Research on Order Tracking System for MTO

Ruijie Wu

ABSTRACT

MTO is the most appropriate approach used for highly customized products. It requires the order tracking system for controlling the delivery date, manufacturing process and products quality. The author has made researches on the order, the manufacturing process and organization model, then presents an order tracking system architecture for MTO (Make-to-Order) based on the study of order tracking functions and contents, and finally proves the model and system architecture valid by the case.

1. INTRODUCTION

In order to cope with the market competition and individual demand, more and more enterprises provide customized products for customers. They provide different configuration options for customers, and even invite them to participate in designing product, such as motor industry. In the environment of vertical division of labor, some enterprises become OEM, such as Semiconductor industry, clothing industry, and Consumer Electronics Industry etc. These enterprises need to deal with order delivery, or they will pay the penalty, and lose their competitive edge. So order tracking becomes the key of management for them.

After the audit and decomposition, Customer orders ultimately converted into the assembly orders, self-made parts processing orders and purchasing orders in ERP system. The system controls the storage of materials but not the manufacturing process, so the information of order status and manufacturing schedule are delayed [1]. That will influence the production. Order tracking will provide the basic information for quality control, product traceability, manufacturing process control,

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performance evaluation and logistics control. So it becomes a subsystem of the Enterprise Management System.

Shunsheng Guo, Tianri Wang and Xiaobing Yu proposed an agent-based technical scheme with RFID (Radio Frequency Identification) technology to track the sales order between the distribution warehouse and sales outlets [2]. Jianhua Jiang, Buyun Sheng, Lixiong Gong, and Mingzhong Yang proposed a Web Service based SaaS (Software-as-a-Service) architecture for the order tracking of the dynamic virtual enterprise [3]. Xiaocai Yang studied the micro architecture of the order tracking under J2EE environment, based on the analysis of B2C e-commerce order process, mainly conducted the research and application of order tracking micro-architecture [4]. Xiaoming Chen, Tenzhong Tang and Zhengxiao Wang put forward the order tracking management system based on key point tracking, studied the evaluation indicators of order tracking, and applied to automotive electrical and mechanical production enterprise [5]. Peihua Fu and Peiliang Wu proposed the order tracking system based on barcode, applied in fabric printing and dyeing factory [6].

Hongmei Jiang and Tongqiu Chen put forward the method of task order tracking based on the study of virtual enterprise network organization coordination model, and mainly solved the leader enterprise of ally enterprise production planning and control problems, that will benefit the control of leader enterprise and the coordination between the ally enterprises [7]. Heng Wang studied the order management for semiconductor packing enterprise, and focused on the tracking orders, especially the production order tracking [8].

Based on researching the elements of the order tracking model, the functions of the order tracking model and the key technique of the system implementation, the author built an order tracking subsystem for discrete manufacturing in MTO.

2. THE ELEMENTS OF THE ORDER TRACKING MODEL

There are three elements for the Order Tracking Model: order, manufacturing process and organization. The order is the object of the order tracking, manufacturing process is the basis of the granularity design, and organization is the boundary of the model.

2.1. Order Model

In this paper, order not only refers to the sales orders, but also all internal orders generated in MTO. After verification and confirmation, sales order will be transformed into finished goods manufacturing order, parts and components manufacturing order, parts and components purchase order.

For finished goods and parts and components, considering Economic Order Quantity and Minimum Manufacturing Cell, the manufacturing orders will be split in different batches, and each batch will get a unique identification. Considering
Economic Order Quantity, Lead Time and quality, parts and components purchase orders will be delivered to suppliers. When all orders are finished, assembly orders will be generated. After assembling, shipping orders will be delivered according to customer requirement.

![Figure 1. Order Model.](image)

2. 2 Manufacturing Process Model

Discrete manufacturing is the most complicated artificial systems, it relates to materiel, process, facility, quality, environment etc. The constraints are strict among different processes. The author built the manufacturing process model in view order tracking. It has two processes, one is processing and assembling of parts and components, the other is finished goods assembling. In this model, finished goods must be tracked and key parts and components as well. For easier quality tracking, the rest of material is managed in batch.
2.3 Organization Model

Organization includes all functional departments and producing departments that related to orders in enterprise. Functional departments deal with the business rule of the order, such as sales, finance, planning, storage, transport etc. Producing departments include processing workshops and assembly workshops, and these workshops be divided into different workspace or manufacturing lines.

![Organization Model Diagram](image-url)

Figure 3. Organization Model.
3. THE FUNCTIONS OF THE ORDER TRACKING MODEL

3.1 Order Status Tracking

Order status tracking focuses on the status of the orders in the model, and makes them visualized. Consider the following pseudo-codes example that could be expanded.

SOs (Sales Order status) = [Intended, Confirmed, Planned, Scheduled, Produced, Finished, Delivered]
POs (Purchasing Order status) = [Ordered, Accepted, Delivered, Received]
MOs (Manufacturing Order status) = [Planned, Scheduled, Produced, Finished, Stocked]
AOs (Assembly Order status) = [Planned, Scheduled, Produced, Finished, Stocked]

There are some constraints among the order status, such as AOs [Produced] be affected by POs [Received] and MOs [Stocked].

3.2 Manufacturing Process Tracking

For Manufacturing Order, the Manufacturing Process is the key of control. The status of the Manufacturing Process as followed.

MPs (Manufacturing Process status) = [X0, X1, … Xn-1]
Xi = 0: the status of process i is “unfinished”
Xi = 1: the status of process i is “finished”
n: the amount of Manufacturing Process

Manufacturing Process Tracking is the necessary basis for Manufacturing Alert. According to the schedule, if the current process was delayed, the system will alarm.

3.3 Manufacturing Abnormal Tracking

Manufacturing Abnormal refers to the events that cause shutdown or breakoff. Manufacturing Abnormal may case delays and extra costs.

From the site management point of view, there are five factors that cause manufacturing abnormal, namely Staff, Equipment, Material, Technique and Quality. Each factor will be split into many niches, and each niche may be divided into concrete objects.
4. KEY TECHNIQUE OF SYSTEM IMPLEMENTATION

The Order Tracking System shows us the data of Sales Order, Manufacturing Order and Shipping Order etc. It can help us to control the processes of the manufacture, improve customer satisfaction, and coordinate with various departments.

4.1 System Architecture

The Order Tracking System is developed with Windows Presentation Foundation (WPF). WPF is a next-generation presentation system for building Windows client applications with visually stunning user experiences, it provides developers with a unified programming model for building rich Windows smart client user experiences that incorporate UI, media, and documents.

The Order Tracking System has three layers, namely Data-layer, Application-layer and Presentation-layer.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Subcategories</th>
<th>Detail</th>
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<td>Matetial</td>
<td>Lack of Material</td>
<td>BOM Missing</td>
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<td></td>
<td></td>
<td>BOM Error</td>
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<td>Material Arrival Delay</td>
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<td>Damage</td>
<td>Transport Damage</td>
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<td>Equipment</td>
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<td>Technique</td>
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Using SQL Server, the system stores the basic data and scheduling data in Data-layer. As server-side, Application-layer includes several service elements, and each of them provides special application service. Presentation-layer displays information resources to the user in web browser, using it to get the order information. The System Architecture is followed.

![System Architecture](image)

**Figure 4. System Architecture.**

### 4.2 Technique Integration

The information resources of order, manufacturing and customer come from different system, such as ERP and MES. These information resources may increase the system load. So the author adopted iWay DataMigrator to solve the integration issues.

iWay DataMigrator is a powerful and comprehensive set of fully automated tools designed to dramatically simplify the creation, maintenance, and expansion of reporting structures such as data warehouses, as well as other data integration tasks such as application loading. With its intuitive, easy-to-use interface, DataMigrator enables fast, flexible end-to-end ETL process creation involving heterogeneous data structures across disparate computing platforms. iWay DataMigrator provides
everything we need to develop an effective, yet economical strategy for accessing, storing, managing, and delivering all enterprise information resources.

4.3 Data Acquisition

Due to the masses, complexity and dynamic of the date, it needs to set up a data acquisition system to collect monitoring data. The system adopts digital data acquisition technique for the consistency and timeliness of data, such as bar code and RFID. Digital data acquisition system may consist of customized elements, but at least include order, process, event, stuff and time. Acquisition terminal could be SMS, PDA, barcode scanner, tag reader etc. The data is transferred by Microsoft Message Queue (MSMQ), and then stored in SQL Server.

4.4 Application Case

This system is carried out as subsystem of the portal of one famous bus manufacturing company, provided real-time feedback of requirement changes, reduced waste, re-works and scrap, increased uptime, reduced inventory, and increased customer satisfaction. Figure 5 shows the relationship between the sales orders, production orders, the assembly of vehicle and track the production schedule.

![Figure 5. Order Tracking.](image)

5. CONCLUSIONS

In the field of B2C e-commerce, order tracking is a very common function, it has been formed a closed-loop control from placing order to receiving feedback. The customer can query the status of orders and logistics progress, it is really a wonderful experience. But in the case of the order tracking in manufacturing enterprise, the manufacturing process is opaque. Based on the enterprises that
followed MTO tactic, the author researched on three elements for the Order Tracking Model, namely order model, manufacturing process model and organization model, and three functions, namely order status tracking, manufacturing process tracking and manufacturing abnormal tracking. After that, the author constructed the order tracking system architecture, and the key technologies were described. Finally, the effectiveness of the system was proved by the actual case.

This paper mainly studied the internal sales orders tracking, parts and components processing order tracking, and finished goods assembling order tracking. Purchasing Order and Shipping Order that integrated with the third party logistics will be the key to further research.

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