

EXECUTIVE SUMMARY

In December, 1981, the Service Research Function (SRF) of the Field Engineering Division (FED) of IBM commissioned the authors of this report as consultants to review existing inventory and distribution procedures for IBM's maintenance parts logistics system, with special emphasis on the Inventory and Distribution Function of FED, and to provide their recommendations for an idealized design of this system to meet IBM's strategic needs for the future. In following discussions with Messrs. Harvey Herscowitch and Larry Lau of SRF, it was agreed that this analysis should not only develop general strategic options for such an idealized system, but should also delineate methods and procedures for accomplishing the most important next steps in moving towards the proposed system. This report is the result of this analysis. A brief summary of the report follows.

In Section 1, we discuss the problem environment of spare parts inventory and distribution in IBM, and we link this to competitive strategy issues in marketing, product development, and manufacturing. We then describe the main area of concern in this study, the structure and operation of the logistics system for maintenance parts.

In Section 2, we provide an overview of the key decisions and trade-offs in multi-echelon inventory systems for spare parts and we discuss the general state of existing theory and practice in dealing with these.

We describe key areas of concern in IBM's current logistics operations in Section 3. In summary form, these areas of concern are the following:

1. Definition and measurement of service levels;
2. Levels of current and projected inventories;
3. Parts Inventory Management System (PIMS);
4. Recommended Spare Parts (RSP);
5. Controllability and accountability of operations;
6. Location and size of stocking points;
7. The echelon inventory control structure;
8. Transportation costs and modes;
9. Outside location stock pooling (Vanning).

The above areas of concern lead us to define three generic problem areas in structuring an idealized system:

1. Performance Evaluation: Determine measures of performance (for example in terms of cost categories, service levels, etc.) to be used for evaluating design options.

2. Logistics Structure: Develop methods for determining the location, size and operation of facilities (field distribution centers, parts stations, outside locations) and linking transportation modes.

3. Stocking Policies: Determine forecasting methods for parts usage and for stocking and ordering policies for prepositioning and for resupply of parts at each echelon of the logistics structure.

Clearly, the above three problems are linked since optimal logistics structure will depend on how desired service level is defined and what stocking policies are used. Similarly, the nature of optimal stocking policies depends on the location and size of distribution facilities and on the costs and speed of delivery of associated transportation modes. A joint analysis of these three areas is therefore required and this is pursued in Section 4, where we specify the structure of a hierarchically structured model for an idealized distribution planning and control system.

In Sections 5 and 6, we use representative data for several parts classes and a problem scenario based on an aggregated model of the national system to indicate the nature of optimal stocking and transshipment policies for IBM's current environment. These policies lead to the estimation of stocking costs associated with various multi-echelon structural design options. The issue of an optimal system structure is then considered in a manner which trades off facility costs and individual part stocking costs. In Section 6 we extend our analysis for a sample of parts classes by considering the impact on optimal stocking policy of constraints on system response time. These results provide the basis for our recommendations and for our specification of follow-on studies in key areas of interest, which we describe in Section 7. In summary form, our conclusions are as follows:

Recommendations

1. Performance measurement systems should be reviewed and revised to allow management diagnosis and control of costs and service levels at each echelon in the logistics system;
2. A classification scheme for maintenance parts needs to be devised which will be useful for structuring optimal stocking policies and performance reports;
3. Present forecasting algorithms should be reviewed and updated to reflect state-of-the-art techniques, especially for very low usage items;
4. Stocking algorithms determined or affected by PIMS and RSP must be carefully reviewed and revised in light of the structure of optimal stocking algorithms elucidated below;
5. The present logistics structure, in terms of number of echelons and location of facilities, is likely not a major problem, but the structure of present transportation modes linking these facilities as well as policies related to which modes are used need careful review and revision;
6. The models developed during the course of this project should be further refined and documented, both in general terms and in providing specific benchmarks for optimal stocking policies and logistics structure.

Areas for Implementation Studies

1. A theoretical and follow-up empirical analysis of demand processes will provide needed information of better forecasting procedures;
2. Given the magnitude of transportation costs in the present system, it is important to perform a transportation systems analysis, concerning both costs and modes, to determine the structure and efficiency of present modal usage patterns;
3. A revised performance measurement system, tracking service levels and various cost and inventory categories, should be implemented on a trial basis to determine design standards for a full-scale implementation of a management control and decision support system for logistics operations;
4. Using the inputs of the demand forecasting, transportation cost, and performance measure studies, the results of the present study should be refined and extended to derive generic, part-specific optimal stocking policies and to predict service and cost improvements resulting from their implementation;
5. Based on the results of the above implementation studies, a pilot study for selected parts and machine types should be undertaken to empirically validate the predicted performance of derived optimal stocking policies;

6. Finally, there are many interesting areas for implementation study in the logistics structure area; we outline just a few of these relating to vanning options, advance diagnostics, and size and location changes of certain major, regional stocking facilities.