Optimizing Order Promising

by

Zhipeng Li

Submitted to the Engineering Systems Division in Partial Fulfillment of the Requirements for the Degree of

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Abstract

Online purchasing is now popular following the growth of E-business. Retailers ordering online will get the exact delivery date of goods for their better management of sales operations. Suppliers should keep their competence at order promising to attract customers in the market filled with increasing competition. Generally Order Promising means that the supplier receiving an order should determine to accept the order or not. If accepted, then the supplier should determine the delivery date. Necessary data should be replied to the ordering customer. Optimizing Order Promising (OOP) is Order Promising (OP) that is optimized. This thesis probed into OP and OOP and summarized the characteristics and differences of the current OP software products on the basis of interviews and the investigation into the existing OP software suppliers – i2 Technologies, Oracle and SAP. Backed by the thorough analysis on a particular case study company, this thesis discusses the workflow and model of OOP by combining the author's own thoughts on improving existing OP workflows. A company can add many new functions to the OOP model designed in this thesis on the basis of the appropriate adjustments to the existing OP workflows and systems. For example, different customers can be managed in a classified way in accordance with historical sales; customer trust can be increased by the approach of Customer Allocation; every deal of the company can be guaranteed to be profitable;

and no negligence to important customers will occur due to favoring unimportant customers. Moreover, in dealing with the disruptions that have frequently occurred these years, the thesis designed the order promising process dealing with emergencies for the manufacturers of public utilities, ensuring that a company will implement their social responsibility while harvesting profits.

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Besides, I'd like to specially thank Dr. Chris Caplice, the director of MLOG program for the resources and instructions he provides to me. In my study in MLOG, Dr. Caplice really gave me a lot of guidance and encouragement. Without Dr. Caplice, I would not have learnt so much knowledge in MIT. I will be always grateful to Dr. Capice for his help in my life!

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1 Introduction

1.1 Motivation

Customers long to know the exact delivery date of goods when ordering goods online. This is the result of the rapid development of E-business and E-commerce. Customers hope to arrange their production or consumption on the basis of a known goods arrival date. But suppliers may have difficulties in making such Order Promising (OP). A late delivery date promised may incur the discontent of customers; if too early, the order may in the peril of being unfinished when the promised date comes. Moreover, some customers do not need early delivery for their worry on excessive inventory. For a company, it is possible that a somewhat delayed delivery is more profitable than a earlier delivery.

Previously suppliers often took into consideration only the ability to complete the order in accordance with customers' requirements at order promising, and determined the delayed completion date if the ordered date was impossible to reach. However, the popularization of new production modes, including Lean Production and Just-in-Time (JIT), caused companies to place higher and higher importance on the saving of resources, which is always accompanied by the shortage of resources. So it is quite important to carry out the rational arrangement of production according to the order. OP should fulfill the requirements of customers as much as possible without impacting the profitability of the company suffering a stressed supply of resources. When promising an order, a company should carefully consider the resources, the resources that can be allocated, the profitability of the order and the importance of the customer etc. It is critical to find an optimized solution dealing well with all these problems.

Starting from these problems, this thesis aims to find a clear workflow to conduct the whole process of Optimized Order Promising to facilitate a company to maximize profits with limited resources.

1.2 Methodology

1.2.1 Qualitative

Currently quantitative analysis dominates the research of this field, but there is no clear description on the whole decision-making process. I found that the former research focused on how to do order promising, but lacked a thorough study into OOP. A clear workflow is necessary to realize OOP. This thesis adopts qualitative study aiming to build a most rational OOP model easy for realization. Readers will know the decision-making process of OOP quickly. Their labor will not be spent on the understanding of lengthy mathematic formats.

1.2.2 Case-Study

This thesis screened out the current enterprises that did a good job on order promising. I only have the further interview with one company for the limitation of time. By communicating many times, I understood deeper the business of the interviewed company and knew clearer the process of order promising. The final OOP model comes from the above experiences and my own thinking and study. I believe that the study results are closer to the reality for the conduct of the actual business experiences. Companies will find the results more favorable.

1.2.3 Software Products

I phone interviewed the top software service suppliers. I hoped to know the design of the current OP software on the basis of the interviews with software product suppliers. Also I wished the easier application of my thought to the software design.

My interviews covered two major software service suppliers, as follows:

- i2 Technologies: i2 Technologies was founded by Sanjiv Sidhu and Ken Sharma in 1988. From the beginning it was a leader of the supply chain industry. Its core techniques are for end-to-end supply chain. Its products include: supplier relationship management, supply chain management, demand chain management, customer service management and transportation.

- SAP: SAP was established in 1972. Its corporate headquarters is in Waldorf, Germany. It is the global largest enterprise management and coordinated business solutions supplier, and global third largest independent software supplier. Currently, in over 120 countries over the world more than 100,600 sets of SAP software products are running in the premises of over 32,000 users. Over 80% of the world's top-500 companies have benefited from the management solutions of SAP. SAP owns branches in over 50 countries of the world, and is listed at many stock exchanges, including the stock exchanges of Frankfurt and New York[1]。

1.3 Writing Structure

Chapter 2 of this thesis is the introduction to the related theories of OP and OOP. The conceptions of related Available-to-Promise (ATP), Capable-to-Promise (CTP) and Profitable-to-Promise (PTP) are presented. The main factors influencing OP are analyzed in detail. Chapter 3 classifies past literature and reviews the literature of quantitative analysis and systematic design. In addition to some imperfections of the past literature presented here, I delivered my own thought. Chapter 4 is the introduction to the designs and features of the current three major software suppliers

[1] Website: http://www.sap.com (accessed on April 9, 2007)

(i2, Oracle and SAP) on the basis of interview records and data available on Internet. Chapter 5 is the complete case study of a company. We disguise the name of the company here, as demanded by the company. In Chapter 6, I delivered my thoughts on how to achieve OOP and presented the design and rules relating to OOP. I developed the OOP model and demonstrated it with/without emergency. The last chapter shows the results and future direction of the research.

2 Introduction to Order Promising (OP) & Optimizing Order Promising (OOP)

On-line purchasing has become prevalent due to the increasingly popularized E-commerce. Retailers hope to get the precise goods delivery date when ordering goods online for the better scheduling of sales operation. Suppliers should have mastered the overall production processes and internal context of the company to respond to every order clearly and correctly with an accurate delivery date estimate. This is not an easy matter. But suppliers should maintain the competence at order promising to attract more customers in markets featuring increasingly intensified competition. The two key research questions of this thesis is that what Order Promising (OP) is and how to achieve Optimized Order Promising (OOP).

2.1 Definitions of Order Promising (OP) and Optimizing Order Promising (OOP)

Generally Order Promising (OP) means that the supplier should assess the acceptance or not of a received order. If the order is accepted, then the supplier should determine the delivery date and send the information to the customers. The supplier that has promised an order should complete the order on time to maintain customer's satisfaction, otherwise there will be a negative impact to the supplier's reputation and the loss of opportunities for future order harvesting.

The name of Optimizing Order Promising (OOP) implies the optimization of Order Promising. What is optimization? Optimization is the maximization of the company's profit or other objectives. Comparing to Order Promising that is of customer-oriented, Optimizing Order Promising (OOP) is supplier-oriented. The ultimate target of Optimizing Order Promising (OOP) is to maximize the company's profit without impacting a customer's satisfaction while keeping an eye on the limited resources of the company.

2.2 Related Concepts to Order Promising

2.2.1 Available-to-Promise (ATP)

ATP (Available-to-Promise) is an important concept applied to the process of Order Promising. It means that the products are available for the company to use for supply when orders arrive. The available products include the products in storage and the products to be produced in certain future periods in accordance with a production promise. The available products should remain isolated from the order promising to other customers. The quantity of ATP Supply is always changing and updated in accordance with the Master Production Schedule (MPS). Generally there are three methods available for the calculation of ATP; they are: Discrete ATP, Cumulative ATP with Look-ahead, and Cumulative ATP without Look-ahead. (Vitasek, 2003)

The calculation of Discrete Available-to-Promise depends on the supply figure in the MPS. The item's ATP supply for the first period is the sum of the initial inventory plus the MPS quantity, and then minus the order backlog. For the rest of the periods, if they have a quantity scheduled, then ATP is the result of this scheduled quantity minus all customer commitments of this and other periods, until the MPS reschedules another quantity. Those periods that have the quantity scheduled at zero will have ATP at zero too (even if deliveries have been promised). The period where the item was most recently scheduled contains the accumulation and shows promised customer commitments.

The ATP figure in the MPS also determines the calculation of Cumulative ATP. There are two methods with and without look-ahead available for the calculation of the Cumulative ATP. The Cumulative ATP with look-ahead is the sum of the ATP and the MPS of the previous period minus the backlog for this period, and then minus the sum of all the differences between the backlogs and MPS for all the future periods until the period when production exceeds the backlogs (this is not the only case). The Cumulative ATP without look-ahead is the previous period's ATP plus the MPS minus the backlog of the same period.

Despite different methods used, the OP calculation is based on ATP. Various ATP calculation methods influence OP a little. For example, production demands, the supply of raw materials, which prices, and what sources are not the key concerns of the production process. Certainly prices and sources of raw materials may influence the whole company, but they do influence only a little the production process. The relationship between raw materials and production is similar to ATP and OP. OP demands ATP, but how to calculate out ATP is not the focus. The above-mentioned three calculation methods have different advantages and disadvantages, and the calculation results may vary greatly. The company should choose the ATP calculation method on the basis of the actual situation; but this is not the focus of this thesis.

2.2.2 CTP (Capable-to-Promise)

CTP is a technique amending ATP to a certain degree. It can be applied to the decision on the acceptance or not of a customer order. Generally a company will not plan the full production capacity during MPS. So the ATP that changes dynamically following the MPS is not the highest production capacity of the company. Thus in addition to ATP, the company uses CTP to determine whether an Order Promising can be made if the company implements production at highest capacity. CTP takes into consideration the existing storage and the output of certain future periods that are also under the consideration of ATP. In addition, however, it considers the company's highest production capacity and the on-schedule order completion capability, premised by factors including the limitations on existing resources and the fixed lead times of raw materials or parts& components.

2.2.3 PTP (Profitable-to-Promise)

PTP is a rational extension after ATP and CTP. ATP and CTP have the common focus of the possibility of completing a particular order, but lack the thought on whether this order generate reasonable profit for the company. Without the consideration on profit, the company may spend excessive resources on some orders containing no profit: this is unacceptable. So the company should have another technique or method in addition to ATP and CTP to maximize the profit, which is the purpose of PTP. At this point PTP is quite similar with OOP.

2.3 Key Factors Influencing OP (Order Promising)

2.3.1 MPS

Another key factor influencing OP is the whether a Master Production Scheduling (MPS) is used for the plant's purchase and inventories are all planned in accordance with it. In the past when Make-to-Stock dominated the plants, the MPS was adjusted according to the forecasted demand. The forecast of future demand was modified incorporating value demand and the MPS was adjusted. Make-to-Order (MTO) and Assemble-to-Order (ATO) were in throne have everything based on an actual order. Industries featuring a production period shorter than ordering period could have the MPS scheduled according to actual orders. But the industries featuring production periods longer than ordering periods used to forecast the demand; they only have a shorter period for the adjustment of the MPS. The pure practice of MTO and ATO remains quite difficult.

2.3.2 Production Coordination Capability

A company featuring the globalization of plants should attach high importance to the coordination of the plants. Firstly, the upstream supply capabilities should be coordinated. The scattered plants of the company complicate the original supply channel and increase the fluctuation in the lead time. So it is critical to reduce the uncertainty of the lead time. Secondly, the uncertainty of the lead time will further impact the raw material storage policy of the company. How to balance the reduction of storage cost and the reduction of the uncertainty of the lead time will influence the whole company's costs and the production. Generally the company will naturally reduce the raw material storage if an upstream supplier with sound cooperation and has an on-time supply happens to be neighboring to the plant. But if the upstream supplier is far away from the plant and the delivery takes a period over ten days or even longer, then the company should have storage with sufficient raw materials to avoid running out of raw materials at production. It is quite important for the seasonal industries having delivery with especially long lead time to have a reliable supply schedule, because they have only one or no opportunity for a second supply.

2.3.3 Information Processing Capability

Information Processing Capability includes multiple factors. Firstly, the globalization of the company's business locations separates the production place and the sales place, which complicates the information system of the company. It is critical to keep accurate information. The ordering system of the company should be flexible to be compatible to various order format for the customers may have many different formats, such as EDI, e-marketplaces, and ERP etc. (H. C. Makatsoris et al, 2004) Moreover, the company should have access to all the related internal data when order promising; i.e., all the information concerning production, storage, and transportation should be visualized, and all the information on ATP and CTP should be maintained and updated in real-time. Luckily many software developers have the ability to provide the manufacturers with powerful information systems, which we will introduce in detail.

2.3.4 OP Flow

Many functions of the company are involved in the flow of OP; For example, the Purchasing Department, Production Department, Sales Department, Financial Department, and Strategic Department. OP's complex considerations need the involvement of many functions. The increase in the number of the involved departments greatly complicates the flow of OP. If no clear flow is available, the resulting OP delay will generate discontent in the customers. The worse case is that the unclear flow would incur various errors bringing losses to the company's profit.

3 Literature Review

In the past many researchers had argued that customer service and customer satisfaction, particularly the speed of response to the customer demand, are important criteria for evaluating the success or failure of supply chain management (Lee and Billington, 1992; Beamon, 1998; Gunasekaran et al, 2001). As the foremost customer service, surely Order Promising will influence greatly customer satisfaction and the effects of supply chain management.

Researchers paid attention to a company's requirement on OP and the features of ATP systems at the beginning of the extensive research on OP (e.g., Lee and Billington, 1995; Zweben, 1996; Fordyce and Sullivan, 1999). The increased recognition to ATP brought forth more detailed research mainly including two major types.

One type is to make improvements on OP and ATP systems on the basis of quantitative analysis. McClelland (1988) was an early researcher who studied the relationship between OP and MPS. His study contains a simulation of an MRP environment and two issues to be considered by MPS: one is the Level of Product Structure; and another is which material demand and capacity demand should be the focus of MPS. There are five approaches to process committed backlog after the determination of MPS. He carried out computations and comparisons on the average percentage of on-time deliveries, the average cycle time and the average total inventory investment among these five approaches, and based on which he provided different advice to different types of companies.

Advance ATP is currently a hot issue of research. Kilger and Schneeweiss (2000) thought that Advance ATP had three purposes: (1) Improve the fulfillment of the lead time schedule by producing reliable quotes, (2) Reduce the loss of business opportunities by using more effective methods of Order Promising and (3) Increase profitability and revenues.

Pibernik (2005) see Advance ATP as “a variety of methods and tools to enhance responsiveness of order promising and the reliability of order fulfillment.” He classified Advance ATP on the basis of three dimensions. The first dimension is availability level, mainly indicating how to determine the quantity and due date quoting; the second dimension is the operation mode that generally is divided into Batch Processing and Real-time Processing. Batch Processing means the company checks the orders received within a certain period to make decisions on the orders one by one; Real-time Processing means the company makes the decision at the time the order is received. Relatively, batch Processing of Order Promising is more profitable for a company for the certain quantity of the orders received within a certain period, as it reduces the uncertainty to some degree. The company may screen or combine different orders to reach relatively profitable Order Promising. The third dimension is interaction with MRP of reactive and proactive. In addition, the paper carried out quantitative analysis on batch processing and real-time processing separately for calculating the requirements of Advance ATP of the two processing types.

Chen et al (2001, 2002) integrated the algorithm of Mix-Integer Programming into Advance ATP on the basis of batch processing. When an order arrived, the traditional ATP only takes into consideration when the supply will match the order requirement and then returns the shortest time. In fact, the customer may only demand an on-schedule delivery, not the quickest delivery, for they may have worry about overstock. Generally suppliers might also have profit from the somewhat delayed delivery, not for the fulfillment of the requirements of other customers who have urgent demand, but for some unpredictable factors or events may disable the on-time delivery. Different from the traditional ATP, Chen et al delivered an ATP model mainly depending on quantity and due date. Their paper calculated the maximized profit from different combinations of three factors (quantity and due-date, quoting or both), and later adjusted the Batch Interval to discover the influence of Batch Interval on the maximization of the company's resources.

Another type of literature has the focus at the system design of ATP and OP. Clay (1990) firstly brought forward the management on the uncertainties of the factors including customer demand, safety stock and lead time by information technology, which will advance the functionality of ATP system, as he said. On the basis of Clay's study Vastag and Whybark (1993) incorporated the data of work-in-process, while Veeramani and Joshi (1997) further added the processing of RFQ (request for quotation) and the estimation of production cost into the model. For the practice of ATP system, Piroird and Dale (1998) applied it to the companies of chemical industry and Weng (1999) combined the design of the whole information system with the manufacturing of "Make-to-Order" type. Jeong et al (2002) built a global ATP system used by the LCD (liquid crystal display) manufacturing industry.

The distance between production location and sales place became longer and longer due to the development of economic globalization, which also complicated the management on supply chain. Often companies cannot finish the committed backlog or will finish it by excessive cost due to the blocked or wrong communication between plants, headquarters and plants, and headquarters and sales points. Xiong et al (2003) delivered a web-enhanced dynamic BOM-based ATP system, which is a decision-making approach for planners and managers of the manufacturers. The popularization of web-based application and web-based ERP requires an ATP system – a module of ERP – to be Web-based. Their paper represented how to carry out real-time calculation of ATP on the basis of the dynamic update of the BOM. Later they conducted a detailed analysis on the structure, architecture and some implementation issues of the whole system. Both papers consider that the application and maturation of Internet technology will facilitate the easy operation of web-enhanced dynamic BOM-based ATP systems as well as the convenient inter-linkage with other management systems. Makatsoris et al (2004) designed a distributed order promising system, which is applicable for international companies featuring business globalization that resulted from a study on the whole workflow of an OP system and the appropriate improvements.

By reviewing the literature, we see that the focus of it regarding algorithms is how to return the most appropriate quantity and due date to the customer order. The focus of the literature on system design is how to find the best approach to coordinate the information channels among different functions to guarantee the data transparency within the company, as the supply chain gets complicated. But, some papers thought it necessary to take into consideration other factors such as customer priority, constraints of items, profit margin of items, and so on in addition to the factors of exact product availability, precise delivery times, and the competitive pricing to be considered during the process of Order Promising. This is the starting point of this thesis. Particularly the thesis discusses the issue of how to increase profit margin for the supplier at Order Promising. This thesis aims to provide a framework of OP workflow on the basis of qualitative analysis to maximize the profit while guaranteeing customer satisfaction. I believe this framework is useful for a company's OP implementation.

4 Introduction to Order Promising (OP) Software Products

We know that software enablement is necessary for companies' correct, in time and quick Order Promising. Currently, many manufacturers of enterprise management software products have released OP software products capable of independent disposition or owning OP functionality. Below we will introduce the OP products of Oracle, i2 Technologies and SAP.

4.1 Oracle

The OP software products released by Oracle include Oracle Global Order Promising and Oracle JD Edwards EnterpriseOne Order Promising, which will be introduced separately below.

4.1.1 Oracle Global Order Promising

As a part of Oracle E-Business Suite (an integrated application designed for combining your enterprise with E-commerce), Oracle Global Order Promising is an Internet-based OP solution targeting at the applications of multinational companies.

Oracle Global Order Promising includes distributed global order promising and multi-level supply chain ATP (Available to Promise), CTP (Capable to Promise) and CTD (Capable to Deliver). Here CTD means the ability to fulfill delivery demand after taking into the consideration of transportation lead time. Oracle Global Order Promising supports various production modes including the complex "configure to order". Its main functions are:

1) Provide accurate data of supply to anybody from anywhere at any time. Oracle Global Order Promising is able to integrate data of supply and demand from various management systems to give the user an overall understanding to the global supply and demand situation. As shown in Figure 4.1, it is accessible though various order inputting systems and other order capturing systems (for example call center or web shop etc.), thus the accurate supply data can be provided to anybody of anywhere at any time.

Figure 4.1 Accesses through Any Device Anywhere

Source: Oracle (2002), Oracle Global Order Promising 11i

2) Flexible Inquiry of Supply capacity. Oracle Global Order Promising enables the user to check the stock of multi-level parts& components or resources of the ordered goods at the whole supply chain. The user can manage the organizations and suppliers involved in the inquiry of supply capacity and the levels of the supply chain to be considered in the inquiry. The user can specify the key components and bottleneck resources to be checked at any level of the supply chain, so he can control the complexity of inquiry. In addition the results can be displayed in a tree structure, which provides the user with visualized information as shown in Figure 4.2

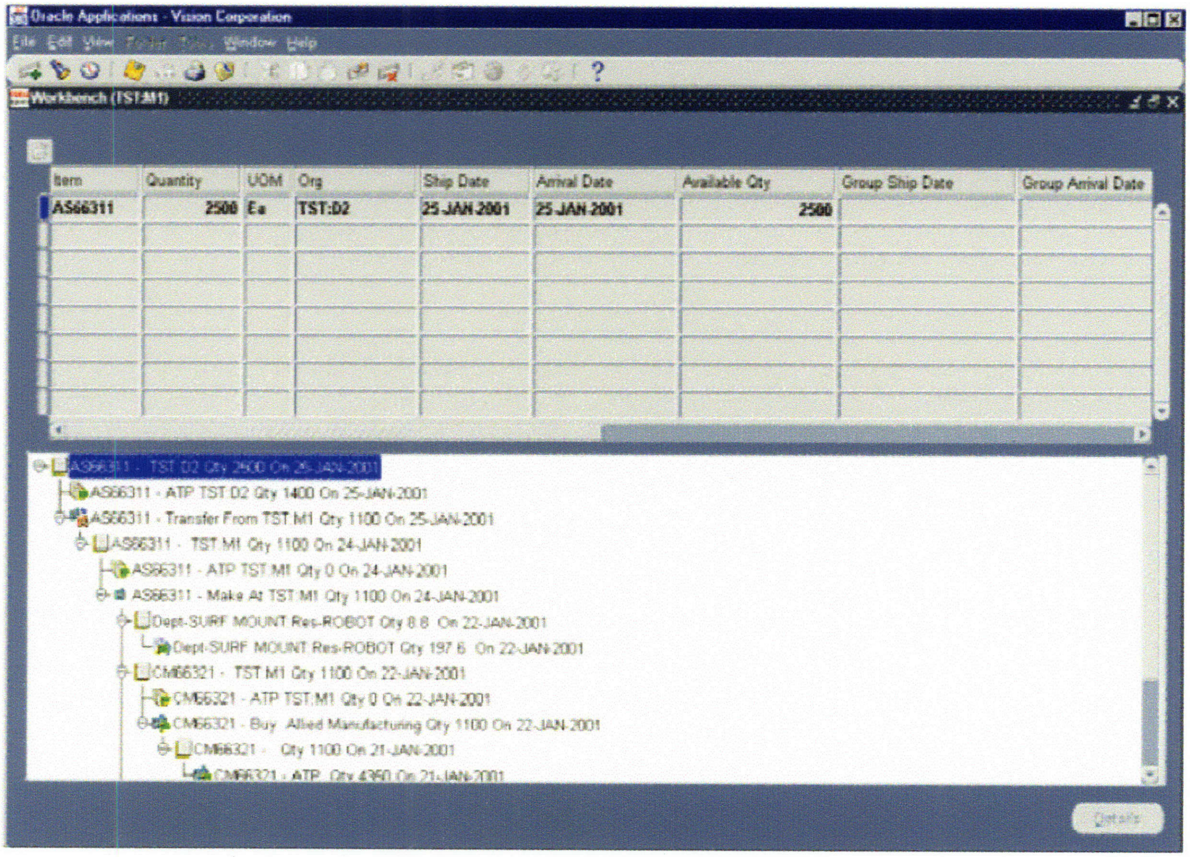

Figure 4.2 Graphical visualized information

Source: Oracle (2002), Oracle Global Order Promising 11i

3) Improve the On-time Delivery Ratio by ATP/CTP/CTD. Oracle Global Order Promising can select the best delivery location among many production and distribution centers to which a multinational company may own by searching and comparing the ATP, CTP and CTD of multiple levels of the supply chain according to the ordered product and demanded delivery date. Here the customized selection rules may help the selection of options meeting conditions to enable the user to manage which orders should be tied to which delivery locations. Here the multi-level ATP considers the transfer lead time at every stage

(beginning from the supplier, passing internal facilities, then arriving at the customer) of the supply chain to estimate delivery promised date to the customer.

4) Manage the Scarce Resources of the Company In A Strategic Way by the Distributive ATP. The distributive ATP will enable the user to distribute the scarce materials or resources in multiple sales channels or customers by flexible or fixed quantity on the basis of the user's own strategy when the total supply cannot meet the total demand. Such a distribution may be established on the basis of demand forecast or constraint. At Order Promising Oracle Global Order Promising follows distribution rules and calculates out the order completion date, and also considers limitations of the raw materials and production capacity at every level of the supply chain. Oracle Global Order Promising can compare the distributions of demand and sales channels and adjust the distribution to maximize order completion and profits at any time.

5) Automation-based Workflow. As shown in Figure 4.3, Oracle Global Order Promising adopts Oracle Workflow to support flow automation and automatic adjustment. For example, event expectations can be processed automatically by the workflow. The user can manage the flow automatically implemented in accordance with their own business procedures to minimize the costs of manual activities that have no added value. Oracle Global Order Promising auto monitors and manages the whole workflow, and deliver notices on the events, such as that

the order cannot be fulfilled on time, or the supply is imported into a higher channel from a lower channel.

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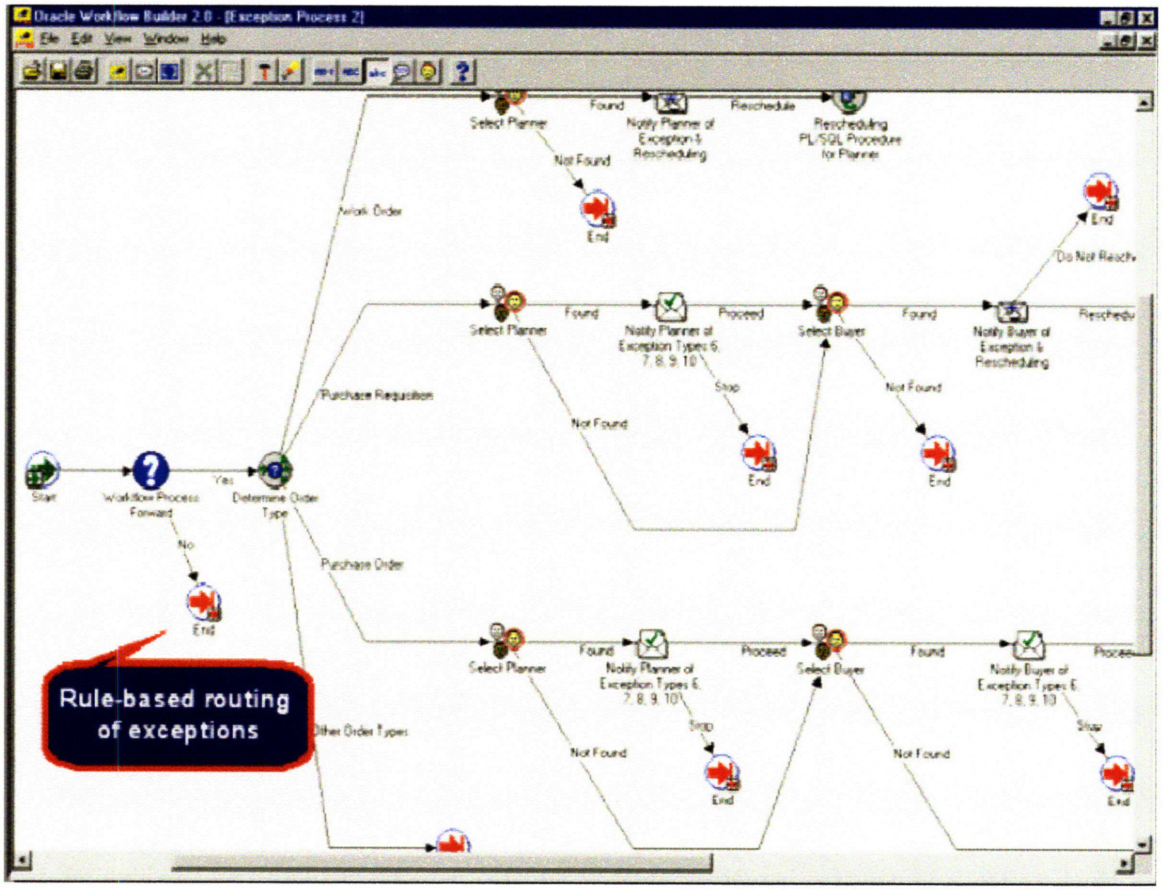


Figure 4.3 Auto-correcting Function of Oracle

Source: Oracle (2002), Oracle Global Order Promising 11i

4.1.2 Oracle JD Edwards EnterpriseOne Order Promising

As a part of the supply chain management software series of Oracle JD Edwards EnterpriseOne, Oracle JD Edwards EnterpriseOne Order Promising is a type of OP solution undertaking end-to-end perspective analysis of the enterprise's capacity. Its function is to improve the user's customer service level as well as to increase the order profitability.

Oracle JD Edwards EnterpriseOne Order Promising includes ATP (Available to Promise), CTP (Capable to Promise) and PTP (Profitable to Promise) mainly offering the following functions:

(1) Provide the User with Real-time, Overall Information

Firstly, the two functions of ATP and CTP can confirm whether the available supply could fulfill the order demand or not. If the supply can fulfill the order, then the costs and margins with different order fulfillment scenarios will be evaluated in PTP, which provides alternatives to be sorted on the basis of user defined business objectives. Generally an enterprise will have the goals of cost minimization, profit maximization and service optimization, to which a different user may choose a different one depending on his requirement. Also an enterprise can set different targets for different customers. So Oracle JD Edwards EnterpriseOne Order Promising may provide the user with real-time and precise information to enable the user to make more reliable promises to the order with higher profitability.

(2) Customer Prioritization and Reservations Management

Firstly, Oracle JD Edwards EnterpriseOne Order Promising will help the user to classify his customers according to appropriate rules of his own definition on the basis of the customers' importance and requirements, and then control the cost by providing different customers with different services. For example, the user may group the customers into A, B and C. If Group A is to enjoy the highest service level, the user may define rules such as Group A should enjoy various options for product substitution and multi-site sourcing, which are to speed delivery time and guarantee high margins. Group B includes important customers who will not accept substitutions. Group B would have rules different from Group A. Group C for less profitable customers would have certain rules to control the group's resources investments. After customer grouping, by the reservations management functionality Order Promising helps the user appoint appropriate capacity or products for the customers in each, or even a particular individual customer before order arrival. Within certain periods, the system will reserve the capacity or products appointed to the customers. But these reservations will be used for the fulfillment of other requirements if the specified customer does not order them within a dated period. Thus service level and profitability can be improved.

4.2 i2 Configuration Order Promising

As a part of i2 Order Fulfillment, i2 Configuration Order Promising is a suite of OP Software products released by i2 for the management of highly configurable products (for example, automobile and industrial equipment) with long production cycles. Its function is to help the user fulfill the customer's requirements at maximum degree, improving or maintaining the user's customer service level.

The design idea behind i2's system is to fulfill the customer's requirements by the searching of existing inventory, planned production, and available capacity. Its major functions are to confirm the alternatives on the basis of certain matching rules

The rule of thumb is that i2 Configuration Order Promising combines the function of search-specific priorities setting. i2 Configuration Order Promising permits the customer to have a priority on every option in the product configuration such as 'Must-match', 'Nice-to-have', 'Do-not-care'.(See Figure 4.5). 'Must-match' means the customer only wants his requested option. 'Nice-to-have' means the customer will also agree to the acceptance of alternatives despite his higher interest in the requested option. 'Don't care' means the customer has no higher interest in any of the options. In addition to the choice of the options of the product configuration, the customer may choose other properties of the product. For example if there are products of new and old types in storage, some customers may choose one of them; some customers do not care about features.

The i2 Configuration Order Promising may capture the preferences (such as price, delivery date, and configuration, etc.) by the approach search-by-search. The user may define reconfiguration rules (reconfiguration rules are necessary for substituting options on items in inventory/production with items specified by the customers（i2 Technologies， 2005）to further provide the customer with substitutable options (multiple combinations of configurations, prices, and availability dates) to maximize the customer requirement fulfillment when the customer's requirements cannot be completely fulfilled according to the preferences of the customer.

As shown in Figure 4.5, i2 Configuration Order Promising supports the functions of locate-to-order(existing inventory, including dealer inventory, in-transit inventory, central warehouse inventory, factory inventory), configure-to-order(planned, re-configurable production orders) and build-to-order(available production capacity). The combination of the former two functions is ATP; the latter function is CTP.

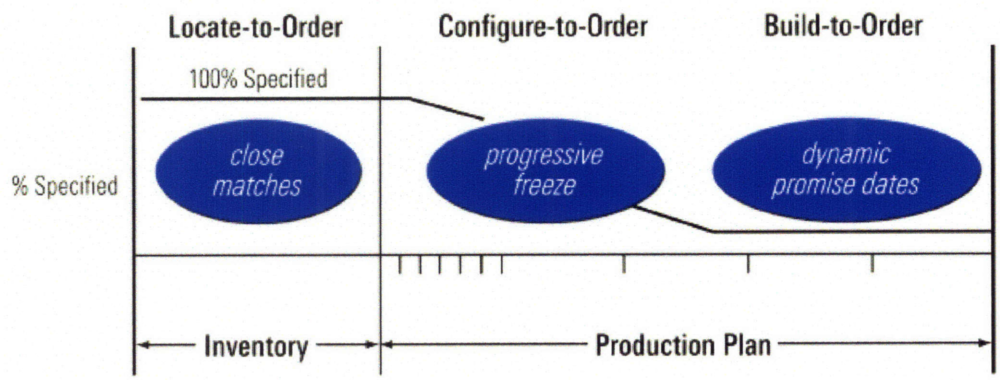


Figure 4.5 i2 Configuration Order Promising

Source: i2 (2005), i2 Technologies

(2) Support Reconfiguration of Planned Items to More Closely Match Customer Requests.

It is quite difficult for the manufacturer to realize assemble to order for highly configurable products with long production periods. Many manufacturers will plan earlier and carry out production in accordance with forecasts, which should be as accurate as possible. Inaccurate forecasts will result in customer orders not matching forecast orders. But it is impossible to make completely accurate forecast. So it is quite important to adjust forecast orders in time before assembly. i2 Configuration Order Promising undertakes reconfiguration on planned items via "modeling the progressive specification of options and the accompanying supply chain and operational constrains" (i2 Technologies, 2005). On the basis of this function, most of the items that are far from being assembled can be changed. However, the change of items in the midst of the assembly process relies on particular factors, for example, production capacity, and the parts & components etc.

4.3 SAP

Although SAP has no independent OP software product like Oracle and i2 Technologies, it has the Global ATP (GATP) module integrated in SAP APO (Advanced Planning and Optimization) – the core component of MySAP SCM (Supply Chain Management) – to help the user to make correct and reliable Order Promising.

SAP APO-GATP can do the following via the integration with other modules (such as R/3, CRM etc.)

(1) Rules-based ATP.

SAP APO-GATP allows the user to define his own solution policy for setting ATP check instructions according to his own target (for example cost minimization or service level optimization) when the existing stock cannot fulfill a customer requirement. For example, if the cost of production launching is high, the user may define such a solution policy: Firstly, search for alternatives and negotiate with the customer to see if the customer will accept an alternative or not; If there is no proper alternative to which the customer agrees, the user may decide to purchase products from other suppliers. If both approaches fail, the user should put the order into the production schedule to launch production for it, as shown in Figure 4.6. Certainly the user may adopt different solution policies for different customers. For example, in the preceding example the user may check an alternative location first before checking alternate products. Once the user defines the solution policy, SAP APO-GATP can provide the user with accurate finished goods information during the conduct of the solution policy.

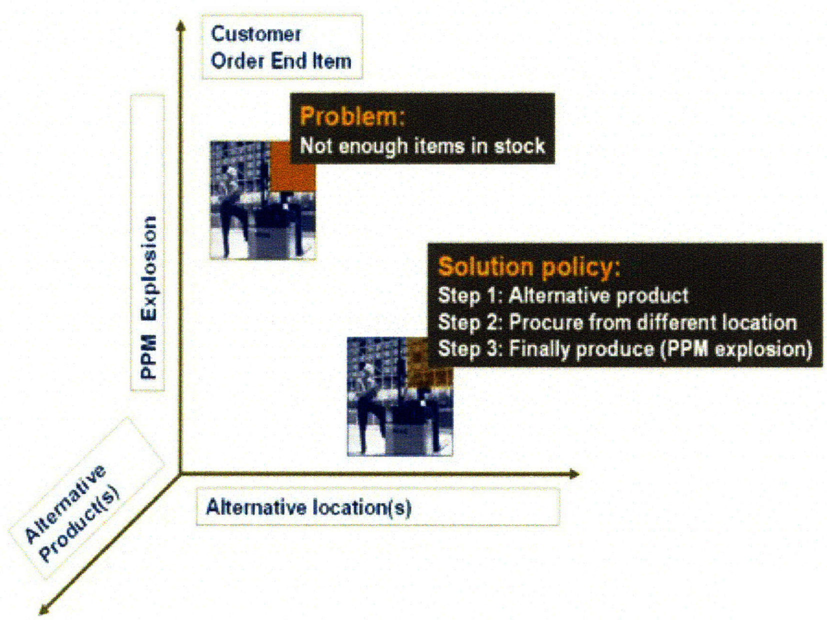


Figure 4.6 A Solution Policy Dealing with Insufficient Stock

Source: SAP AG 2003, Improving order to cash with ATP, Patti Kimler

(2) Multi-level ATP Check.

SAP APO-GATP not only can provide the user with finished goods information, but also can search for the alternate products and the locations of components, and return the results to the user following certain ATP check instructions based on the BOM

(Bill of Materials) of the finished goods, as shown in Figure 4.7. This will enable the user to get an overall understanding to his actual production capacity to facilitate making correct and reliable promises.

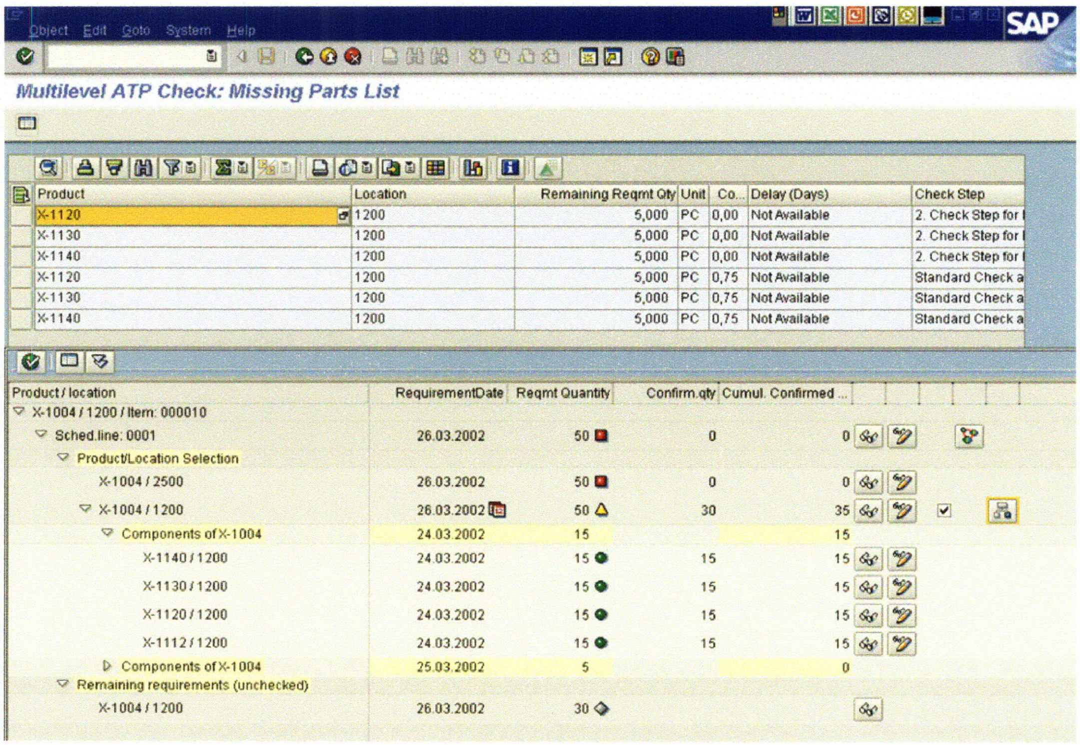


Figure 4.7 Result of Multi-level ATP Check

Source: SAP AG (2003), Improving order to cash with ATP, Patti Kimler

(3) Product allocation

By the integration with CRM, SAP APO-GATP allows the user to set certain criteria (such as purchase quantity of customer, contribution ratio to the enterprise's profits, and potential value) to group the customers on the basis of historical sales. Next the user may allocate certain quantity of products to every group of customers or particular individual customer. Customer allocations are not fixed and can update continuously at certain intervals. The consumption of unused quantities from other periods for production allocation can be of forward and backward types. For example, if customers' allocations update once per month and customer orders 120 pieces in May 2006 while no allocation is available, then the available allocations of the months neighboring to May can be utilized for the fulfillment of the customers' order requirement, as shown in Figure 4.8.

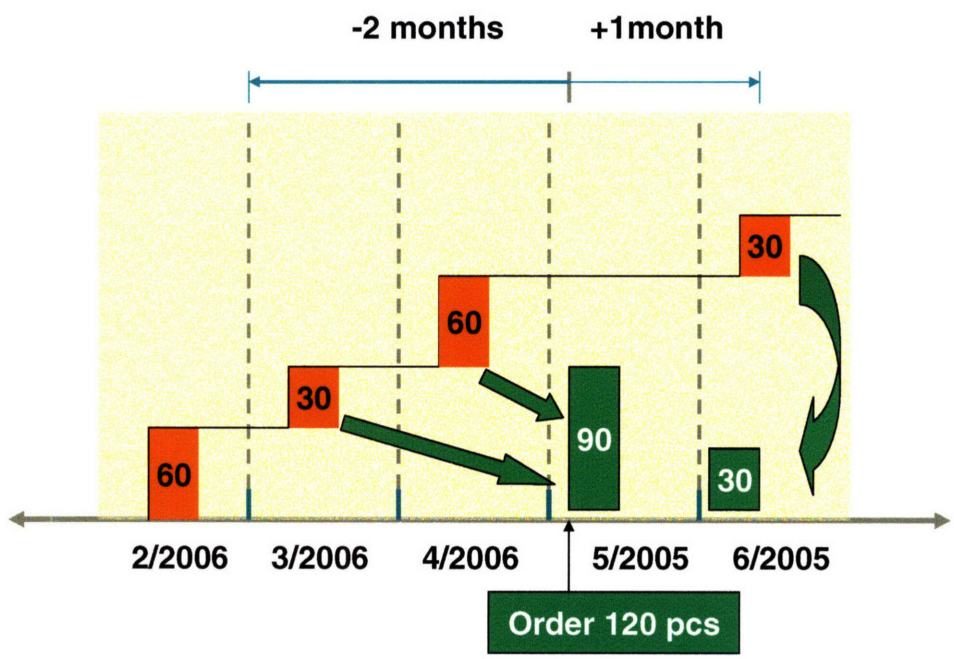


Figure 4.8 An Example of Product Allocation Consumption

In addition to the OP implied in SAP APO-GATP for the user, the integration of My SAP SCM (Supply chain management) and My SAP CRM (Customer Relationship Management) can realize PTP (Profitable-to-Promise) to facilitate the user's profitable OP.

4.4 The Similarities and Difference of Order Promising (OP) Software

An analysis of the similarities and differences was conducted among the software systems discussed above.

4.4.1 Similarities of Different Order Promising (OP) Software

1) ATP and CTP capacities are combined for providing the user with available supply capacity. The user with multiple supply points may choose the best one by comparing the supply availabilities in addition to the consideration of lead time (according to the delivery date required) to reduce cost while fulfilling customer requirements.

2) Customer allocation is supported to help the user allocate resources (including production capacity and products) – especially the strategic scarce resources - among different customers. This will allow the user to give prioritized treatment to some products or customers to retain key customers. In addition, the different service levels corresponding to different types of customers helps the user reduce cost while maintaining service level.

3) The function of alternatives searching is available for the customer. This function helps the user to seek a satisfactory substitution when the old one cannot meet customer requirements, for example, to seek proper substitution, or to evaluate combinations of basket price and delivery dates for the customer's choice.

4) Flexible configuration. The user may define policies and rules according to his own target or the customer requirement. For example, the user may control his inquiry scope of supply capacity, or to make rules for customer allocation.

5) Compatibility. We will explain it by Oracle Global Order Promising. On one hand Oracle Global Order Promising is compatible with other Oracle applications, which enables Oracle customers to carry out Oracle Global Order Promising without upgrading other Oracle applications; In addition, Oracle Global Order Promising can interface with non-Oracle applications to import the data of non-Oracle systems into Oracle Global Order Promising. The OP products of i2 and SAP also have such compatibility.

4.4.2 Differences of various OP software products

1) Compared to the OP products of Oracle and SAP, i2 Configuration Order Promising has two different features: i2 Configuration Order Promising has higher relevance but narrower application at market positioning as it is a special application for highly configurable products with long production periods. Another feature is that for functionality, i2 Configuration Order Promising allows the user to choose his preference on every option thus more enhancement when matching customer requirement.

2) Compared to i2, the OP products of Oracle and SAP enhance two points: Firstly, multi-level ATP/CTP Check will help the user to check multi-level parts& components or inventory for the ordered goods among the whole supply chain. Secondly, backlog order management incorporates backlog order by rational production planning and scheduling.

3) Compared to i2 and SAP, Oracle stresses product family management. The products are managed in groups when the user has many supply points to facilitate the user's clearer and simpler selection of the source for order fulfillment.

5 Company Profile

5.1 Company Overview

Founded over 30 years ago, SemiCo is a leading global supplier of high performance semiconductor products to multiple end market applications. It provides advanced solutions to fulfill the requirements of the current and future electronic markets. Today its products are widely applied to the fields including computer manufacturing, communication, consumable products, industry, and automobile etc. SemiCo currently employs approximately ten thousand people for the development, manufacturing and sale of products at its corporate headquarters in the US and other locations worldwide (See Figure 5.1).

Figure 5.1 SemiCo: A Global Company

Source : SemiCo, Meeting Commitments: Real-time Order Promising and Capacity Allocation

5.2 Business Objective and Challenges

SemiCo has a single mission: to be the world's leading supplier of high performance products to multiple end market applications. Guided by this mission the company made and implemented three strategic imperatives: product innovation, cost-effective manufacturing and superior customer service. As a result the high-performance products and quality services won for SemiCo high reputation and promoted its rapid progress. In the mean time it faced more and more supply chain challenges, for example comparatively long end-to-end cycle times, short product life cycles, a distributed planning model, and 8-10K order lines shipped per week and 10-15K quotes and commits as well. SemiCo had increasingly emerging problems at the key phase of demand fulfillment. Firstly, the separation between the order fulfillment system and the planning & forecasting system limited the efficiency of order fulfillment. In the semiconductor industry, generally enterprises adopt a hybrid production mode for the long production period. For example, adopting "build to stock" at the upstream phase of the production flow and adopting "build to order" at the downstream; which requires the integration of the demand forecast and demand fulfillment. Secondly, the low automation level of work processes, such as the manual maintenance of the lead time and the non-automatic scheduling of FG (Finished Goods) or WIP (Work-in-Process), nearly half of demand lines scheduled manually, produced inaccuracies of demand fulfillment. Thirdly, the visualization of the storage and production capacities at various phases of the supply chain was hampering the optimization of all the resources in the supply chain to fulfill a customer's demand on time. The resulted inefficiencies and inaccuracies in the legacy order fulfillment system resulted in the company's failure to make timely, correct and reliable Order Promising, which impacted negatively the company's profitability and customer service.

5.3 Improved Order Promising (OP) Flow

SemiCo imported the demand fulfillment software of i2 Technologies a couple of years ago to achieve the timely, correct, and reliable Order Promising. This software was integrated with the demand planning& forecasting system and the MPS system.

With the support of the new information system, the company altered the workflow of Order Promising, as shown in Figure 5.2.

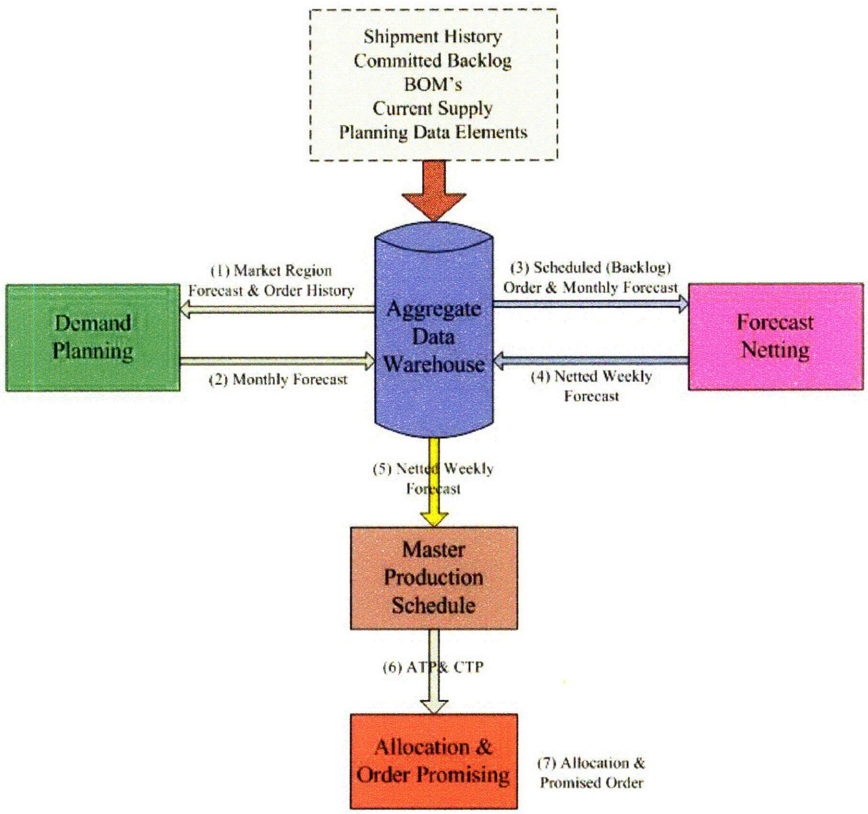


Figure 5.2 The Workflow of Order Promising (OP)

Source: SemiCo (2004), Meeting Commitments: Real-time Order Promising and Capacity Allocation

The manufacturing system and Order Management responsible for the real-time update of the information of production and customer demand information separately. It provides the foundation data for the workflow of Order Promising, including shipment history, committed backlog, Bill of Material (BOM), current supply and planning data elements. Aggregate Data Warehouse is the hub for data transmission. With the support of the Enterprise Resource Planning (ERP) software and Aggregate Data Warehouse, the workflow of Order Promising is divided into four steps as shown in Table 5.1:

Step 1: Demand Planning. As the platform of demand planning i2's Demand Planner (DP) uses data from the market region forecast and order history from Aggregate Data Warehouse to create an unconstrained monthly forecast, which can be generated at varying levels of customer and product aggregation.

Step 2: Forecast netting. The Forecast Netting Engine subtracts backlog from the unconstrained monthly demand forecast. The result of this netting creates a netted weekly forecast and allows the Master Planner to prioritize by demand type (Backlog versus forecast) appropriately. Forecasted demand is segregated by customer tier, which is an input to determine production priority in Master Planner.

Step 3: Master production schedule. Driven by scheduled orders and netted weekly forecast, Master Planner schedules the production and output on the basis of production capacity, existing stock and the lead time to match the demand with supply and provide the real-time information of ATP and CTP for the Order Promising.

Step 4: Allocation and order promising. The company will allocate ATP of a certain quantity to every customer tier even individual customer, on the basis of the forecasted backlog and the importance of the customer tier to prepare for Order Promising before the arrival of orders. Allocations are set at "super group". For promising purposes products are grouped into super groups using certain business rules. Each Super Group is comprised of devices that share the same factory work center(s) and are interchangeable from a capacity standpoint. Super Groups are maintained by the SCM Planners for each individual product Division. Now, SemiCo has about more than 300 super groups, of which about 90 are on tier allocation. SemiCo currently is able to allocate by all customer tiers, including (Tier 1, Tier 2 and Tier 3 customers), and allocate to High Value Products (including high margins or strategic value products and even new product, which are defined in its Enterprise Resource Planning (ERP) system as Tier 1 products). Upon the arrival of an order, the company will implement automatic processing on various data (for example customer profile, requirements on order requirements and the ATP& CTP) via the order promising functionality in the Demand Fulfillment engine in accordance with certain order promising rules, aiming to the decision-making of order acceptance. If an order is accepted, then the company will promise the delivery date (lead time).

Processing Steps	Data Input	Data Output	Software Platform
1. Demand	Market region	Unconstrained	Demand

planning	forecast & order history	monthly forecast	Planner (DP)
2. Forecast netting	Backlog orders & monthly forecast	Netted weekly forecast	Forecast Netting Engine
3. Master production schedule	Netted weekly forecast	ATP&CTP	Master Planner （MP）
4. Allocation & order promising	ATP&CTP	Allocation & promised order	Demand Fulfillment Engine

Table 5.1 Data Flow of the Workflow of Order Promising

6 How to do Order Promising (OP) and achieve Optimizing Order Promising (OOP)

6.1 Achieving the best ATP & CTP

The information about ATP and CTP is critical in improving the accuracy and effectiveness of OP. We have introduced the calculation methods of ATP and CTP in Chapter 2, and have once introduced the flow of ATP and CTP for SemiCo (Figure 5.2). The SemiCo Flow is a somewhat typical flow. Other companies may have slightly varied calculation flows with a basically common core. But the company's demands on production are higher due to the development of the Assemble-To-Order (ATO) mode of production. So we should pay attention to more details on the corresponding processes of ATP, CTP, and the information needed. In this section we will carry out further analysis of these issues.

6.1.1 Products Family Management

We should choose one or several organizations to complete an order from one customer if the company is cross-regional and operating with organizations responsible for different regions. Moreover, a company's products may require different materials and the purchase prices of the same material in different regions may vary. Thus, the organizations in different regions will have different product families. The company may also have multiple schemes for the implementation of the customer's order consisting of multiple products. It is important to choose the simplest approach. We might adopt the method of Product Family Management for dealing with this.

Generally, when an order arrives, we will analyze the information of the ordered products to see how many products are needed. Product Family Management means that it is to put together several products as a combination, and then to decouple this combination as a Product Family for the purpose allocating orders. So we only need to access how many Product Families an order has in order to greatly shorten the time of OP. Below we will make a simple comparison.

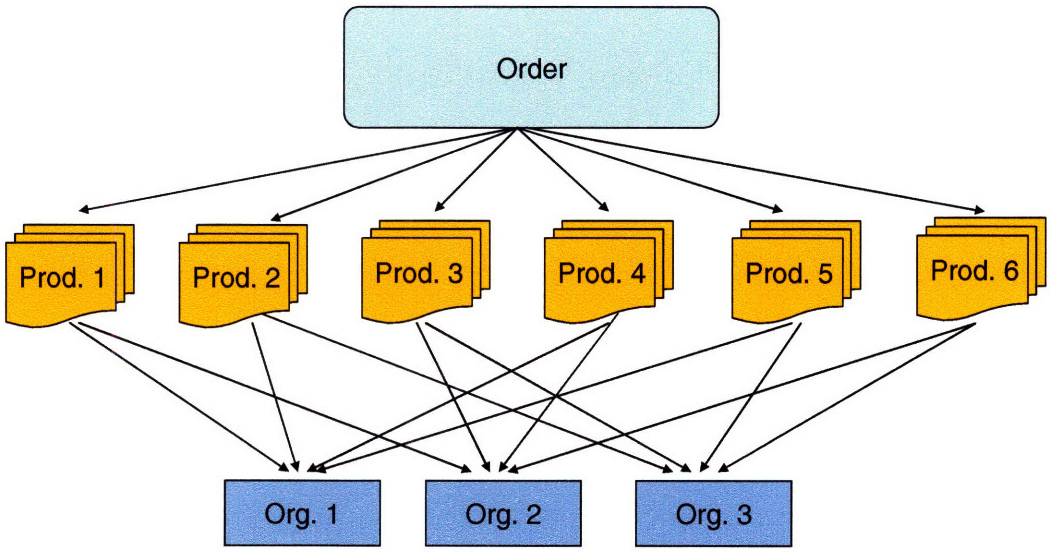


Figure 6.1 The Selection of Different Organizations for A Multiple-product Order

Let's make a simple assumption. It is assumed that there is one company with three subsidiary companies. The company manufactures 6 kinds of products but each subsidiary company manufactures different products (see Figure 6.1). Before adopting Product Family Management, the company needs to divide the order to distinguish different products after receiving an order. As shown in Figure 6.1, assuming that an order only includes product 1 and product 2, then we would preferentially select Organization1 to complete the order because of better management and the reduction of distribution cost in central production.

However, if the order includes more products such as products 1, 2, 4 and 5, it will become fairly complex to choose which organization to fulfill the order.

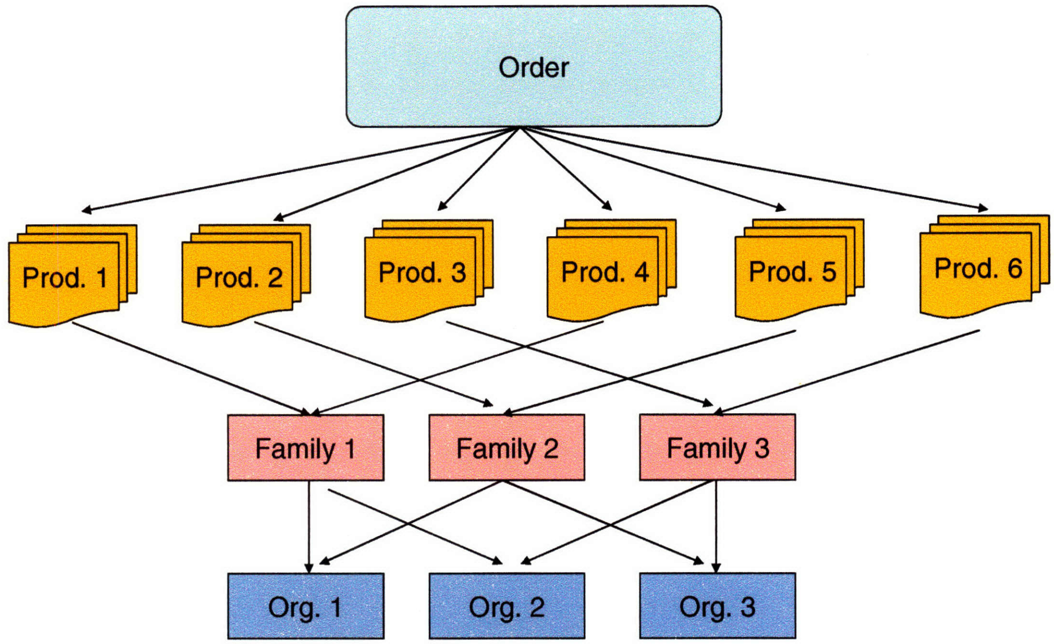


Figure 6.2 The Effect of Product Family Management for a Multiple-product Order

Figure 6.2 shows the effect of Product Family Management. Comparing Figure 6.1 with Figure 6.2, we can distinctly see that it becomes much easily to preferentially choose which organization to perform the order after using Product Family Management. We can see that the organization selection process is dramatically simplified because fewer options are possible.

When the product varieties increase, it seems that the Product Family will probably increase exponentially in the view of mathematics. And the final selection process will become more complex on the contrary. However, generally Product Family is decided by the company itself. Just as some supermarkets carrying out bundled sales, the company can combine the products according to the historical records, purchasing strategy or corporate policies to form different product families. Therefore the product complexity will be controlled much more easily using Product Family Management

6.1.2 Organization Ranking

A more important aspect of at the OP process is to do Organization Ranking in addition to product management. For most of the companies organizations will produce the same products. So our first thought on receiving an order is to select the most appropriate organization for the completion of it.

The first element to be considered is the lead time, certainly. The lead time is an important index of a customer's satisfaction. Generally the lead time is proportional with the geographical distance; thus, we can commission a region to which a corresponding organization is responsible for. In addition, some organizations may be at places with poor transportation conditions, while others may be located at places near an airport or railway. The organizations having excellent transportation conditions may have an expanded area of responsibility region, or become the second choice of other regions.

We may define a ranking among the organizations for dealing with customers from different places. At Order Promising we should examine the ATP status of the organizations on the basis of the ranking (See Figure 6.3). Organization1 is the first choice for the customers of certain region according to Figure 6.3. We should examine the statuses of Organization 2 and Organization 3 at the same time to see which can complete the order, or whether they cannot complete the order when Organization 1 cannot complete the order.

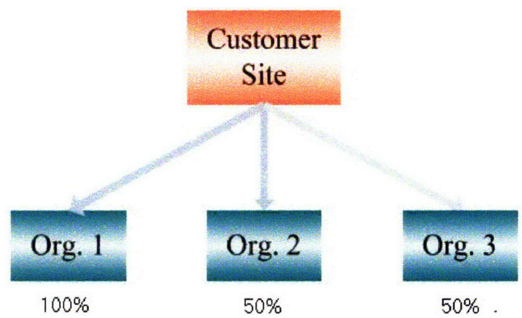


Figure 6.3 Organizations Ranking Of ATP

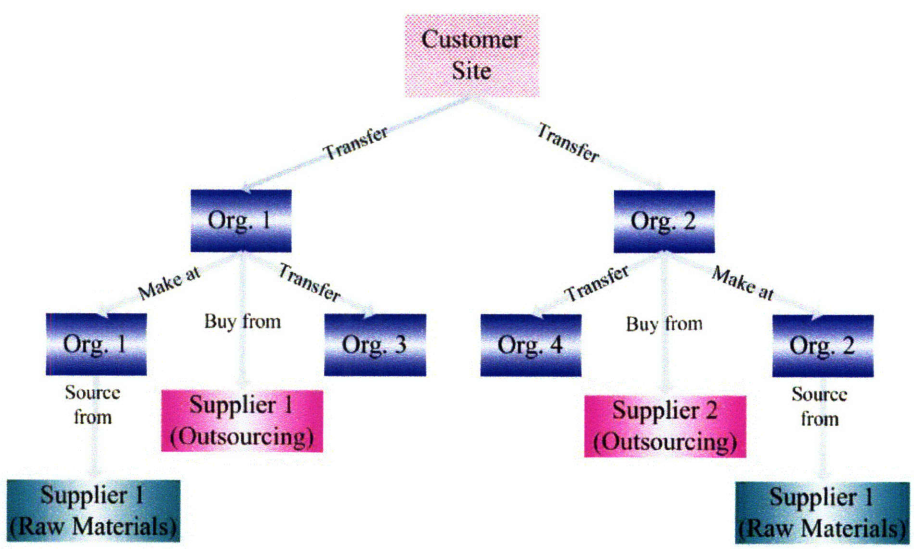


Figure 6.4 The CTP Coverage of Organizations

If the order completion is beyond the capabilities of all the organizations, then we should investigate the production capacity of the organizations, i.e., CTP, which complicates the context (See Figure 6.4). Production capacity includes the contents of three aspects: real production capacity, outsourcing capacity, and allocation capability. Firstly, we can image that the organization with a higher production capacity will cover a larger scope of customers, while the organizations with lower production capacity generally can only meet the requirements of the customers in neighboring areas. In addition to the production capacity, the possibility and capacity of outsourcing also should be included in the integral production capacity. If the company can get the products quickly by other channels, we may increase the production capacity of the company, correspondingly. The quantities of the available products of the organizations are the substantial indexes at the comparison between production capacities. Thirdly, the allocation capability of the organizations can be an index for measurement on emergency-response ability. In some sudden events the organizations should have emergency allocations. If an organization has difficulty at communicating with other organizations, then such an organization should not be the first choice.

6.1.3 Sourcing Rules

We should determine the coverage of the ranking (priority) after we have determined the organization ranking. For example we know in Figure 6.3 that Organization 1 has the first priority; we also should know whether this priority is for a particular customer/product or for all the customer's products. Thus we should determine the Sourcing Rules in addition to the determination of the organization ranking, i.e., the application of the organization ranking.

Generally we have two dimensions of sourcing rules – Item Level and Range. Item is mainly of three levels, i.e., Single Item, Category Item, and All Item. Range of Customer Site is of two levels, Specific and All (See Table 6.1).

		Range of Customer Site	
		Specific	All
Item Level	Single Item	(1)	(2)
	Category	(3)	(4)
	All Items	(5)	(6)

Table 6.1 Two Dimensions of Sourcing Rules

We have six levels of Sourcing Rules for every organization according to Table 5.1:

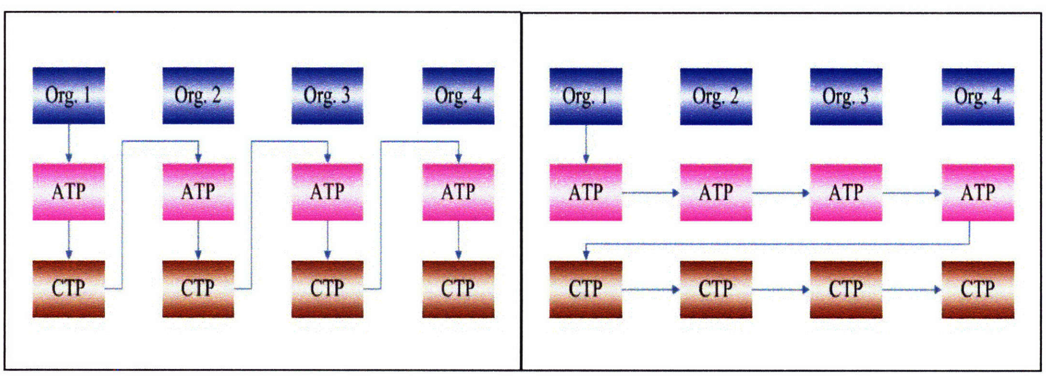
1) A single item for a customer site
2) A single item across all customer sites
3) A category of items for a customer site
4) A category of items across all customer sites

5) All items for a customer site

6) All items for all customer sites

6.1.4 ATP/CTP Checking Rules

We have the necessity to determine the ranking between ATP and CTP after determining Organization Ranking and Sourcing Rules. Certainly within a single organization we will check ATP before checking CTP. But if many organizations of a company are involved, we should have a ranking on checking ATP and CTP in the organizations. There are two common types of ATP and CTP checking rules, i.e., Vertical Checking and Horizontal Checking (See Figure 6.5).



A. Vertical Checking B. Horizontal Checking

Figure 6.5 Two Types of ATP & CTP Checking Rules

Vertical Checking pays attention to completing the same order via minimal organizations; Horizontal Checking is to complete the order by ATP as much as possible. If the organizations are scattered, far away from each other, the fulfillment of the same order by many organizations may incur various uncertainties or rapidly increased cost, which favors of Vertical Checking. If the organizations are close to each other, and their common fulfillment of the same order will not incur increased cost or the cost just increases slightly, then Horizontal Checking is feasible for it will not impact the existing MPS.

However, generally we will adopt Vertical Checking for better control and less risks associated with the order implementation by a single organization. Therefore, we will adopt Vertical Checking in the later analysis

6.2 General Workflow of Order Promising (OP)

The workflow of OP is simplified after the best data from ATP and CTP are available. Some companies in their OP rules may regulate a period to have the principle of "First in First out" (FIFO). For example, SemiCo adopts FIFO in the first eight weeks. FIFO demands a clear OP workflow for easy for operation, so it follows the simplest OP workflow (See Figure 6.6).

Firstly, OP workflow begins from the receipt of an order. The company's ordering system shall be compatible with the different channels that may transfer the customer's requirement. Next the orders with real intent are to be selected. Sometimes customers only need a quotation, to which we have no need fully to do OP. So the OP model discussed in this thesis only focuses on orders with real intent.

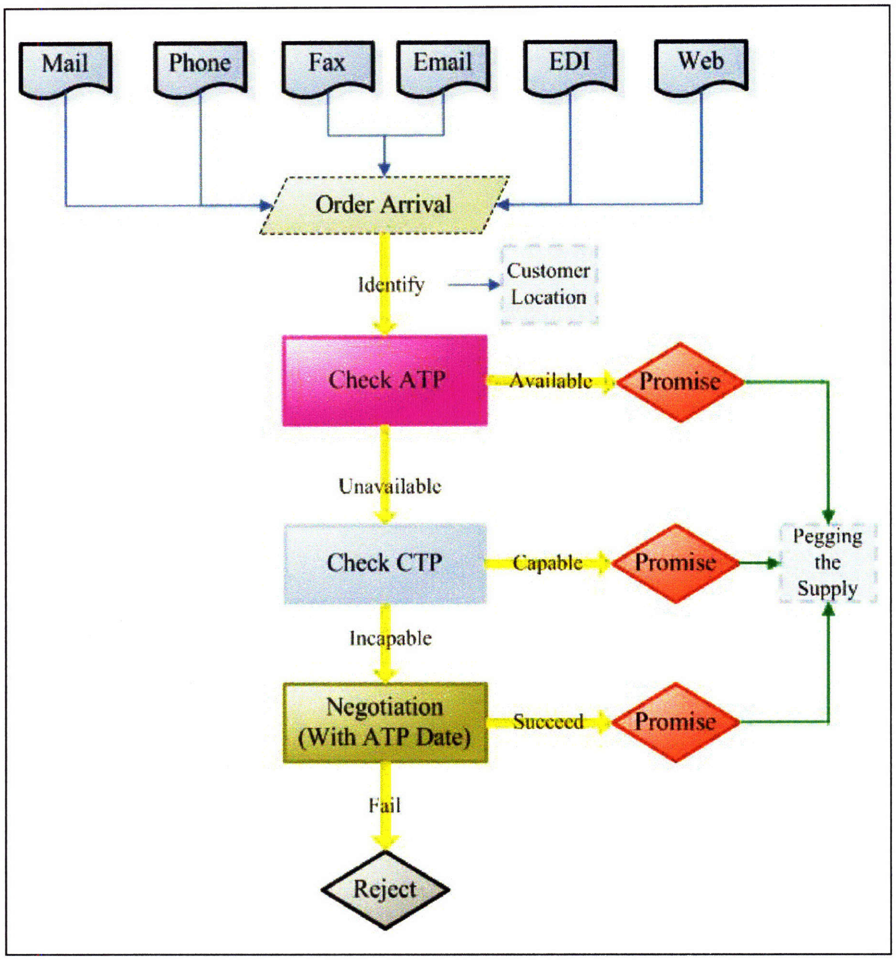


Figure 6.6 Simple Order Promising (OP) Workflow

Then, what are the orders with real intent? This problem looks simple, but deserves a correct definition, or else many unexpected problems may occur beyond the processing capability of our model. Not all the orders entering into our model are valid; we just want the orders featuring rational price and rational quantity.

Rational price means that the sales price is higher than the cost. Here the cost only includes the costs actually occurring in the processes of production, storage, and distribution etc.; no opportunity cost implied in the loss by the company will be considered. Orders featuring cost higher than price (i.e., no profit margin) are excluded for few companies will receive such orders when everything goes well.

Rational quantity means the ordered quantity of the products is reasonable relative to the production capacity of the company. No company can fulfill the requirement of the order with a quantity higher than the total production capacity of the company. Certainly, if the customer is important or the profits are high, and the company has the ability to fulfill the demand by approaches such as outsourcing, the company will likely accept such an order. However, our OP model does not consider this case. We just pay attention to the company's own ability to make the optimized choice within the production capacity of the company.

Next we again identify the ordering customers after the arrival of valid orders. We are to find the customers' location and our corresponding responsible organization to make OP decisions on the basis of ATP and CTP – such as to promise the order or not, when to arrange delivery, and the feasibility of a delayed delivery etc.

As shown in Figure 6.6, the ideal situation is that we have sufficient ATP to enable a direct promise to the customer. Insufficient ATP will move us to add CTP to see whether there is a sufficient amount to OP. If this fails again, then we should deduct the amount period of the order completed on the basis of ATP. We should negotiate with the remainder and it will usually be longer than the period required by the customer. We could make a promise if the customer agrees, and would have to give up the order if the customer does not agree. It is notable that, we should fix the corresponding supply and update the data of ATP and CTP after every finalization of OP.

Sometimes the company should split orders and deliver the goods in stages, to which our OP model can be divided into two or more periods.

In this most common OP workflow our sole care is at the company's ability to fulfill an order. But in practice we should consider more, for example, whether this order is profitable or if it is not profitable, why should we accept such an order and give up higher profits? Besides, we should also consider the importance of the ordering customers, and should not lose major customers through the fulfillment of orders from small customers. We need an improved OP model.

6.3 Approaches to Improve OP Workflow

We need to import some approaches and measurement criteria for improving the workflow of OP to increase the company's profits while guaranteeing customer satisfaction. But these approaches and criteria are to be updated on the basis of certain periods.

6.3.1 Customer Allocations

We may adopt the approach of Customer Allocations to divide the original ATP in accordance with the importance ranking of the customers to enable the company to operate OP better while guaranteeing the benefits to major customers. By this approach, the company will specify the allocations to every customer on the basis of ATP. Generally these allocations are estimated on the basis of the customers' historical purchases. Here we can use ABC classification to divide the existing customers into three tiers. Certainly, an independent tier can be assigned to a core customer. In addition, the customers in an emerging market might be in a top tier as the emerging markets may occupy an important place in the company's strategy.

According to ABC classification approach about 50%—70% of sales of the company are from 10%—20% of customers; which are of Group A (Core Customers 1 and 2). Group B generally contains 20% of customers generating 20% of the total sales of the company; While the rest of the 60%—70% of customers of the company are in Group C for they generate just 10%—30% of the total sales income of the company. (Vitasek, 2003) We should group the core customers of Group A into an independent tier, which with the tier for the customers of emerging markets contributes to the final

5-8 tiers or more of the company (See Figure 6.7). However, we should control the number of tiers to fewer than 10 to avoid difficulties in Customer Allocations. The increase in the number of the tiers' would make the uncertainty of the requirements be increased in geometric progression, which will impact the correctness of allocations.

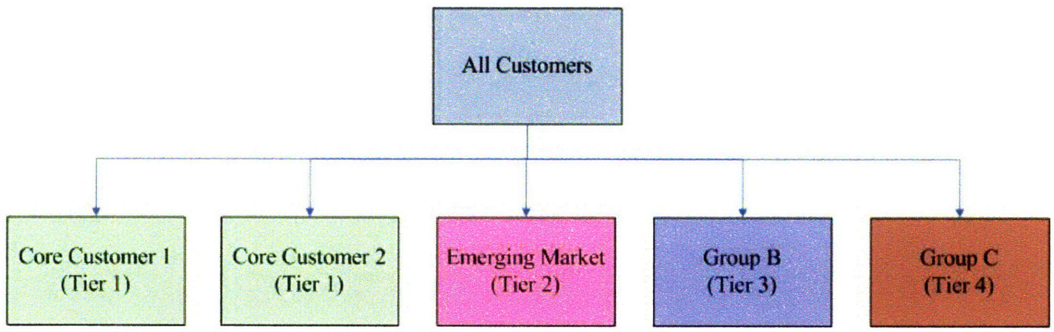


Figure 6.7 Customers Grouping

However, the tier settings of the customers grouping here is just an illustration. In practice, the situation may vary; perhaps 20% of customers generate above 80% of sales of the company. So the customer grouping of Group B and Group C would also be adjusted accordingly.

We may carry out customer allocations on the basis of the sales history of the company. In customer allocations the total ATP amount of the company is allocated to different tiers according to the corresponding purchase percentages of the customers of different tiers.

Firstly the requirements of the customers of Group A have the first priority to be fulfilled for the company's business relies upon these core customers to a high degree.

The allocations given to the customers of Group A should be equal to or higher than their purchase amount to ensure adequate supply.

Secondly, before Global Allocations we should make clear the company's attention and corresponding allocations to the emerging markets. Here our key foundation for decision-making is the global strategy of the company. The customers of these markets should have a high allocation ratio if a growing company attaches much importance to and is confident of the growth of the emerging markets. The customers of emerging markets should have a place more important than Group B and Group C. A mature company may reduce the allocations to the emerging markets with a place less important than Group C as the company may focus on the guaranteeing of the satisfaction of existing customers. The customers of emerging markets could also be grouped into Group C. After the determination of the importance of the customers of emerging markets and Group B, we will have basically determined the allocations of the customers of all tiers.

Later we may view the allocation of the customer when an order arrives after the process of Allocated ATP. Moreover, we may tell some core customers how many allocations we will give them weekly to improve the relationship with them; these allocations might be reserved for them for one week. If within one week these customers order the goods with an amount lower than the corresponding allocation, then OP can be immediately done. If no order in that week occurs, the company will dispose of these allocations freely.

Therefore, we should classify customer allocations into two types. One type is Committed Allocation, i.e., the company promises the reservation of allocation for a customer; another type is Uncommitted Allocation, i.e., the company will dispose of these allocations that are not reserved for any customer.

Certainly the orders may be within or beyond the fulfillment capability of the allocations. The processing is relatively simple when the order is within the fulfillment capability of the allocations. If the order is beyond the fulfillment capability of the allocations, we should implement the following principle:

The orders of higher tiers may steal some quantities from the allocations of lower tiers to fulfill the requirements of important customers, while no order can steal quantities from other customers of the same tier, not to mention lower tier cannot steal the allocation of higher tiers.

6.3.2 Measurement of Profitability

We use profitability to measure whether an order is beneficial. To gain profit on deals is the most important good of a company. Profitability has multiple meanings.

Perhaps an order is non-profitable, but the customer has high potential value, which will make us deal well with this order to win the acknowledgement of the customer and build a sound foundation for future cooperation.

But here we will only consider the profit margin of the order itself when measuring profitability; as future profits are unpredictable. Hereinafter we will probe into the factors such as potential profits and emerging markets as the part of the importance of customers.

We should evaluate the cost and profit of an order first when it arrives to calculate out the profit margin. The company may set an acceptable profit margin on the basis of the sales history. If an order has a profit margin higher than the profit margin set by the company, we should consider this order to be highly profitable. If an order has profit margin lower than the profit margin set by the company, although the company is still able to make money, we should use the ordered products to fulfill other more profitable orders, from the view of opportunity cost.

6.3.3 Measurement of Importance of Customers

Every customer has different importance to the company, which is used during the process of Customer Allocations. However, if a customer has demand higher than the corresponding allocation, we should make different decisions according to the relative importance of the customer.

As shown in Figure 6.7, we grouped the customers into four tiers: Core Customers, Emerging markets, Group B and Group C, which importance lowers in sequence. Generally we view the customers of Tier 1 as the most important customers. We should fulfill their reasonable orders, as many as possible. The importance of emerging markets varies when the company's strategy changes. Generally a company will have a plan for market expansion, which usually makes the importance of emerging markets be higher than Group B. So as shown in Figure 6.6 we placed Emerging markets in Tier 2, while Group B was placed in Tier 3. Certainly the company may place Group B in Tier 2, higher than emerging markets. However, it is notable that we should always differentiate the importance of the customers of Tier 2. If Group B is in Tier 2, then we should select the customers with higher profit margin to be important customers. If the emerging markets is in Tier 2, then we certainly will have some important customers to draw our attention. We usually should place the customers of Group C with unimportance into Tier 4 (See Table 6.1).

<table>
<tr><th>Tier Type</th><th colspan="2">Customer Type</th><th>Important</th><th>Unimportant</th></tr>
<tr><td rowspan="3">Tier 1</td><td colspan="2">Core Customer 1</td><td>√</td><td></td></tr>
<tr><td colspan="2">Core Customer 2</td><td>√</td><td></td></tr>
<tr><td colspan="2">Core Customer 3</td><td>√</td><td></td></tr>
<tr><td rowspan="4">Tier 2*</td><td rowspan="2">Emerging Markets</td><td>Core Customers</td><td>√</td><td></td></tr>
<tr><td>The Rest</td><td></td><td>√</td></tr>
<tr><td rowspan="2">Group B</td><td>Profitable Customers</td><td>√</td><td></td></tr>
<tr><td>The Rest</td><td></td><td>√</td></tr>
<tr><td>Tier 3</td><td colspan="2">Group B or Emerging markets</td><td></td><td>√</td></tr>
<tr><td>Tier 4</td><td colspan="2">Group C</td><td></td><td>√</td></tr>
</table>

**Tier 2 is one of Emerging markets or Group B; the left one is of Tier 3.*

Table 6.1 Measurement of Importance of Customers

6.4 Optimizing Order Promising (OOP) Model

6.4.1 OOP Model without Emergency

Now we can build the improved OP model with Allocated ATP, Measurement of Profitability and Importance of Customer. We called it the OOP Model. Let's first put eyes on the most common situation –Model without Emergency.

The company may need to mobilize all the resources to fulfill the social requirements on urgencies such as 911 terrorist attacks, Virginia Tech shootings, and the South Asia Tsunami Disaster. At which time all costs and profits are beyond the considerations. But most of the companies have no need to face such urgencies if their products are not of public utility. Thus we build the OOP Model without Emergency first (See Figure 6.8 for its logic; and check Figure 6.9 for the detailed process).

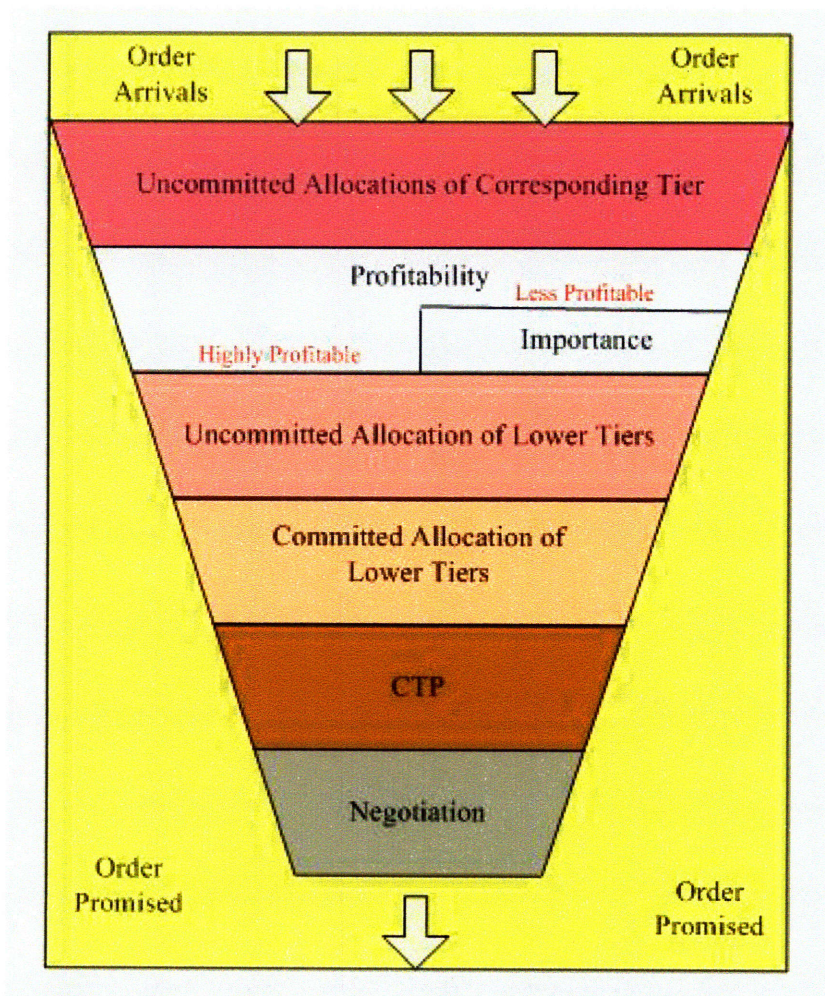


Figure 6.8 The Logic of OOP Model without Emergency

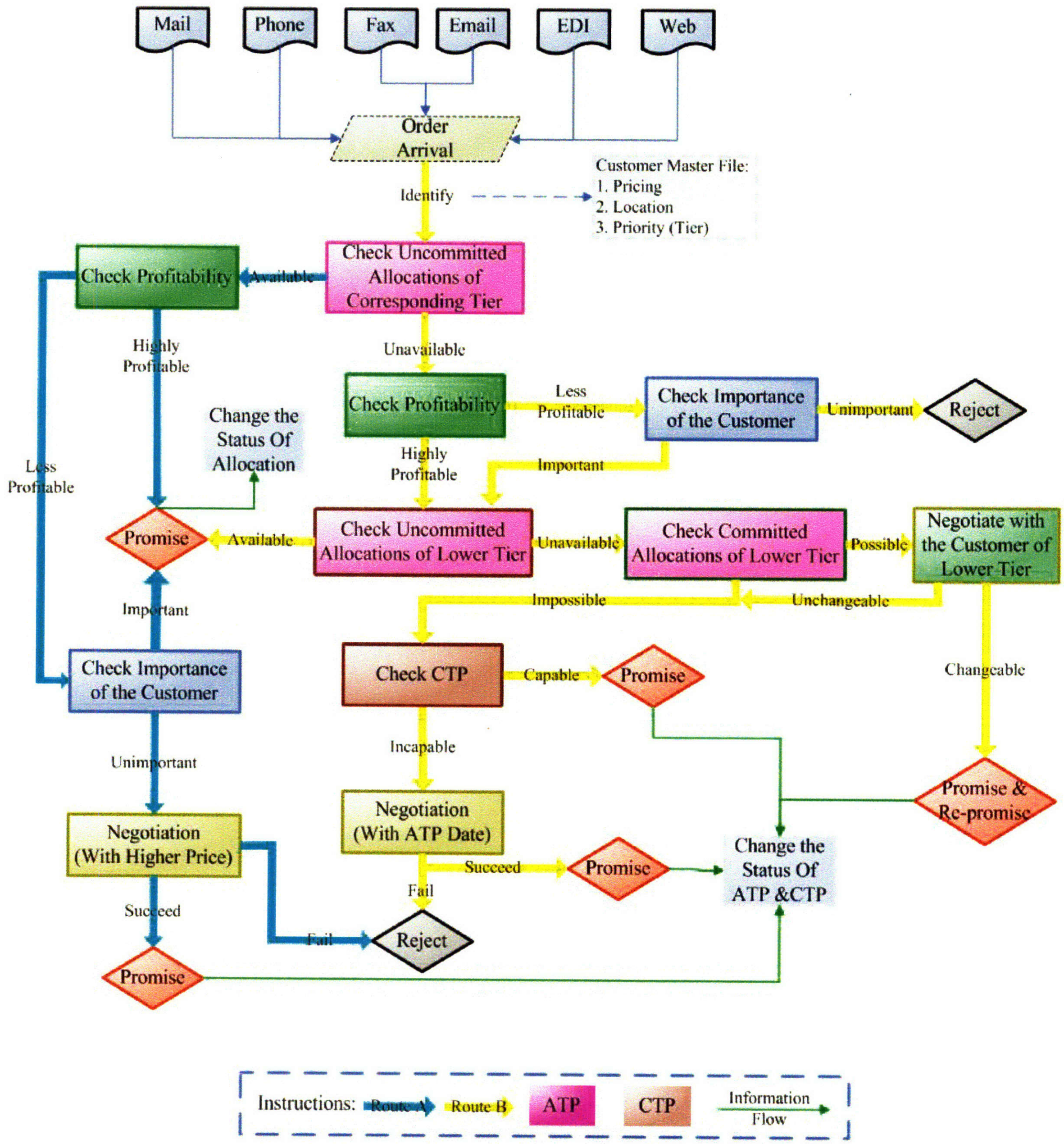


Figure 6.9 OOP Model without Emergency

The logic of OOP Model is the same as in the general OP workflow. We should consider many sources of the order when it arrives. The only difference is that we not only should remove enquire at order arrival to get an organization's information corresponding to the customer, but also should get the tier information of the customer.

Firstly we should see whether the uncommitted allocations of the tier could fulfill the order. Next we should proceed on two routes. If Uncommitted Allocation is available to fulfill this order, we enter into route A (blue); if unavailable, we enter into route B (yellow).

(1) Route A

Step 1:

If uncommitted allocation can fulfill order, we should see whether this order is profitable; if high profitable, we promise this order; if less profitable, we go to Step 2.

Step 2:

Let's get the importance of the customer by consulting Table 6.1. If important, we promise this order, if not, go to Step 3.

Step 3:

We contact the customer to negotiate a higher price for we have the ability to fulfill the order, but dislike the low price. If the customer agrees to a higher price, we promise the order, else we reject the order for we consider the ordered products can win us higher profits from the view of opportunity costs, which is the key difference between the OOP Model and the OP Model.

(2) Route B

Step 1:

If Uncommitted Allocation cannot fulfill order, we should view the profitability of the order. If profitable, we should seek another approach to fulfill the order, go to Step 3. If the order is not highly profitable, go to Step 2.

Step 2:

Consult the customer's importance in Table 6.1. If the customer is not important, the company may directly reject this order for the unimportance of the customer and non-profitability of the order. If the customer is quite important, then go to Step 3.

Step 3:

We attempt to steal quantity from the uncommitted allocations of lower tiers in accordance with the principle set in 6.3.1. The company may dispose of the stolen uncommitted allocations freely. If these allocations can fulfill the order, we promise the order; if they cannot, then go to Step 4.

Step 4:

Examine the committed allocations of lower tiers. We should try to fulfill the order including the stealing of the committed allocations because of the order's high profitability or its customer importance. We cannot steal the committed allocations of the same tier in accordance with the principle of 6.3.1 for these customers are equally important. We only seek a solution in lower tiers.

If we find a committed allocation can be stolen, we negotiate with the corresponding customer (suppose Customer A). If Customer A agrees to re-promise, i.e., the order is changeable, we promise the important order and re-promise Customer A. If Customer A rejects the negotiation, i.e., the order is unchangeable, we should not breach our commitment, go to Step 5. If no allocation allowing movement is found, then go to Step 5, too.

Step 5:

In this step we should examine CTP for the high cost of production adjustment. Here we should examine the production capacity and CTP of the company. We should promise the order if the fulfillment is feasible, else go to Step 6.

Step 6:

This order cannot be fulfilled without harming the profits of other customers and the company. We have to negotiate with the customer, telling him when we can fulfill the order to see if he agrees. If he agrees, we promise the order; if not, we have to reject this order.

Note: The data of ATP and CTP should be updated once a promise or re-promise is carried out to maintain the latest of data of OP.

In conclusion, comparing to the original simple OP workflow, the OOP Model takes into consideration the company's ability and the most profitable orders to maximize profits during limited production capacity; it also guarantees as much as possible the service to important customers without harming the interests of other customers. Besides, similar to the general OP workflow, the OOP Model also can process the cases of "Split Order".

Although the flow chart looks much more complex than the original one, we only need to go through the whole flow during quite rare cases in practice. Generally we could make decisions by doing two or three steps. For example, if a customer with a long-term contract with the company puts forward an order, the company will reserve for him sufficient allocation with a fixed price, which also is profitable for the company. So we only need two steps to make a decision on OP.

6.4.2 OOP Model with Emergency

It is necessary for the manufacturers of public utility products to make adjustment corresponding to the events and disasters such as tsunami, hurricane, terrorism, and shooting etc. The accidents demand the supply chain to have an Emergency mechanism. For Order Promising the company should use the products to fulfill the requirements of urgencies, if possible. We adjusted the original OOP Model to include Emergency. This adjustment is quite appropriate for the public utility product suppliers. (See Figure 6.10 & Figure 6.11)

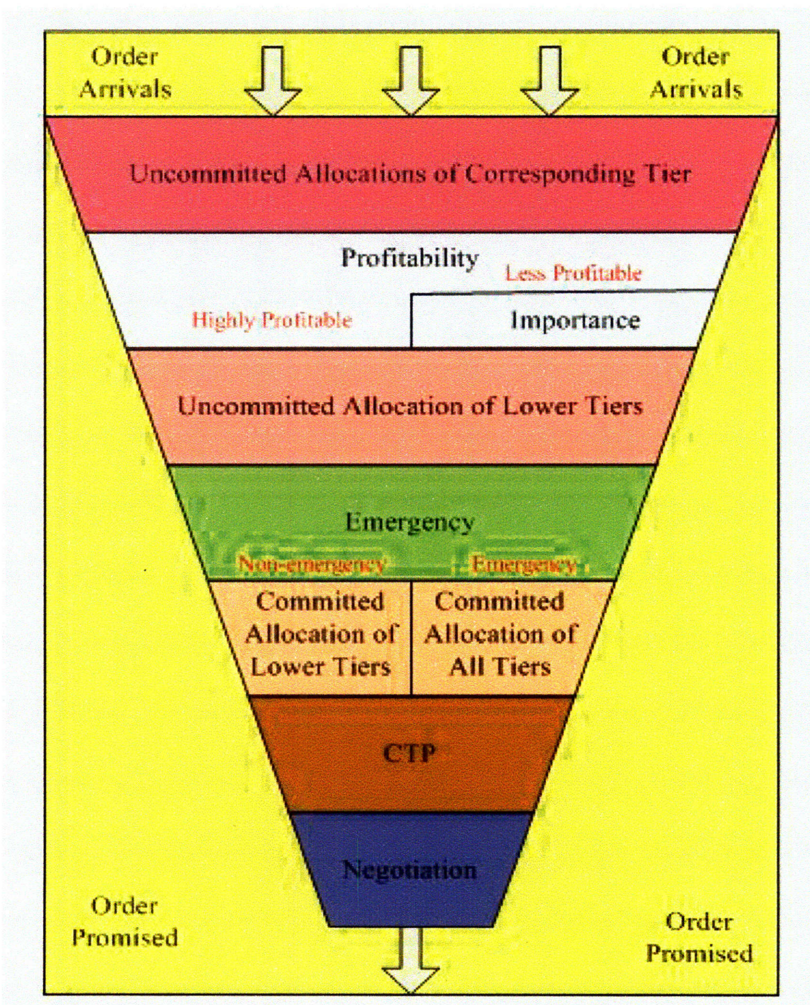


Figure 6.10 The Logic of OOP Model with Emergency

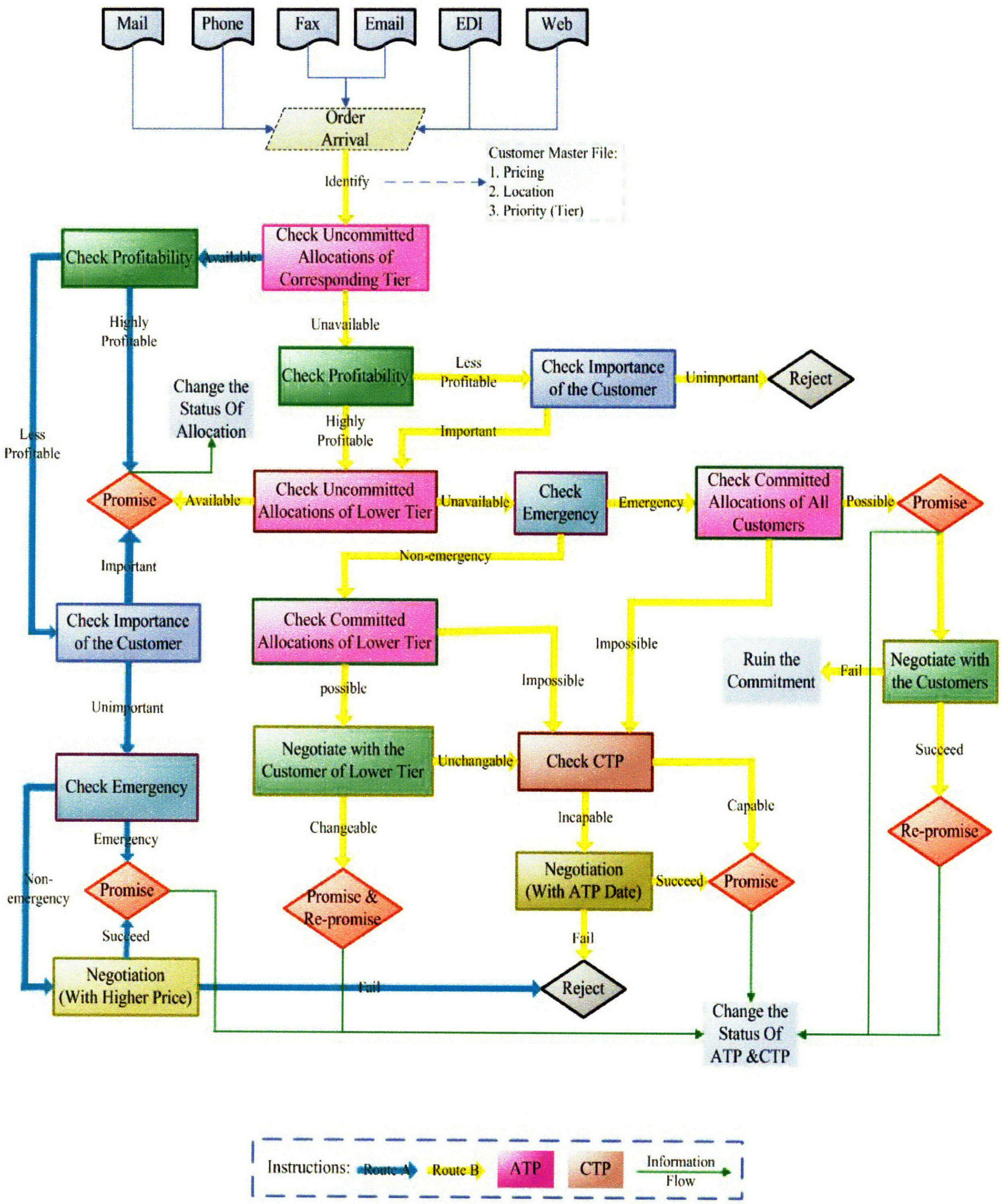


Figure 6.11 OOP Model with Emergency

(1) Route A

Step 1:

It is same as that of 6.4.1. Check profitability.

Step 2:

It is same as that of 6.4.1. Check importance of customer; if not important, then go to Step 3.

Step 3:

Check Emergency, promise order, else go to Step 4.

Step 4:

It is same as Step 3 of OOP without Emergency; negotiate with higher price.

(2) Route B

Step 1:

It is same as that of 6.4.1. Check profitability.

Step 2:

It is same as that of 6.4.1. Check importance of customer.

Step 3:

It is same as that of 6.4.1. Check uncommitted allocation of lower tiers.

Step 4:

Here we begin checking Emergency, for it influences our processing of the order. If not urgent, go to Step 5.

If urgent, we should have special processing. Examine all the committed allocations of the company to draw fulfillment. If feasible, we promise the order and negotiate with the affected customer and apologize for it. We re-promise the customer if he agrees; if not, we have to fulfill Emergency first. If all the ATP of the company cannot fulfill order, then we should go to Step 6.

Step 5:

It is same as Step 4 of OOP without Emergency. Check committed allocation of lower tiers.

Step 6:

It is same as Step 5 of OOP without Emergency. Check CTP.

Step 7:

It is same as Step 6 of OOP without Emergency. We have to negotiate with ATP Date. Re-promise the customer if he agrees.

Note: The data of ATP, Allocation and CTP should be updated correspondingly after every promise to maintain the latest data

In conclusion, the OOP Model with Emergency and OOP Model without Emergency have the same processing approaches if the order is without Emergency. Therefore the manufacturers of public utility products will not change the approaches of order processing for the consideration of Emergency. However, when the Emergency occurs, the OP process of the company can adjust itself automatically. Thus we see this model has high flexibility. But certainly, the increased quantity of the factors to be considered complicates the model.

7 Conclusion

In the past companies pay little attention on customer needs when "Make-to-Stock (MTS) and "Make-to-Order" (MTO) dominated the market. Also Order Promising was not quite important. With MTS companies could fulfill customers' requirements excellently with plentiful storage, but incurred much waste. MTO reduced most of waste but carried out production after an order was received, which displeased the customers, especially when the production period was long. ATO was born to find a solution balancing waste elimination and customer satisfaction increases. However, ATO challenges intensively the supply chain management of manufacturers. Manufacturers need to guarantee upstream supply capability, their production capability, and the downstream distribution capability as well as improve customer satisfaction. Order Management stands at the fore front to customers. Moreover, customers always hope to know the delivery date and on-time order completion feasibility, immediately at ordering. Thus Order Promising became a focus of Order Management.

Certainly the optimization of Order Promising needs the support of the supply chain. In return a clear OP workflow will promote the optimization of a supply chain. A clear workflow is helpful to the acquisition of order data and the real-time update of ATP and CTP data, which are beneficial for the improvement of customer service levels, and are the main foundation for the scheduling of future production.

From the birth of the OP concept in 1980s, enterprisers, scholars and experts delivered their opinions on the optimization of Order Promising. Some undertook macro qualitative analysis while some carried out quantitative analysis by mathematic measures. There are also scholars who made more detailed analysis on the workflow of OP from the perspective of systematic design in the world flourishing with information systems. On the basis of inheriting the methods, approaches and conclusions of many researchers before, this paper offer new opinions on the optimization and improvement of Order Promising.

Companies may add many new functions to the existing OP workflow and system by appropriate adjustments in accordance with the OOP Model designed. For example, to carry out classification management on different customers on the basis of historical order data, to increase the customer's trust via Customer Allocation, to guarantee every deal be profitable, and to make sure that the company will not neglect more important customers by fulfillment instead of the orders of unimportant customers. Moreover, the thesis designed the OP process with Emergency for the manufacturers of public utility products for dealing with the types of accidents that have recently occurred; ensuring that the company would perform their social responsibility while harvesting profits

This thesis, however, remains at theoretic stage without practice. In the future a real company may be modeled for case analysis. In addition, this thesis just made a further step on the focused model for the companies of the public utilities. In fact companies of different industries may vary largely. The best OP decision of the company can only come from the model adjusted and rules coordinated due to particular industrial features.

In addition, we should note that currently the research of this field focuses on quantitative research. Actually the OOP model presented in this thesis can also be developed into a sound mathematic model for quantitative analysis. We may compare the OOP model and other models to see whether the OOP model has actual improvement or not.

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