MIT SCALE RESEARCH REPORT

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Classification of SKUs as a Way to Improve Company Performance:
A Case Study from the Telecommunication Industry
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KEY INSIGHTS

1. Inventory classification is able to provide benefits for the company via treating heterogeneous items in a different way.
2. Different classifications produce diverse results, which affect company performance in terms of costs associated with inventory.
3. There is no the “best” classification method. As assumptions and conditions change, different classifications outperform each other.

Introduction

Inventory being an integral component of operations of virtually every company has been a matter of great concern and increasing attention in the academic and business world for the last few decades. Indeed, carrying high levels of inventory incurs financial and operating costs undesirable for any company. However, for the companies functioning in certain industries, the issue becomes a matter of vital importance.

The present Thesis Project is sponsored by company named TeleCo (a fictitious name was used in order to hide the company’s true identity) that operates mainly as an Internet, mobile network and cable television provider. The nature of these operations implies rendering repair services, and therefore, carrying a certain level of spare parts inventory.

Companies operating in the telecom industry are required to have as a high service level as possible. Indeed, the outcomes of shortage of important spare parts can be disastrous for telecom companies, especially if institutions such as banks or hospitals are affected. This service constraint leads to carrying extremely high levels of spare parts, which in general are expensive. The resulting high capital cost moves companies in the opposite direction – towards lowering inventory level.

The dilemma described above poses the following challenge to TeleCo:

*How could the Company optimize the level of spare parts inventory given the service level in the telecommunication industry it operates?*

TeleCo holds a substantial number of spare parts, which are extremely heterogeneous in many ways. Naturally, this diversity requires applying different inventory policies, which is not realistic without appropriate spare parts classification. Hence, the
approach to inventory optimization without hurting customer service level would be multicriteria classification of spare parts.

First, we applied four classification methods to the data sample obtained from TeleCo and illustrated the disparities of classification results across different approaches. Our next step was the investigation of the impact that different classifications have on the total cost associated with inventory. Further, the sensitivity of total cost was examined while changing different assumptions. The final step was determining the optimum classification for the data sample under study.

Classification

We applied seven criteria in order to classify the sample of 109 spare parts obtained from TeleCo. The criteria included price of spare part, total demand, variation of demand across different regions, mean of lead repair time, coefficient of variation of lead repair time, criticality, and accuracy of replacement.

Four classification methods were employed, specifically, ABC analysis, multicriteria ABC-based classifications using Analytic Hierarchy Process (AHP) and weighted linear optimization (so called Ng model), and cluster analysis.

ABC analysis is a simple and widely applied technique in the managerial world, which is based on 80/20 Pareto law. The law states that 20% of SKUs (class A items) generate 80% of dollar usage, which is a product of price and annual demand. However, it is often criticized for employing only a single criterion, namely, annual dollar usage, and therefore ignoring other crucial aspects worth being considered.

Multicriteria ABC-based classifications fill the gap, introducing several criteria into the analysis. One of the main issues with the methodology is criteria prioritizing or assigning weights to each criterion. The problem was solved by using the AHP approach, which is based on pair wise comparisons of criteria by decision makers. The alternative solution was obtained by applying the linear weighted optimization model in order to get weights for each criterion.

Clustering is a statistical method that is often regarded as a form of classification. The goal is that the objects within the groups be similar to each other, and different from the objects in other groups. We used the SPSS software package in order to obtain three clusters which were further approximated to A, B and C groups.

We found out that all classifications produce different results, which are illustrated on the Figure below.

Total relevant cost (TRC)

In this paper, we considered inventory holding cost, shortage cost, review management cost, and transportation cost as a total relevant cost (TRC) to determine the impact of each classification method on management performance. Also, several assumptions were made, including both endogenous and exogenous assumptions. Under current assumptions, the total relevant costs are seen below.

TRC simulations with endogenous assumptions

The simulations about endogenous assumptions, which managers can change, allow managers to easily find where the total TRC has the lowest value. The endogenous assumptions include review periods, service level, and transportation modes. First of all, the review periods for group A items should be 2 or 3 weeks depending on the classification methods, while those for group B should be 3 or 4 weeks, and those for group C 3 or 4 months. (Green shaded cells represent the lower cost, while red cells the higher cost.)
As for the service level, under current assumptions, the spare parts with ‘H+’ and ‘NBD/E’ criticality should have 99% of service level while those with ‘NBD’ 96% under current assumptions. This is mainly because the impact of penalty constant currently assumed is much higher than that of inventory holding cost, which is resulting from the attribute of telecom industry – “always on service”. When the assumptions about penalty constants are relaxed while increasing the inventory holding cost, the optimal set of service levels can be changed.

When it comes to transportation modes, once classification methods are introduced, then it is easier to apply aggregate orders because different review periods and policies can be applied to the company’s inventory. As an example of this, the Ng model can have the lowest cost if group A items are delivered by ground parcel and group B and C items by less-than-truckload.

**TRC simulations with exogenous assumptions**

The simulations about exogenous assumptions, which managers cannot choose, can make it easier to predict what classification method will be the best under given situations, which accordingly allows managers to properly cope with future changes in advance. These exogenous assumptions include the inventory holding unit cost, the labor salary, and the transportation cost.

There can be a trade-off between inventory holding cost and salary for those in charge of inventory review activity, because frequent review usually lowers the inventory level and increases the labor cost. If other assumptions stay the same, the Ng model has the best management performance and a quite stable position regarding changes in the salary level. Also, the Ng model yields the lowest cost regardless of the inventory holding cost.

Unlike that of the salary and the inventory holding cost, the simulation results of transportation costs show unstable patterns of the best classification like the Figures below. First of all, if the variable cost of the air parcel service is low, then the current method, in which TeleCo orders spare parts whenever one item is used, is the best. This is because there is no reason to aggregate procurement orders. However, as the variable cost of the air service increases, the probability that the current situation would be the best decreases.

**Conclusions**

Our research started with the belief that classifications of spare parts can provide TeleCo with the opportunity to reduce the total relevant cost, like the transportation cost, without hurting the service level because different decisions on the inventory can be made by the classification segment.

This paper introduced several classification methods to TeleCo, including not only the ABC method but also the multicriteria classification methods such as the AHP, the Cluster, and the linear optimization model. The reason why multicriteria classification methods were introduced is that the ABC method cannot perfectly reflect the attribute of the telecom industry – ‘always on’.

After that, the impact of each classification method on the management performance was examined to see which one can have the lowest total relevant cost. On top of that, several simulations about how the total relevant cost and the best classification method vary were conducted by applying different levels of assumptions.

One of implications from the findings of this research is that there is not ‘one best’ classification method that can be applied for all industries or for all situations. Therefore, managers have to revise the company’s classification of spare parts and to examine this impact regularly. In addition, many papers regarding classification usually compare only the different grouping results of classifications, but do not consider the management impact. In this sense, this paper can make a contribution to the field of classification research.