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APPLICATION OF A DECISION SUPPORT SYSTEM FOR OPERATIONAL DECISIONS

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ABSTRACT

This paper discusses the application of a Decision Support System (DSS) for making operational decisions in a food processing industry. A model is developed for determining the optimum production scenario for every week based on the tradeoffs between service levels, costs, inventories, changeovers and capacity. The experiences of the authors in designing, developing, and implementing the Decision Support System are shared in this paper.

KEYWORDS

Decision Support Systems; DSS; operational decisions; food process industry; optimization model; optimum production; computer aided tools; production planning; sequencing; balanced scorecard.

INTRODUCTION

Operational and tactical decisions, such as production planning and scheduling decisions, play a significant part in the successful operations management of every company. With the advancements and availability of information technology and services, computer aided tools are providing intelligence to make real time decisions instead of being a repository of unlinked information. We see decision support systems replacing the traditional MRP and even ERP systems as they help managers evaluate several alternatives and make informed decisions rapidly. This paper discusses the application of one such system that has helped a food products company to efficiently make operational decisions which are aligned with the profitability of the company.

THE CHALLENGE

The company under study manufactures more than 100 varieties of products. The product volume and mix varies significantly from week to week. The company produces according to a weekly forecast which is usually not very reliable. The manufacturing plants were typically built to meet large volume and low variety mass production needs. The market has changed and the challenge is to utilize the same assets to produce a greater variety of products in lower volumes. The equipment is inflexible to meet the low volume, high variety needs of the food industry. This is further exacerbated by the seasonality of the company's product offerings. This new market reality has significant impact on product cost, inventory, and ultimately the profitability of the

company. This is compounded by the conflicting objectives and priorities of functional organizations within the company (Fig.1). For example: the manufacturing plant is measured on minimizing product costs; logistics is measured on minimizing inventory; and marketing is measured on maximizing customer service. In short, each part of the organization attempts to make its decisions based on how it is measured. Frequently managers manually juggle customer service levels, operational costs, inventory turns, productivity and capacity to make decisions. It is a hit-or-miss, trial-and-error approach that is based on the experiences of long time employees.

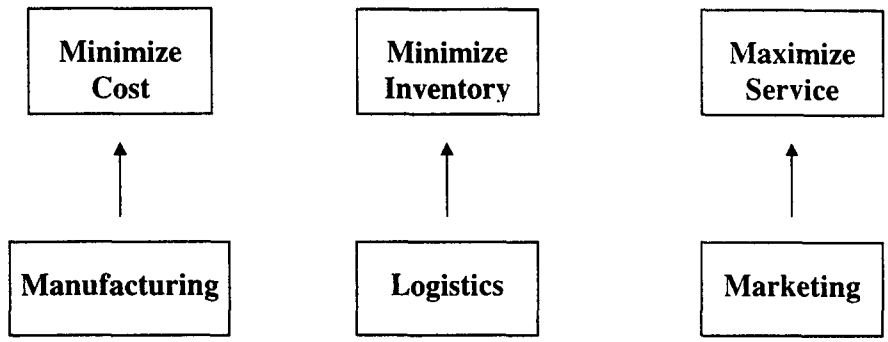

Fig. 1. The Challenge

DSS MODEL CONCEPT

The model is designed to provide an integrated system that meets the overall objective of the firm rather than sub-optimizing to the needs of the individual departments. The model is also based on the notion of a balanced scorecard -- i.e. balancing the various factors such as costs, inventory, customer service level, capacity, and internal productivity -- to provide the optimum solution for the company as a whole (Fig.2). It was also decided to develop a PC based Decision Support System that would provide management a real time tool to make timely and optimum decisions that can easily be communicated across the company. This system could also provide alternate solutions based on user interaction and requirements.

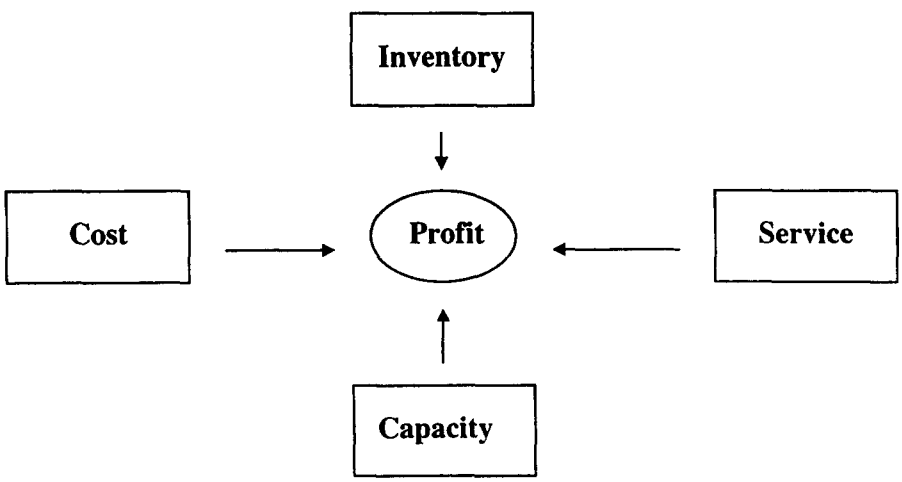

Fig. 2. DSS Model Concept

DSS MODEL SCENARIOS

The DSS developed for the factory is essentially a planning and scheduling tool for operational decision. The user inputs the number of weeks for which plans have to be made. This can vary from one to twenty-four weeks (with a default value of four). The DSS reads the expected forecast and demand for the specified number of weeks and solves any of the three models that the user chooses. These are:

1. As-is Scenario: Production scenario based on the existing MRP system
2. Optimization Scenario: Optimized production scenario based on DSS
3. Batch Scenario: Production scenario based on maximum number of batches of each product

In addition to the above, the user has the option of changing the weekly production quantities of the products generated by the models. The cost and the performance measures are evaluated for the new scenario whenever the user changes the production quantities for single variety or for multiple varieties. This helps the user to plan for urgent orders and to include capacity constraints.

DSS MODEL SPECIFICS

Inputs from existing company databases and additional user defined inputs are fed in to the optimization module which then provides the outputs as indicated in Fig. 3.

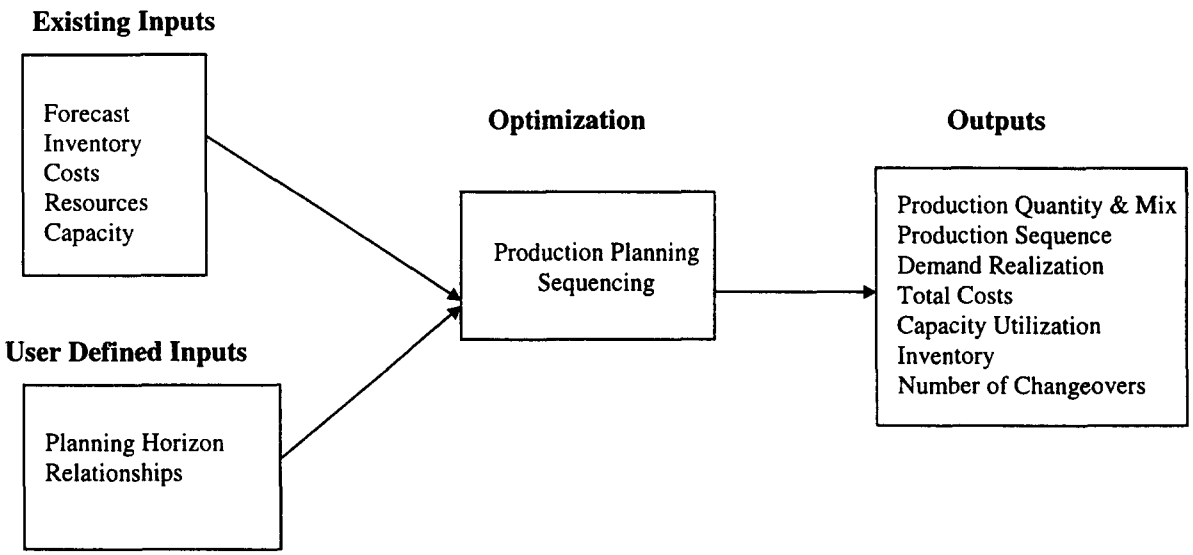

Fig. 3. DSS Model Framework

The Optimization Module

There are two parts to the optimization module. The first part is the production planning module which uses an approximate algorithm to determine the production quantities for each week based on the least cost option to achieve 100% customer service levels. Inventory levels and capacity utilization are subordinated to optimizing the cost. A production sequence is generated for each week within the user selected planning horizon to meet demand plus minimum inventory. The

excess capacity, if any, is filled with products such that the overall cost is minimized. This is repeated for all the weeks.

The second part is the sequencing module which determines the order in which products are made. A heuristic based algorithm is developed to minimize changeover time. The company presently follows a few rules for sequencing the products based on experience. This has also been modeled and presented to the user, who can now make a choice between the two sequencing alternatives.

BENEFITS

The proposed DSS has been implemented in the company. The benefits are:

1. For the first time, the company has a tool that enables the company to make timely, informed, and consistent decisions in support of the production needs that is the best for all departments.
2. The company is able to meet 100% of its customer's needs at the lowest cost and optimum inventory.
3. The company is saving about 10% of its cost of production due to better planning and sequencing of the products.
4. The company is able to prioritize its improvement efforts based on the accurate and reliable reports on performance.
5. The company is able to identify capacity availability and needs more accurately and can plan future investments and growth effectively.

CONCLUSIONS

The decision support model that has been implemented is one of the few that is currently being used by industry. Even though companies have MRP and ERP systems, they are providing only islands of information. The authors believe that more companies will be moving to leverage their islands of information into intelligent decision support systems. This is bound to transform the entire manufacturing support software industry in the near future.

REFERENCES

Robert S. Kaplan and David P. Norton. The Balanced Scorecard – Measures That Drive Performance, Harvard Business Review. January-February 1992, 71-79.

Robert S. Kaplan and David P. Norton. Putting the Balanced Scorecard to Work. Harvard Business Review September-October 1993, 134-139.

Steven L. Goldman, Roger N. Nagel, and Kenneth Preiss (1995). *Agile Competitors and Virtual Organizations*. Van Nostrand Reinhold, New York.

Kenneth Preiss, Steven L. Goldman, and Roger N. Nagel (1996). *Cooperate to Compete*. Van Nostrand Reinhold, New York.

Wagner H M and Whitin T M (1958). Dynamic version of the economic lot sizing Model, Management Science. Vol. 5 89-96.

M.Bellmore and G.L. Nemhauser (1968) Traveling salesman problem - A survey Operations Research, Vol 16 558-568.