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Decision Support Systems: A Case Study in VESTEL

INTRODUCTION

Many of the advances in the control and management of supply chains are driven by advances in computer technology. Supply chain management problems are not so rigid and well defined that they can be delegated entirely to computers. Instead, in almost all cases, the flexibility, intuition, and wisdom that are unique characteristics of humans are essential to the effective management of such systems. However, there are many aspects of these systems that can only be analyzed and understood effectively with the aid of a computer. It is exactly this type of assistance which decision-support systems are designed to provide. As the name implies, these systems do not make decisions; instead, they assist and support the human decision maker in his or her decision-making process.

Decision-support systems range in form from spreadsheets, in which users perform their own analysis, to expert systems, which attempt to incorporate the knowledge of experts in various fields and suggest possible alternatives. The appropriate DSS for a particular situation depends on the nature of the problem, the planning horizon, and the type of decisions that need to be made. In addition, there is frequently a trade-off between generic tools that are not problem-specific and facilitate the analysis of many different kinds of data, and often more expensive systems that are tailored to a specific application. Within the various disciplines that make up supply chain management, DSSs are used to address various problems – from strategic problems such as logistic network design, to tactical problems such as the assignment of products to warehouses and manufacturing facilities, all the way to day-to-day operation problems like production scheduling, delivery mode selection, and vehicle routing. The inherent size and complexity of many of these systems make DSSs essential for effective decision making. DSS in supply chain management are often called Advanced Planning and Scheduling Systems. These systems typically cover the following areas: demand planning, supply planning, manufacturing planning and scheduling.

Typically, decision-support-systems use the quantifiable information available to illustrate various possible solutions, and allow the decision maker to decide which one is the most appropriate, based on other, possibly non-quantifiable factors. Often, DSSs allow the decision maker to analyze the consequences of a decision, depending on different possible scenarios. This kind of *what-if* analysis can help avoid problems before they occur.

Many decision-support systems use mathematical tools to assist in the decision-making process. These tools, often from the mathematical discipline of operations research, were first developed to assist the armed forces with the enormous logistical challenges of World War II. Since then, improvements in these techniques, as well as ever-increasing computer power, have helped to improve these tools and make them more accessible to others.

The tools of artificial intelligence are also employed in the design of decision-support systems. Intelligent agents use AI to assist in decision making, especially in real-time decisions, such as determining how to supply a customer in the shortest possible time, or quoting a delivery lead time as the customer waits on the phone. Following Fox, Chionglo, and Barbuceanu, we define an agent as a software process whose goal is to communicate and interact with other agents, so that decisions affecting the entire supply chain can be made on a global level.

Supply Chain Decision Support Systems

Supply chain management involves several decisions that a decision-maker must face. A list of such decisions is provided below:

- Demand Planning
- Logistics network design
- Sales and marketing region assignment
- Distribution resource planning
- Material requirements planning
- Inventory management
- Production location assignment
- Production scheduling
- Workforce scheduling

LITERATURE REVIEW

A supply chain can be defined as a network of autonomous or semiautonomous business entities collectively responsible for the procurement, manufacture and distribution activities associated with one or more families of related products. Different entities in a supply chain operate under different sets of constraints and objectives. However, these entities are highly interdependent when it comes to improving the performance of the supply chain in terms of objectives such as on-time delivery, quality assurance and cost minimization.

As a result, the performance of any entity in a supply chain depends on the performance of others, as well as their willingness and ability to coordinate activities within the supply chain. The globalization of the economy and the increase in customer expectations regarding cost and service have influenced manufacturers to strive to improve processes within their supply chains, often referred to as supply chain re-engineering (Swaminathan, 1996).

The goals of supply chain management entail the design, operation and maintenance of integrated value chains to satisfy consumer needs in the most efficient way by simultaneously maximizing customer service (Christopher, 1998; Hewitt, 1994; Ross, 1998). Today, SCM is accepted as a concept that integrates inter-organizational business processes, and encompases other concepts such as Efficient Consumer Response, Quick Response, Continuous Replenishment and Customer Relationship Management (Bechtel and Jayaram, 1997). The design of supply chains requires the specification of business processes and supply-chain-wide planning routines as a special task, subsumed under the development of information systems as the backbone of any supply chain integration. Information technology is widely perceived as the enabler of supply chain integration (Bechtel and Jayaram, 1997; Hewitt, 1994). Enterprises participating as partners in a supply chain have to provide their activities in a way that maximizes supply chain efficiency. Thus, they have to concentrate on their core competencies (Christopher, 1998).

SUPPLY CHAIN MANAGEMENT AT VESTEL

Vestel Electronics A.S. is the largest electronics manufacturer in Turkey. Its core product, television sets, accounted for 70% of total sales in 2000, and monitors represented 5%. In 2001, Vestel Electronics produced a total of 4.6 million televisions, making up 65% of the country's total TV set production. In 2002, TV set production increased to 6.4 million.

Along with being a leading brand in the Turkish television market, with a 30% market share as of the year 2002, Vestel Electronics is also the largest domestic brand exporter, with a 65% share of the market. As the largest full-range television ODM (Original Design and Manufacturing) enterprise in Europe, Vestel Electronics had a market share of 17% in OEM sales.

Vestel Distribution Network

Most of the production occurs in a plant in Manisa, were imported foods are also received. Until 1999, the company had four warehouses that served dealers and outlets in different regions of the country. Distribution is performed by Horoz Logistics. In light of the flat price per item pricing scheme given by the third-party-logistics (3PL) company, it became clear that there was no need to keep four warehouses. This led to an initiative for warehouse consolidation, whereby the distribution network took on its current form with two warehouses. In spite of the reduction in durable goods markets caused by the financial crisis in Turkey in 2001, Vestel's production has increased steadily, as is demonstrated in the following table:

Table 1. Number of Units Shipped: Monthly and Annually

	2000	2001	2002	2003
Annual	900,000	518,867	592,652	1,007,701
Monthly	75,000	43,239	49,387	83,975

A New Planning System: Manugistics Transportation Management

Given the objective of instituting a better measurement system, in 2000 Vestel decided to implement Manugistics' Network Transport Management (MTM) module as the next stage of improvement efforts for the distribution system. This package was chosen based on the service options made available in Turkey by the various SCP providers and subsequent negotiation on price. Vestel Durable Goods Marketing was the first company in Turkey to implement such a transportation planning system.

Manugistics Transportation Management

Manugistics is a transportation optimization software program which schematizes the optimal route and truck volume for daily-prepared deliveries. The inputs to the system include (a) the location of Vestel's warehouses, transfer stations, and customers, (b) customer orders, (c) transportation modes, and (d) associated costs. The optimization program uses these inputs and finds a solution within the constraints imposed by the management to minimize total transportation costs. The route and truck planning is made according to the inputs and constraints.

There are three different location types in Manugistics: warehouse, transfer station and customer. All locations have zip codes generated specifically for Manugistics. These codes are different for each province. Some big provinces are divided into two or more regions. The distances between each two zip codes are put in a network table, and the distance between two points located in the same zip code is set to three km.

Vestel Durable Goods Marketing Inc. has two warehouses, one in Manisa and the other in Istanbul. There are nine regions throughout Turkey, and the total number of transfer station in these regions is nineteen. The logistics company owns and operates these stations.

The volume information for each product is provided as an input into the system.

Three different truck sizes can be used for transportation, in addition to a direct cargo alternative. The costs of using each alternative are set in the system. Ten-wheel or eight-wheel trucks are used for transportation from the warehouses to transfer stations. Small trucks then make the deliveries from the transfer stations to customers. There is also a direct cargo alternative from the warehouse in Manisa. Dealers with high volume demands can receive direct deliveries with large trucks. Manugistics selects the direct cargo option based on transportation costs. Truck utilization constitutes an important criterion for deciding on the mode of delivery.

The management uses two policies related to efficiency and customer service. The first policy is related to truck utilization. A truck must be at least 65% full in order to depart for its destination, otherwise it waits until this rate is achieved. The maximum waiting time is the other policy related to customer service. Waiting time is restricted to a maximum of three days, in order to provide good service to distributors. After three days, even if an appropriate truck is not 65% full, an order will leave the warehouse by truck or by cargo, whichever is more efficient. Manugistics does not optimize truck loading. Since Manugistics does not plan inside the truck, loading problems may occur: Given the difference in the shape of various goods being transported, not all items planned by Manugistics may be loaded on a truck due to space constraints. As a result, volumes were increased to enable the feasibility of the plans generated by the software. While truck load optimization would be feasible for simple deliveries between two points, the Vestel distribution problem is significantly more complex due to routes that have multiple drop-off points. As a result, the planning objective is not to find the loading that maximizes truck utilization, but rather the loading that facilitates the best unloading of trucks without having to load and unload different items at the various drop-off points.

Table 2. Transportation Figures

Year	Month	Amount	Total Scheduled Truck Volume (dm^3)	Cumulative Truck Utilization
2002	January	41,153	18,667,200	61%
	February	43,160	16,691,200	57%
	March	35,594	17,062,400	57%
	April	46,284	25,747,200	68%
	May	58,658	32,291,200	64%
	June	64,319	25,102,400	72%
	July	60,552	35,147,200	70%
	August	46,983	26,148,800	82%
	September	43,418	20,894,731	85%
	October	52,533	26,940,860	73%
	November	69,612	32,733,792	66%
	December	68,257	25,111,986	76%

2003	January	77,063	28,046,400	89%
	February	82,877	25,745,600	91%
	March	104,717	33,944,000	90%
	April	115,406	31,480,000	95%
	May	158,242	43,228,800	93%
	June	154,923	42,427,200	90%

Implementation Issues for Vestel

The results obtained from the implementation of Manugistics were phenomenal. Truck utilization went up while the transportation costs decreased between 1999 and 2003.

Table 3. Decrease in Total Transportation Cost from 1999 to 2003

	1999	2000	2001	2002	2003
Index Trans. Cost/Sales Revenue	100.00	119.92	96.69	84.08	81.32
Index Trans. Cost/Cost of Goods Sold	100.00	118.21	98.84	87.91	80.67
Index of TL/dm3 transportation	100.00	109.82	124.61	158.93	163.12

In 2002, transportation costs were decreased by 46% despite the increase in diesel prices and increase in the Consumer Price Index. The unit cost of transportation per item went down in some cases by as much as 75 %.

Table 4. Unit Transportation Cost Decrease Between 1999-2002

Products	% Change in USD
TV	-42.92%
Washing Machine	-47.36%
Refrigerator	-12.92%
Dish Washer	-44.73%
Mini Music Player (portable)	-68.62%
Small home appliances	-51.25%
Receiver	-66.41%
Carpet washing machine	-29.31%
Computer	-66.20%
Oven	-60.77%
Vacuum cleaner	-71.20%

In addition to the new planning system, a number of other factors were also instrumental in achieving high utilization rates. First, the number of orders entered manually into the system decreased. Moreover, the total volume also increased in 2003. Finallly, an increase in pre-paid orders helped to achieve a more even distribution of the orders within a month.

Table 5. Weekly Distribution of Monthly Revenue and Truck Utilizations

		1st Week	2nd Week	3rd Week	4th Week
Weekly Distribution	**2003 Jan-June**	19.5%	20.8%	24.3%	35.4%
	2002 Jan-June	10.28%	17.17%	19.91%	52.65%
	2002 Jan-Dec	9.92%	18.42%	19.62%	52.04%
Cumulative Truck Utilization	**2003 Jan-June**	93%	94%	71%	90%
	2002 Jan-June	41%	44%	53%	79%
	2002 Jan-Dec	78%	72%	75%	78%

The figures below reflect the increase in rates of truck utilization and total scheduled truck volume. Rates of truck utilization are calculated using the following formula: Cumulative Truck Utilization = Total Transported Volume (dm^3) / Total Scheduled Truck Volume (dm^3).

Figure 1. Cumulative Truck Utilization (%)

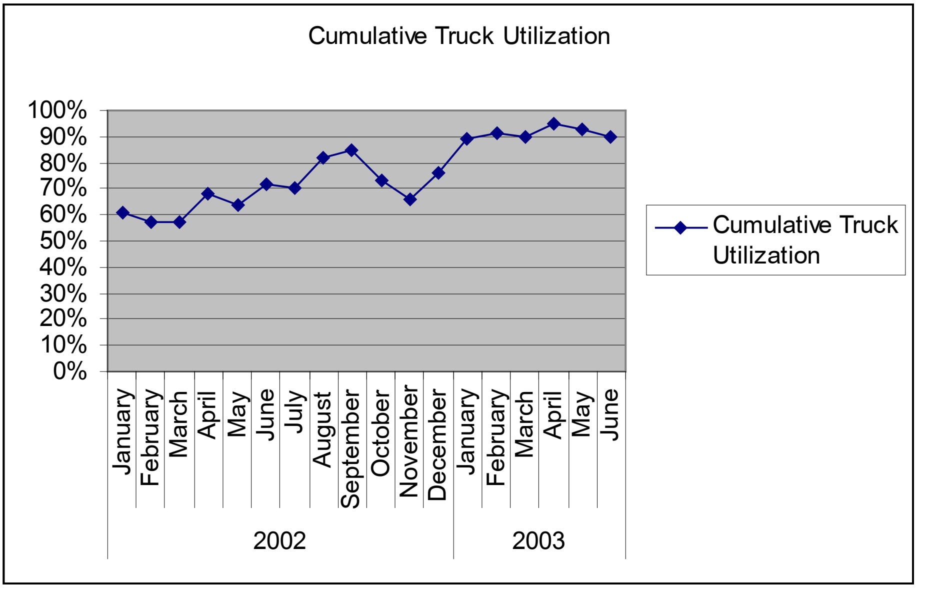
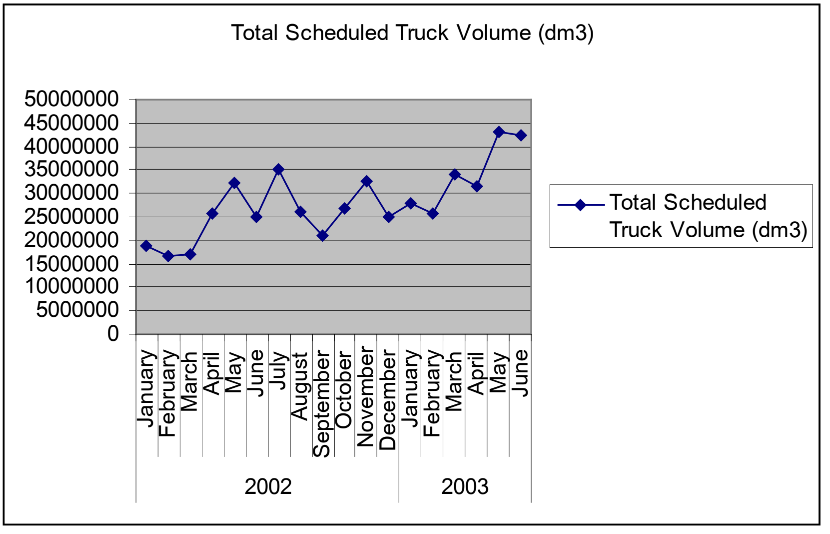


Figure 2. Total Scheduled Truck Volume (dm³)



CONCLUSIONS

Decision support systems for supply chain management are a fast growing sector of the logistics software industry. DSSs will continue evolving and adopting standard features and interfaces in order to adapt to the competitive environment and provide the flexible solutions required in today's markets. Since the basic data that are required to make decisions are being collected, there is a strong drive to utilize this information in sophisticated ways in order to gain a competitive advantage by improving service and cutting supply chain costs. 'Integration with ERP systems,' 'Improved optimization,' and 'Development of standards' are the current major trends in DSS, especially within supply chain DSS and advanced planning systems.

The success that Vestel has experienced after implementing a DSS model in the distribution planning process has once again demonstrated the important and vital role of DSS in effective supply chain practices.

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