order to produce quickly the item out of stock.
- The Customer wants to be served as promised.

Question 2: How should contradictory objectives be considered in the Order Management activity?

3. Literature Review of Existing Methods

In practice, there are several methods that support the OFP and more precisely the OM activity.

The most important is probably ATP (Available To Promise). According to the APICS (American Production and Inventory Control Society) dictionary (9th edition) [14], ATP is the uncommitted portion of a company’s inventory and planned production maintained in the master schedule to support customer order promising. This promising mechanism is adapted in a make-to-stock (MTS) production model. Actually, in the MTS model, finished goods are produced according to demand forecast and put into inventory before an order is received from a customer.

In the make-to-order (MTO) strategy, to avoid "over promising" and "under promising" on job orders, you have to set your delivery dates based on available capacity and material constraints. Capable To Promise (CTP) determines whether you can meet your customer's requested delivery dates (or at least the earliest realistic date a product can be promised).

ATP and CTP are searched along three dimensions [15]: the time dimension, the customer dimension and the product dimension.

In case of shortage, different rules can be envisaged to manage the ATP/CTP along these three dimensions. As an example, customers’ allocation might be done through: ranked based, fixed split, First-Come First-Served or per committed (quotas).

A third technique used to determine the delivery date is Profitable-To-Promise (PTP). This method is used in manufacturing systems which have a big product mix and many kinds of customers [16]. In this case, we can prioritize individual orders based on margins, preferred customers, preferred orders or any other criteria, which affect the bottom line. PTP analysis allows the business to find out if a particular order will be profitable to make, considering the raw material costs, process costs, inventory costs and other costs against the price the customer is willing to pay. PTP works well for all industries whether it is discrete, process, mill or flow manufacturing. In the case of MTS companies, PTP works on the data from distribution planning. In the case of MTO companies, PTP works on the data from production planning. In summary, profitability is the only criterion considered by the company.

Note that if no promise can be found for an order, the SC will not be able to fulfil the order within the allocation planning horizon [15]. But orders have to be fulfilled
nevertheless! Today, no ATP methods allow managing bulk orders in order to deliver them efficiently.

Some authors have proposed to develop the Advanced Available-To-Promise (AATP) in order to enhance the responsiveness of order promising and the reliability of order fulfillment [17]. AATP directly links available resources (i.e. finished goods and work-in-progress) as well as raw materials, production and distribution capacity with customer orders in order to improve the overall performance of the SC. While ATP is simply a monitoring of the uncommitted portion of current and future available finished goods, AATP provides a decision making mechanism for allocating available finished goods inventory to customer orders and concluding order quantities and due date quotes.

The characteristics used for classifying AATP are [17]:
- The availability level: finished goods inventory or supply chain resources (including raw materials, work-in-progress, finished goods…);
- The operating mode: real time or batch mode;
- The interaction with manufacturing resource planning: active (AATP modifies the Master Schedule) or passive (AATP is done independently with information regarding finished goods and resource availability).

Some additional advanced ATP functionalities are currently discussed by researchers [17][15]. These functionalities mainly refer to strategies applied to an anticipated shortage of finished goods or supply chain resources. Siala et al. [18] summarize them in a fourth dimension which is the flexibility of the solution proposed to the customer. Three different strategies can be supported by AATP [17]:
- AATP with substitute products: in certain cases substitute products can be delivered within the given delivery time window in place of the product originally ordered by the customer.
- Multi-Location AATP: if the customer order cannot be fulfilled with the finished goods or supply chain resources at a certain location, available finished goods and resources can be sourced at other locations.
- AATP with partial delivery: if the ordered quantity is not available within the given delivery time window, the customer order can be fulfilled with two or more partial deliveries.

These different strategies can be combined in any possible sequence in the AATP planning mechanism [17]. Besides generating these strategies sequentially, they can be combined in the AATP planning mechanism in such a way that all feasible solutions are determined and assessed simultaneously. This provides a partial answer to Question 1 presented in section 2.3. But, no research work seems to have developed rules for identifying and assessing alternative strategies in case of a temporary shortage of finished goods [17].

It becomes clear that models and algorithms generating order quantity and due date quotes, based on pertinent information concerning customer orders, uncommitted finished goods quantities as well as customer priority and preference, represent the core of AATP planning mechanism [17]. But if some authors such as Pibernik [17] or Siala et al. [18] have tried to consider these strategies in their AATP planning mechanism, none of them seems to have studied the impact of the different decision-makers in the SC (see the problem of Governance and Question 2 discussed in section 2.3.). Practically, these papers refer to a single decision-maker point of view that is the customer point of view [17] or the Decision Centre point of view [18].

4. Our Proposition: Multi-criteria AATP

Customer requirements and preferences in regard to the questions discussed in section 2.3 may necessitate AATP to be operated.

While Siala et al. [18] have proposed a planning mechanism for a multi-location real-time AATP based on finished goods inventory and substitute products, we propose to develop a single-location batch-time AATP based on finished goods inventory, substitute products and partial delivery within a non sequential mode. In addition, we want to consider the Governance problem by considering that results of OM need to include the diversity of the stakeholders’ interests.

As an evidence, AATP only based upon the use of one decision-maker point of view may fall through the cracks. We can note effectively that disparate local objectives - SC and DC point of views - may result in superfluous and incompatible choices concerning the OM. There is need to define strategies for the Order Manager as a whole and to be able to drill down to different impacts at different levels of the SC. We propose a multi-criteria decision-making system to support the OM Activity.

To summarize, the aim of this research is to present an approach to manage bulk orders by developing a specific AATP that:
- Analyses Order Lines in batch mode;
- Studies partial delivery, substitute product, delay and alternative location possibilities;
- Allows comparing all the Order Strategies by considering all criteria and constraints of the
different actors that participate to the OFP (non-sequential mode): SC and DC.

The mechanism developed in our proposition (Figure 2.) is triggered by the arrival of a Customer Order:

1. The order is fragmented in different Order Lines. In the following parts, we will consider an Order Line composed of an item “A”, with a due date “t” (notation At).
2. Then, the stock allocation for this Line is checked. Allocations are calculated from forecasts and relate to the commitments done to the customer. When there is no allocation defined, the Line should not be fulfilled. But in some cases, the Line could be fulfilled if there is an Overstock.
3. When the Line refers to a commitment (quote), the stock availability within the time window can be checked. If the item “A” is available then the Line can be fulfilled on time.
4. In the event of a shortage of the product “A”, the AATP looks for alternative strategies to serve the customer under good conditions. Thus, four axes will be studied in a nonexclusive way to determine:
   - availability of substitute product;
   - a probable inventory of the original product (or substitute product) in an alternative location;
   - the possibility to split the Line and to serve it in two times or more;
   - the possibility to delay more or less the Line.
If at least one solution can be executed then feasible fulfilment strategies are generated. All the strategies have to be recorded.
5. The previous steps are run for all the Lines in order to be able to decide the best strategy to execute for the complete Customer Order. From all the Order Line’ strategies (one or more for each line), Customer Order’ strategies have to be defined. This step considers a set of rules complying with SC specific conditions (cost and required time for shipping and handling, unit profit margins for regular and substitute products as well as customer specific information such as delivery time requirement and the potential acceptance of partial delivery and substitute products). By these sets of rules it must be ensured that only feasible and relevant strategies are generated from the supplier’s and the customer’s point of views. When several Customer Order strategies are available, the planning mechanism has to support their assessment. The assessment is based on a multi-criteria approach that considers criteria of all the actors that participate to the OFP. The aim is to reach a judicious compromise between SC and DC points of view.

6. This assessment then determines the sequence in which the Customer Order fulfilment strategies could be proposed to execute the OM Activity.
5. Case study in Progress

The application deals with the OFP in a European healthcare SC. This work is in progress and some actions are not yet completed.

The network considered is mono-sourcing oriented (one manufacturing plant per product). The distribution channel is articulated around Distribution Centres (based in different countries). Final products are necessarily delivered to consumers through a pharmacy retailer. The pharmacies supply the products directly from the Distribution Centres or through a Healthcare Wholesaler (that must hold all products in their stocks). Thus, this organisation allows sourcing products at alternative locations (several Distribution Centres and several wholesalers). Moreover, customer orders can be pushed in the pharmacies by sales forces or can be pulled through medical prescriptions. Consequently, the OM activity must be relevant to ensure the agility of the SC. Actually, the OM activity has to guarantee the market qualifiers of an agile SC (Quality, Cost, Lead time) but also the Market winners (Service Level) [13].

5.1. Actual AATP System

Until 2007, the OM activity was realised with some basic office tools. All the bulk orders were treated completely manually. Since few months, a new AATP system has been installed.

This AATP system calculates in batch mode for each Order Line (AATP can nevertheless run in real time during the day). Each Line is analysed, in pure sequence, according to Allocation, Stock Availability, Product Substitution within the due date, Delay, Product Substitution with a delay. Let us consider a Line of a product A and a due date t (notation A_t). The product A can be substituted by the product A' or delayed at a new date (t+x).

The steps of the analysis are:

1. Allocation is checked. If there is no allocation, the Result is A_{t+y} (y>x). If OK, 2. Stock of A is checked at due date t. If OK, the result is A. If not, 3. Substitute product A' is checked at due date t. If OK, the result is A'. If not, 4. Stock of A is checked at a new date t+x. If OK, the result is A_{t+x}. If not, 5. Stock of A' is checked at a new date t+x. If OK, Substitute product A'_{t+x}. If not, 6. The result is A_{t+y} (y>x).

Consequently, 6 different results are possible for a Line:

- Not validated,
- Validated with the initial product on time,
- Validated with a substitute product on time,
- Validated with the initial product at a new date,
- Validated with a substitute product at a new date,
- Validated with the initial product at horizon.

We can remark that as soon as a solution is possible, the process stops and retains the solution. This system considers finally that the best solution is of course n°2, but also that the alternative n°3 is better than the alternative n°4. The system aggregates all the Lines for a Customer Order (within a solution and only one for each line) and decides how to serve the Order. This decision is based on a Completeness KPI (e.g. ratio of the number of Lines that can be served on the number of Lines included in the Customer Order) and a check of linked items (e.g. synchronization of the items in the case, of promotions, for example).

5.2. Identified limits: the DC point of view

The main customers of our case study are pharmacies and healthcare wholesalers. Customer service can be defined for them as:
- Pharmacists do not really manage their stocks. In addition, Pharmacists market products of various nature (medicines, cosmetics, etc.), subjected to some constraints (legal, promotional operations, etc.), and different flow logics (pull and push). Consequently, each Order Line can be associated to a different objective: imperative due date (whatever the product is: A or A'), imperative quantity (whatever the time is: t or t+x), imperative completeness of the Customer Order (to be able to launch a promotional operation).
- Some particular products, like vaccines, must be delivered, even in the event of shortage. So, sometimes Order Lines must be split.
- Some products have a high value-added and/or submitted to legal constraints. In this case, substitutions are not allowed.

Some particular customer constraints appear and the sequential analysis of the actual system may not correspond completely to these requirements. Does the customer prefer receiving the substitute product on time or the original product a little bit later?

As an illustration, we consider an order with 3 products A, B and C within the due date t. B and C are available but A is out of stock. A can be delivered later (date t+x) or can be substituted by product A’ (on time or later). If we consider the sequential analysis, the result would be: “A’_t, B_t, C_t”.

But, wouldn't strategy “A_{t+x}, B_t, C_t” be better?
5.3. Identified Limits: the SC point of view

As discussed in section 2, the OFP is based on several actors that do not necessarily have the same objectives. The different points of view are not considered in the actual AATP process. For example, because the products are generally small in volume and orders include very few units, the Distribution function will prefer to group orders for the same customer in order to minimize its transportation costs. Thus, strategy “A_1, B_2, C_1” would be the best…

But, on the other hand, because an increasingly significant part of the sales come from sales forces (and not from the physicians’ prescription), the Sales department will prefer to send backorders separately in order to maximize the turnover of the current period. Thus, for the Sales department, strategy “A_1+x, B_2, C_1” would be the best…

5.4. Perspectives with our Proposition

With our proposition, three different Order Line strategies could be identified for A. Thus, three Customer Order strategies are preserved and analysed:

1. A_1, B_2, C_1
2. A_1+x, B_2, C_1
3. A_1+x, B_2, C_1

The third solution is necessarily less interesting than the first one (degraded solution). But, between solutions 1 and 2, which is the best?

The next step is to develop the Multi-Criteria Assessment method in order to answer this question by considering not only the DC point of view but also the point of view of all the other actors that are involved in the OFP (SC point of view). It is worth noting that the integration of the OM activity in the OFP could facilitate conciliation between supply and demand. The final result (after assessment, for example) will be different according to the criteria of the problem.

6. Conclusion

In this paper, we tried to demonstrate that the gap between supply chain (SC) and demand (DC) can be bridged by integrating Customer and Commercial Logistics (C2L) processes, hence increasing customer satisfaction. After having presented C2L processes and the Order Fulfilment Process (OFP), we have remarked that the Order Management (OM) activity encompasses a majority of the interactions within the different functional entities. To support the integration of the OM activity in the OFP, we have proposed an approach to manage bulk orders by developing a multi-criteria Advance Available-To-Promise (AATP) methodology.

In the case study, the actual AATP system presents some limits:

- The sequential analysis may not correspond completely to customer requirements (from the perspective of the DC).
- The point of view of the different actors are not considered (from the perspective of the SC)

The case study reveals the existence of day-to-day operational problems and illustrates how our approach would help in the decision-making process by looking at the problems from both perspectives – the DC and the SC. In other words, our approach takes into consideration the points of view of all the actors involved in the OFP. The next phase of our research will consist of developing the multi-criteria tool for the assessment step of our methodology.

References