

# A DESIGN FOR BUSINESS INTELLIGENCE SERVICE IN DEMAND DRIVEN SUPPLY CHAIN MANAGEMENT

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**Abstract:** This paper discusses the problems inherent within traditional supply chain management's forecast and inventory management processes arising when tackling demand driven supply chain. A demand driven supply chain management architecture developed by Orchestr8 Ltd., U.K. is described to demonstrate its advantages over traditional supply chain management. Within this architecture, a metrics reporting system is designed by adopting business intelligence technology that supports users for decision making and planning supply activities over supply chain health.

## 1 INTRODUCTION

Supply chain management has been evolving since the 1980s through various stages, such as cost realignment, business process reengineering, and vertical integration in the value chain. Recently there has been an increasing concern regarding an emergence of demand-driven supply chain management methodology. Traditional supply chain management improvement approaches in the manufacturing industry are based mostly on improving capacity and internal efficiency and attempting to increase forecasting accuracy to support better inventory planning using MRP systems. However, to deal with the challenges of managing today's supply chains, characterised by ever decreasing lead time demands from customers allied to a need for greater choice and customisation, responsiveness and agility have to be considered as part of the main principle.

Adjusting to this change in supply chain management, certain supply chain processes need to be redesigned, e.g., sales and operations planning, pull replenishment logic, and timely demand capture. The U.K. based supply chain management consulting company, Orchestr8, has developed a

demand-driven supply chain management methodology which is now being implemented with a number of its blue chip multi-national clients. The development of the demand driven supply chain management system with these major clients has produced a range of business and technical components which advance the management of the supply chain from supply-driven to demand-driven. The software system has benefited its clients to align its daily supply chain operations with long-term supply chain strategies which in return reduces inventory cost and builds up stable relationship with their suppliers. This paper describes the architecture of Orchestr8's demand-driven supply chain management system and its conceptual design toward a business intelligence based metrics reporting service.

## 2 SUPPLY CHAIN MANAGEMENT PROCESSES

Supply chain is featured by Lambert et al. (Lambert et al , 1998) as a supply network which coordinates organisations, people, activities, information and resources involved in moving a product or service

from supplier to customer. Judging the effectiveness of supply chain management normally includes monitoring delivery and order fulfillment performance, production flexibility, warranty and return's processing costs, inventory and asset turns, and other factors in evaluating the overall performance of a supply chain (Poluha, 2006). To achieve excellent supply chain management, it is important to understand the supply network and its detailed processes.

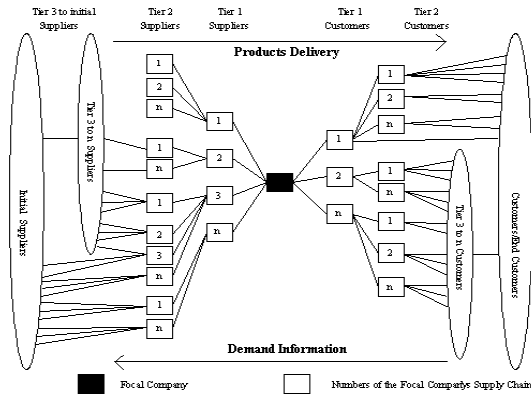


Figure 1: Structure of Supply Network (Lambert et al., 1998).

A supply network as shown in Figure 1 consists of a focal entity of a manufacturing company networked by downstream entities of customers and upstream entities of suppliers. In the current information era, the supply network becomes more complex and challenging when dealing with the dynamics of upstream suppliers and highly uncertain international markets' demands. Therefore, the supply chain management is seen as an information-intensive process, where material/products delivery and demands have to be effectively managed in order to maintain supply chain's visibility.

Because of the large amount of business data in supply chain management, most companies implement enterprise information systems such as ERP, MRP or supply chain management modules to improve supply chain workflow and efficiency. However, these systems have not provided sufficient impact on the effectiveness in the workflow, as two influential functions, i.e., forecasting and inventory management, play limited roles in the supply network.

Forecasting concerns the issues such as how to project historical data; how to deal with the change of lead time; and how to recognise different demand patterns regarding various components (Donald,

2003). Warwick Manufacturing Group (WGM, 2003) points out that the critical reasons for failing in getting quality forecasts are:

- Fails to have a single formal forecast process by all of the management and all the parties;
- Fails to monitor forecast accuracy over different time periods and constantly review the forecast as it changes from time to time.

More often than not, in manufacturing business, an ineffective forecast can cause a production plan ending up with either pushing too much production and excessive stock, or totally running out of products.

Inventory is summarised by Richards (Richards, 1982) that time, discontinuity, uncertainty, and economy feature in the existence of inventory. Inventory is expected to work as a buffer between supply and demand to minimise the risk of investment. Therefore, there are problems concerning what to stock, when to stock and how to stock. It is no doubt that a holistic view over parts' behaviour and aligning that with an appropriate supply chain management strategy could take inventory management into a more strategic level and thereby enhance the effectiveness in setting stock policies. However, some companies find that this process, normally called inventory or stock management, is complex in terms of the diversity of parts and the time involved.

These limitations of the current common approach to supply chain management may hinder a company's ability to achieve its business goals. Consequently, companies may find themselves losing their competitive advantages. Inspired by its various experiences in tackling supply chain management difficulties and issues, Orchestr8 realises that the traditional supply network needs to be driven by real-time demand.

### 3 DEMAND DRIVEN SUPPLY CHAIN MANAGEMENT ARCHITECTURE

Demand driven supply network (DDSN) is a system of coordinated technologies and processes that senses and reacts to real-time demand signals across a network of customers, suppliers, and employees. It enables organisational efficiency, streamline new product development and launch, and maximise

margin (Askegar, 2004). The main characteristics of DDSN are featured as follows (Laura, Kevin and et al, 2004).

- Business manufactures to demand, not inventory or capacity;
- Processes are to be integrated across the supply chain.

Orchestr8 adapted this approach and developed a demand driven supply chain management architecture (see Figure 2). One of its clients, who is a market leading manufacturer and retailer focusing on healthcare products with turnovers in excess of £5 billion, has benefited from the demand driven supply chain services. This client is based in the United Kingdom and having branches in Australia, Canada and many other countries; and its supply network extends from European countries to East Asia. As a typical large scale international manufacturing and retailing company, the client found it becoming increasing difficult to maintain its competitive advantages in the value chain. High percentages of excess stocks, low efficiency in managing supplier’s delivery and not having the right stock at the right time in the right place jeopardise the manufacturing effectiveness. Orchestr8 took on these problems of this client and provided the solution based on a demand driven supply chain management process.

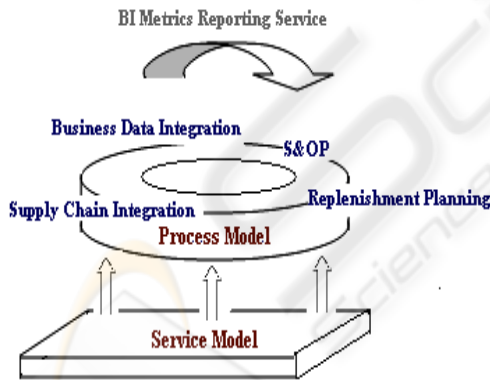


Figure 2: Orchestr8’s DDSC Management Architecture.

Supported by Orchestr8’s three tier service model, its demand driven supply chain management process assimilates the data integration, Sales and Operations Planning, replenishment planning and supply chain integration. Orchestr8’s business intelligence based metrics reporting system facilitates their forecasting and real-time inventory monitoring within the supply network.

### 3.1 Service Model

The service model (Figure 3) in the architecture provides a supply chain management infrastructure on which stock turnover, supply and demand stability and other metrics can be measured. In order to establish a holistic view on the supply network, a planning for demand driven supply should be carried out at the strategic, tactical, and operational levels. Sales & Operations Planning (S&OP) enables Orchestr8’s clients and their suppliers to build a mutual understanding of the inventory strategies selected for all the stock items.

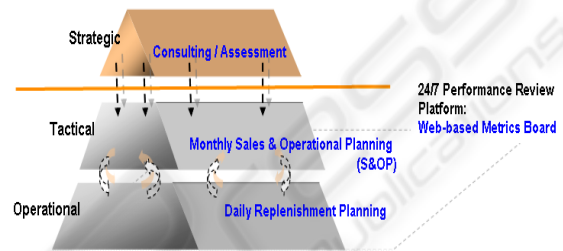


Figure 3: Orchestr8 Service Model (Orchestr8 Ltd., 2005).

Important changes in product life cycle or market demand will also be drawn for attention to reach a better demand visibility. Based on the inventory strategies formulated by the S&OP process, daily replenishment is then planned at the operational level that triggers orders when necessary. A web-based metrics system monitors the supply activities by producing timely analysis in reports for decision making processes.

### 3.2 Process Model

The process model (Figure 4) is designed to streamline the inventory management process.

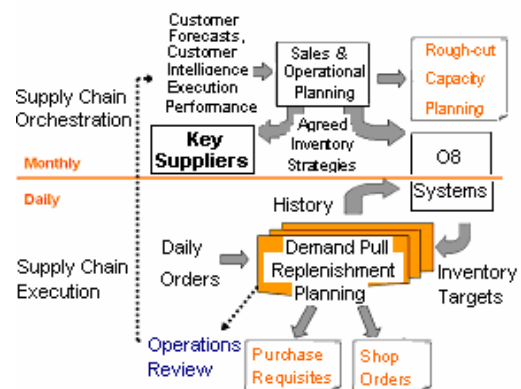


Figure 4: Orchestr8 Process Model (Orchestr8 Ltd., 2005).

From the diagram, it can be seen that the monthly process is the one where the inventory strategies are defined for the next period. These strategies are created based on the intelligence gathered as part of the S&OP process. An automated replenishment order-generating process then ensures that the inventory is managed in accordance with the policies.

### 3.3 Sales and Operations Planning

The importance of the S&OP process arises from its ability in gathering all the stakeholders' requirements to reach a common understanding of the most effective inventory strategies. The S&OP process also provides the opportunity of realigning the clients' forecast by ensuring that the 'plan' is conditioned to incorporate other influences such as seasonality or promotions management. Orchestr8's forecast models allow these options to be tested through various what-if simulations which can be done at various levels e.g. by individual item, by product family or by common grouping.

### 3.4 Demand-Pull Replenishment Planning

The replenishment planning process incorporates inventory items' historical demand patterns with their current replenishment rules. Figure 5 shows the analysis of parts regarding their daily usage and demand variability based on historical archives.

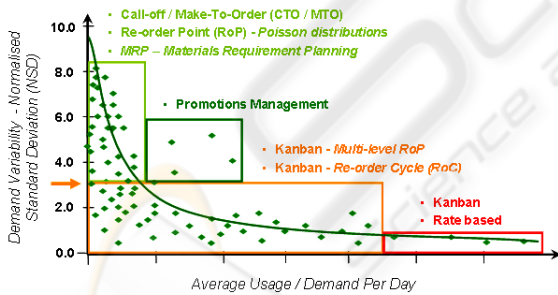


Figure 5: Volume & Variability Analysis (Orchestr8 Ltd., 2005).

The rules can be applied by product family or individual item to achieve most effective replenishment planning. Vendor Managed Inventory and Kanban replenishment logic are deployed where appropriate to enhance lean manufacturing which results in benefits such as lead time improvement and stock reduction.

### 3.5 Business Data Integration

Business data, including order information and part master, is essential to the successes of effective forecasting and inventory management. Orchestr8's system can be integrated with most ERP, MRP and other workflow systems and carries out a validation function on the data imported to ensure that the necessary data is in complete and accurate which in turn improves the consistency within the supply chain management processes. During the restrict data validation process, the system filters corrupted data out with relevant implication about its problems and meanwhile, allows correct data to pass through for further planning which dramatically reduces potential problems in the supply chain management process.

### 3.6 Supply Chain Integration

Table 1: Traditional SCM vs. Demand-driven SCM.

Topic	Traditional SCM v.s. Demand-driven SCM	
	Scope of Management	Focus on internal process
Forecast Effectiveness	Inaccurate and not understood by all of the management	Using demand driven forecast model & agreed by all of management
Demand Capture	Push and produce to production plan method	Pull and produce to demand
Inventory Management	Efficiency but not managed as per various parts' behaviour	Effective and detailed to each product family or individual item
React to Change	Difficult to achieve as the core calculation is rigid	Flexible based on improved supply network with lean inventory & shortened lead time

Organisational alignment is always a key concern of demand driven supply chain management. Orchestr8 encourages the collaboration amongst stakeholders across the supply networks. Inventory strategies are clearly formulated and monitored by all the stakeholders periodically. Great efforts are made on building good relationships with the suppliers to ensure the supply chain is aligned to

their capabilities and customers' expectations.

The demand driven supply chain management architecture focuses on improving supply chain management effectiveness in an extensive sense across the value chain. Table 1 summarises its business value in comparison with the non-demand driven approach in supply chain management.

#### 4 CONCEPTUAL DESIGN FOR BUSINESS INTELLIGENCE METRICS REPORTING SERVICES

Business Intelligence (BI) Metrics Reporting Service plays a strategic role in Orchestr8's demand driven supply chain management architecture. It produces reports and dashboards which support the collaboration between Orchestr8's clients and their suppliers in a real-time supply network. The design of the metrics reporting system has adopted an advanced business intelligence approach based on Kimball's model (Mundy, 2006) to ensure that this system has agility.

Various performance measures' mechanisms from business intelligence methods have been critically assessed by this development. The technologies, such as data warehousing, Online Analytical Process (OLAP) (Sandeep and Sourabh, 2006), and Microsoft integration and reporting services have been adopted in the design of the metrics reporting system (see Figure 6).

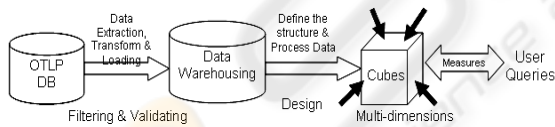


Figure 6: Data Transformation (Orchestr8 Ltd., 2006).

The operational data of the clients and its suppliers is transformed from the Online Transactional Process (OLTP) database into a data warehouse which schematically structures the information for report generation. The cubes facilitate the execution of the reporting process which takes the user's request on visualising their supply chain performance measures.

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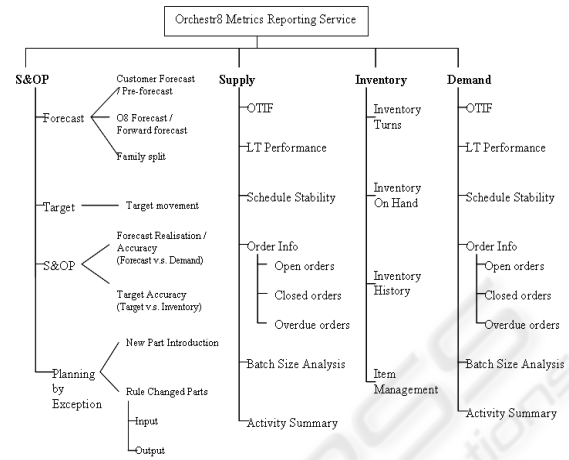


Figure 7: The Metrics Reporting Services' Structure.

A schema of the metrics reporting services, shown in Figure 7, represents S&OP, supply, demand and inventory. The S&OP is mainly represented by forecast and target in its granularity. The supply, inventory, and demand cover the relevant information in their functionalities in the supply network.

Similar to Debra's method of organising supply chain metrics hierarchically, the metrics provided by the reporting service are designed to demonstrate different degrees of detail at various business levels. In other words, the structure of the metrics represents details of the supply chain management process at its granularity. Figure 8 illustrates a process of evaluation for a client's total inventory on hand performance (Orchestr8, 2006).

This process produces the inventory turns at the upper level, total inventory value at the middle level, and the inventory policies by part at the lower level in the metrics. The inventory turns illustrates the top level effectiveness of the stock management process by looking at the ratio between the value of total usage of the stock and the average value of all the stock on hand in a certain time period. Indicated by this measure, managers then can use the inventory on hand reports which are categorised by suppliers or by product families or by inventory policies at their preference to investigate the efficiency of their inventory strategies. To help clients to obtain further insight into an individual item or exceptional items, some special analysis driven reports are available to cater various decision-making needs.

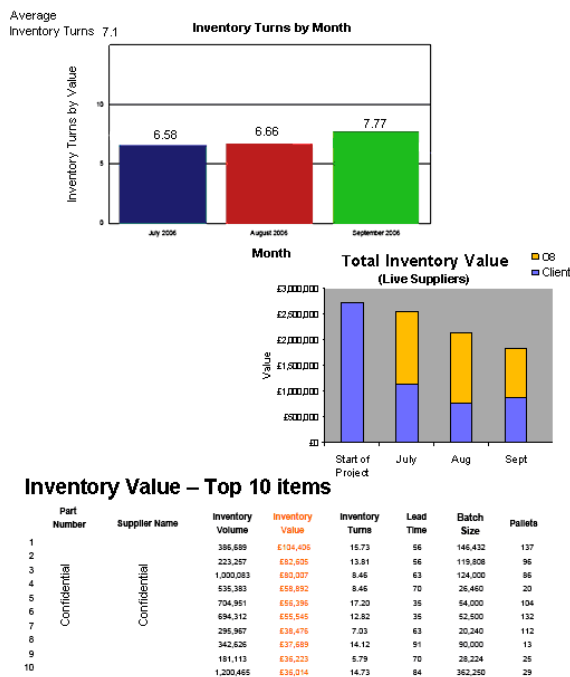


Figure 8: A breakdown structure in Inventory Management performance evaluation.

All in all, the information presented in the metrics reporting service can support the managers to assess the overall supply chain health, diagnose problems, and plan actions progressively.

## 5 CONCLUSION AND FUTURE WORK

With respect to the traditional supply chain management methodology, Orchestr8 in collaboration with its academic partner has developed and deployed the demand driven supply chain management methodology. The development has delivered the demand driven supply chain management architecture with the software tools to perform real-time forecast modelling, inventory monitoring and supply planning. Clients of Orchestr8 have benefited by managing their supply chain on demand. This development has also provided the client with strategic impact on redesigning their supply chain planning process.

There are still some further work and improvements need to be carried out, such as deploying business intelligence using advanced analyst methods, incorporating ad-hoc reports in the metrics reporting services and designing formal

performance management processes. Effectiveness of the demand driven supply chain management process will be under close monitor as well for continuous improvement purpose.

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