# NEW ISSUES OF ATP SYSTEMS IN A SUPPLY CHAIN (Literature Review)

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## ABSTRACT

This paper discusses the concept of studies an Available to Promise (ATP) system by looking beyond what traditionally highlighted in literature concerning Supply Chain. Advanced ATP systems are implemented in practice depends on the company's strategy. However, The performance measures of ATP system become very important and more complex in order to measure the efficiency and effectiveness of ATP system in a supply chain. This paper concludes seven factors influence ATP system in a supply chain.

**Keywords :** ATP System, Supply Chain

## 1. INTRODUCTION

Customer satisfaction is one of the important performance indicators in supply chain systems. In a supply chain system, the partners such as suppliers, manufacturers, distributors and retailers work together to satisfy the customer requirements. The ability to respond quickly and effectively to the ever changing customer requirements becomes very important to gain the competitiveness of companies, (Weng, 1999). In other words, they require accurate information on their ability to response to changes in customer requirements in order to effectively communicate with their customers.

One such system to help company respond to customer requirements quickly is known as available-to-promise (ATP) system. The ATP systems attempt to meet the actual customer requirements in the dynamic and unpredictable environment by considering fluctuating capacity and resource availability. Some research works have been done in this area. They applied the ATP systems to enhance revenues, reduce costs, speed distribution, and maximize utilization of the facilities.

## 2. ATP SYSTEM

APICS (1998) defined ATP as " the uncommitted portion of a company's inventory and planned production, maintained in the master schedule to support customer order promising. The ATP quantity is the uncommitted inventory balance in the first period and is normally calculated for each period in which MPS receipt is scheduled. In first period, ATP includes on hand inventory less customer orders that are due and overdue".

Ball et al (2002) stated that an ATP system is a set of available resources that support the response to customer orders requests. An ATP system must ensure that the quantity promised can be delivered on the date promised. It activates within a short term operation where most resources availability is considered fixed. Distinctions between advanced ATP systems and traditional ATP are shown in Table 1 below.

**Table 1. The Distinctions between Traditional and Advanced ATP Systems**

| | Traditional ATP | Advanced ATP |
|---|---|---|
| Demand | Forecasting | Forecasting and actual customer orders |
| Production philosophy | Associated with make to stock (MTS) | Associated with make to order (MTO) and assemble to order (ATO) |
| Production scheduling | Based on master production scheduling (MPS) | Based on resource availability |
| Production Lead time | Long | Short |

Five examples of ATP systems in practice described by Ball et al (2002) are: (1) Conventional ATP. Conventional ATP is associated with make to stock (MTS) production environment with long process lead times. The conventional ATP quantity is calculated in several ways and can be shown in Table 2. (2) Toshiba ATP system. In order to emphasize the customer satisfaction, Toshiba electronic applies the ATP system that never refuses an order. If an order cannot be fulfilled within the customer due date then the promised due date beyond the customer due date is given i.e.: the order is split with a portion given an early promise date e.g.: a portion is given before the customer due date and the rest given one or more promised due date. (3) Dell two stage order promising. First stage of order promising provides a standard shipment date after receiving the order. Second stage of order promising provides the accurate shipment date. Dell assembles customized computers based on customer orders and ships directly from the factory to the customers. (4) Maxtor ATP execution for hard disk drive (HDD). In this ATP system, customer orders are not given as specific order quantities and order due dates. Instead, only the total order quantity in each week is specified with permitted minimum and maximum quantity limits. (5) ATP functionality in commercial software. The ATP function is integrated with other modules like transportation scheduling, production scheduling, etc.

**Table 2. The Conventional ATP Calculation**

| ATP Calculation | Definition |
|---|---|
| Discrete ATP | Compute ATP for those periods with non zero planning quantity |
| Cumulative ATP without look-ahead | Compute ATP for other periods by subtracting the new orders from previous time period and ATP system allows shortage ATP quantities |
| Cumulative ATP with look-ahead | Compute ATP for other periods by subtracting the new orders from previous time period and ATP system does not allow shortage ATP quantities. |

Ball et al (2002) further distinguished various ATP systems into four major dimensions: (1) ATP decision support. The purpose of ATP is to provide a simple query capability and a specific response to customer orders under consideration. (2) ATP decision space. The ATP can provide a response to customer orders. (3) ATP execution scope. It refers to the extent of supply chain elements included within an ATP model. (4) ATP execution mode. It can be divided into batch mode ATP and real time mode ATP. In batch mode ATP, orders are collected over a batching interval and it is executed at the end of that interval. In real time mode ATP, individual order customer is executed as it is received.

Moreover, Ball et al (2002) classified ATP model by adopting push-pull production system framework. The ATP model is classified into push-based ATP and pull-based ATP. The differences between push based ATP and pull-based ATP are shown in Table 3 as follows. Push-ATP models can be divided into: (1) push ATP rules and policy. Allocation rule is applied to perform the ATP allocation. Kilger and Schneeweiss (2000) summarize the rule classes as follows: (a) rank based rules. The ATP quantity allocation is based on the rank or priority of the demand. (b) per committed rule. The ATP allocation is based on forecasted demand for each demand dimension. (c) Fixed splitting rule. The ATP quantity is based on historical business information. (2) The optimization of push-based ATP models. The optimization of push based ATP models can be achieved under deterministic or stochastic optimization. The difference between stochastic and deterministic is on demand perspective along time period.

**Table 3. The Differences between Push Based ATP and Pull Based ATP Models**

| | Push- based ATP models | Pull-based ATP models |
|---|---|---|
| Response to Customer | High inventory based on demand forecast | Dynamic resource allocation |
| The advantage | • Reliability of customer order promising<br>• Long term profitability | • Reduce the difference between forecast and actual order<br>• Production system is more flexible and responsive |
| The disadvantage | • More dependence on pre-allocation<br>• The inaccuracy of demand forecast | • Greedy algorithm and myopic nature |

In pull-based models, they distinguish between make to stock (MTS) environment and make to order (MTO)/assemble to order (ATO)/configure to order (CTO) environment. In MTS environment, the problem is to assign customer orders to some products availability. In MTO/ATO/CTO, the problem is solved by the real time order promising and scheduling or the optimization of the batch ATP models. Zhao et al (2002) describe a scalable supply chain infrastructure (SCI) research test-bed and defines the integration architecture and model. Several enterprise resources planning (ERP) components, a supply chain management (SCM) component, a middleware component, a simulation component and a decision model component are included in the scalable SCI. Advanced ATP models and simulation models based on supply chain operations reference (SCOR, 1999) models are implemented in the SCI test-bed. The objective of the ATP is to maximize the net revenue over the predefined planning period. The simulation models are developed using ARENA software along with the SCOR process elements. Some performance measures used for comparing ATP systems are introduced in the following section.

## 3. PERFORMANCE MEASURES OF ATP SYSTEM

Performance measures are conducted in ATP to measure the efficiency of ATP. Jeong et al (2002) compared their ATP and factory ATP using four performances: the number of tardy orders, the average tardiness, the number of early orders and the average earliness. The ATPs are compared in real manufacturing and the differences are investigated to measure the performance of ATP system. Zhao et al (2002) applied the maximum net revenue as performance measure of ATP system. The ATPs are evaluated to compare net revenue or not. The experiments are run using ARENA with the different size of batching interval. The results show that the significant revenue loss caused by missed orders whose due dates are too close with a lengthy of batching interval. It shows also that the impact of order quantity flexibility is higher than that of configuration flexibility when material availability is relative tight. The next section will focus on an overview of ATP logic in general to provide basic idea for developing ATP system.

## 4. OVERVIEW OF ATP LOGIC IN GENERAL

Jeong et al (2002) presented a description of an ATP system in a supply chain. An ATP is described in four functional units: customer, headquarter, distribution center (DC) and factory. The customer is associated with a physical location where the products are received and the order information is given. The headquarter is the processing unit to capture the customer order and has the information of ATP results. The DC is related to places where the products are received from factory and given to the customers. The information in the DC required inventory status, receiving and shipping status of product. The last functional unit is the factory where the products are manufactured.

In the factory, the information includes inventory status, Work in Process (WIP) status, MPS, Bill of Material (BOM), material inventory data, material supplier and shop floor schedule are made. Basically, the customer demands can be classified into: planned and unplanned. The planned demand is the unplanned demand from the previous planning period or the demand from forecasting. The unplanned demand is the demand from current planning period and should be satisfied within current planning period. An ATP system is applied to meet the unplanned demand after satisfying planned demands. An ATP system in general can be described as follows:

The unplanned demands from customers are received and necessary data such as: order data, inventory data, transportation time between physical locations, and production quantities of various products are entered. The inventory status is checked to decide whether the DC can complete the orders within due dates or not. An ATP is calculated and the customer is informed whether the order can be completed as requested. Otherwise, an ATP system verifies the inventory availability of finished good and raw material, transportation in factory, and capacity at the shop floor whether the order can be produced using the unused capacity or not. The inventory policy used in factory can be divided into 2 cases as follows:

Case 1: the shortage is not allowed. In this case, the production quantity in the factory must be less than the number of raw material inventory in production unit.

Case 2: the shortage is allowed. It means the production quantity can be greater than the number of raw material inventory in production unit.

The unused capacity is computed after the planned demands are scheduled in shop floor. Finally, an ATP is calculated with the consideration of transportation times among customer, DC and factory. Moreover, Jeong et al (2002) recommended a heuristic scheduling for determining the optimal unused capacity in shop floor. One of heuristic algorithms that can be applied to determine the optimal unused capacity for job shop in shop floor is known as Giffler & Thompson algorithm.

## 5. THE JEONG ATP (JATP) PROCEDURE

The JATP system is the ATP system developed by Jeong et al (2002). It only considers the component availability and machine capacity to estimate the promise delivery time for the unplanned demand.

The JATP process starts with new order arrival from customers. The JATP system will determine the new orders priority by considering the arrival sequence, demand quantity, the product type and customer priority. Then, the JATP system will check the inventory status in the DC to determine whether the new order can be completed within due date or not. If the new order can be met in DC, the JATP system is calculated and provided to the customer. Otherwise, the available capacity at shop floor is checked whether the capacity can meet the new order within the new order's due date. If the capacity cannot meet the new order within its due date, the new order will be rejected.

In JATP system, the capacity allocation can be classified into two parts as capacity to promise (CTP) and capacity available to promise (CATP). The CTP is the unused capacity and CATP is the capacity allocation results for the order. The new orders are allocated without changing in sequences of jobs that have been sequenced. The CATP is computed by considering the transportation times among factory, DC and customer.

In order to achieve the capacity allocation decision efficiently, the heuristic scheduling is used for the assembly process in thin film transistor liquid crystal display (TFT LCD) manufacturing. The algorithm consists of two procedures as LP procedure and minimum setup time (MST) procedure. LP procedure is applied to allocate feasible schedule that subject to component requirements. MST procedure is applied to obtain a feasible schedule that subject to machine capacity.

The weaknesses of JATP are shown as follows:

- The static schedule is applied in JATP model. It means that if there are *n* jobs to be scheduled at any time and the new jobs arrive, the shop floor will check the unused capacity without changing in the sequences of jobs that have been sequenced. In the real world, the sequence changes may be necessary to satisfy the customer demand. Therefore, the dynamic sequencing is required to accommodate the unexpected rush jobs.
- The JATP model is not appropriate for the multi process in job shop. Since heuristic scheduling proposed by Jeong et al (2002) is applied for solving problem on single process with parallel machines.
- The outcomes of JATP model are more pessimistic in term of customer satisfaction. Since the methods in JATP model only can offer the decision to reject or accept the orders.

## 6. CONCLUSION

It can be concluded that the implementation of ATP is influenced by seven factors: (1) the flexibility of orders specification such as due date, delay, quantity and configuration;(2) Time to response the customers. The response time to customer order is measured from the order placement until the time the goods are delivered as promised; (3) Profitability and priority. The company prefers the higher profit and the priority criteria should be considered to achieve the maximum profit. Back end factors are factors that related to material suppliers and production processes. (4) Production framework. The production philosophy has the significant impact on the nature of ATP functionality. (5) The variation of product variety and resource commonality. (6) The scope of system, such as retailers, warehouses, manufacturers, suppliers. (7) Resource type. The resources include material, factory and distribution. Therefore, ATP models can be classified into many ways depends on the affected factors.

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