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A Decision Support System for Inventory Management in High Research & Development Environment

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ABSTRACT

Inventory management is being discussed recently as one of the key elements for survival and success in the production industry today. Little efforts were made to solve inventory problems in the Hi R&D environment.

In this paper, a prototype of a Microcomputer Based Decision Support is introducted to support decisions for managing Hi R&D inventories. The decisions involve timing and scheduling of purchased components, as well as classification of those items.

1. Introduction

This paper suggests a Decision Support System (DSS) for inventory and purchasing management in the Hi Research and Development (hereafter "Hi R&D") industry.

The term Hi R&D is not well defined. We will strictly define it as a knowledge based industry whose attributes are as follows:

- The cost of development out of the total business turnover is relatively high.
- "Time to Market" is a crucial element in respect to other factors.
- There are relatively high technological uncertainties as well as marketing risks.
- The technological life cycle of products are relatively short.
- In many cases high complexity of products, and small and diversified lots impose job shop production characteristics.

In this complex, risky and ever-changing environment, the raw material inventory can be characterized as follows:

- The raw material percentage out of the total development cost is relatively low.
- The technological life cycle of some of the components is relatively short.
- High percentage of the raw material components are not available in the company's stock, and have to be purchased from outside vendors.
- The lead time of the non-standard component is long, and may vary from time to time.

A DSS is designed for managing purchasing and lead time in this industry. The data base of this DSS is introduced in this Sections 2. This section modifies the traditional ABC policy (Pareto's Principle) to the Hi R&D industry, and sorts the data according to the new criteria.
In section 3 we present the model base for DSS and apply a model for purchasing items (For further readings on the various components of a DSS the reader may refer to Ariav and Ginzberg, 1985). Section 4 will deal with implementing the model. Section 5 will draw conclusions.

2. The Principle in the Hi R&D Industry

One of the most common principles in managing inventories is the Pareto (also known as the 80/20) principle. It is well known and observed that few inventory items usually account for most of the inventory value as measured by dollar usuage. We can apply other criteria for classifying items for the Hi R&D industry (Some of them suggested by Sipper, see Globerson, 1980). The criteria are:

- The purchased items' Lead Time.
- Standardization of the purchased item.
- Sole source items.
- Critical items. The definition of "criticality" differs from one industry to the other, from company to company, and from product to product. Thus we leave this the definition of "Critical Item" to the project manager in each site.

Those four attributes (Lead Time, Standardization, Single Source and Criticality) will draw the pareto classification of Hi R&D companies, regardless of their cost. Thus managerial attention will be the important items, rather than to the expensive ones. In the Hi R&D environment the purchased items are a small portion of the cost product (10%-15%), and the mentioned attribute will enable better deliveries and reduce Lead Time caused by lack of components.
A utility function (or, if you will a "final score") of those attributes can be easily derived. A simple one may be having "1" for the existence of the attribute and "0" for not having it. The DSS proposed enables to download the data from a central database and to a microcomputer and sort it according to those criteria. Then an ABC analysis is carried out using those criteria.

In every project, the project manager should fill in, BY HIMSELF or HERSELF, the appropriate attributes of EACH ITEM. By using this methodology, we first make the project manager review his own decisions on the purchased items. Since the project manager's supervisor has less knowledge on those issues, as well as the purchasing staff, this is a very effective way to identify the problematic items.

Managers should also use the traditional ABC monetary analysis. By having both classifications, the negotiation process as well as the expedition efforts will yield better results.

3. The Model for Scheduling the Purchased Items

The Model used in this DSS is a Purchased Items Scheduling model which was applied and modified for use in the Hi R&D projects. For further details the reader is referred to Ronen and Trietsch (Ronen and Trietsch, 1986). The model minimizes the expected total cost of an item. Those costs include the item's holding cost (in case the item arrives before it is needed) and the penalty cost for late delivery. For the one item case optimization yields

$$F(t^* - T^*) = P / (P + C)$$

Where t* is the desired time for the item's arrival

F() is the lead time CDF

T* is the time the order is placed

P is the penalty for late delivery per period

C is the holding cost per period

Solving the n item model is much more complicated. A good approximation for the optimal scheduling by computing a simple lower bound. This is achieved by treating each item separately. Thus, if we have n items, Ti* will be derived by the solving the following equation:

$$Fi(ti^* - Ti^*) = 1 - Ci / S$$

where Ci is the holding cost of item i, and S is P + Ci. In other words, we calculate the T* for each part independently.

4. Implementing the Model

A normative approach to use this model will follow these steps:

First, we will classify the items needed for the project by the traditional ABC classification. This will help the purchasing department to focus their efforts on the more expensive items, and have an effective negotitation process.

The second step should be to classify the items by the utility function as proposed in section 2. All the class A items (according to the utility function suggested in section 2) will be ordered at once, regardless of the optimization carried out in the model. For class B and C, the due dates of the items will be calculated using the model.

The CDF's of the items' lead times can be derived from past experience, for old components, or estimated, for new ones.

5. Conclusions

This paper suggests a DSS for managing inventories and purchasing in the Hi R&D industry. The various problems of managing inventories and purchasing in this environment were presented. The traditional ABC inventory classification does not seem to be enough for the Hi R&D industry. For this reason we have suggested an additional classification for the purchased items. An optimization model was modified to solve the scheduling and timing problems of this industry.

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