Inventory control of Finished Goods for the Aftermarket

Sercan Eminoglu, Joan Esteve Magrané
Lund University, Faculty of Engineering, LTH
Division of Production Management

Abstract
Selling spare parts to the Independent Aftermarket (IAM) segment differs a lot from supplying Original Equipment Manufacturer (OEM) which has been TitanX traditional business. The orders in the IAM segment are smaller, more unpredictable and no good forecast is given by the customers. Servicing the new customer segment thus constitute new challenges for TitanX. At a first step they see a need for an improved forecasting method and system for inventory control. This project aims to provide these tools which given the demand structure of the IAM is inherently difficult.

Background
TitanX Engine Cooling is a global supplier of powertrain cooling solutions to commercial vehicles, both for OEMs and the independent aftermarket. The company with annual sales of over 1.6 billion SEK (US$ 192 million) has some 800 employees worldwide. TitanX is headquartered in Gothenburg, Sweden and has manufacturing sites in Sweden, USA, Brazil, China and Mexico.

Its manufacturing facilities are designed and operated with a strong and continuous application of lean manufacturing principles, and they perceive themselves as a very flexible supplier. The production sites have a high level of vertical integration, including the manufacturing of key critical components to ensure the highest quality results. The production operations are continuously adjusted to meet variations in customer demand. The vision is to be the number one global supplier of powertrain cooling solutions to the commercial vehicle industry.

The facility in Sölvesborg consists of three zones; a raw material warehouse, a shop floor, and a finished goods warehouse. TitanX generally keeps high inventory levels of raw material and finished goods. An important reason for this is the marketing strategy to increase the current market share above 30% of the independent aftermarket for truck engine cooling systems. Therefore, high customer service levels and good availability are key performance measures that drive high production rates and stock levels.

Purpose
The purpose of the degree project is to analyze the finished goods inventory for independent aftermarket products to provide both more accurate forecasting methods and a scientific approach for controlling these inventories by finding the reorder points for a given service level and considering trade-offs
between the production lead times and the safety stock needed for those.

**Methods**

Liebermann & Hillier (2001) described all the major phases of a typical operations research (OR) modeling approach used to conduct the research in this project.

Quality assurance was conducted using a process of validation and verification based on Banks, Carson II, Nelson, and Nicol, (2005)

Data collection was conducted using semi-structured interviews, direct observation, literature review and data provided by the company.

By using those, a new forecasting model and inventory control tool have been developed and the results have been compared to the older model currently used by the company to observe the level of improvement obtained.

**Research questions and results**

The two research questions are:

- RQ 1. How to forecast the demand of independent aftermarket products with sporadic patterns?
- RQ 2. How to control inventory levels of the same group of products?

For RQ 1, the article by Syntetos et al. (2005) also referred in the spare part management book by Altay and Litteral, (2011) was the main source used to choose the categorization scheme and forecasting methods. There are some instances where in the given period the old model provides a better forecast, which can be explained by the stochastic nature of the demand. Generally, the new model is better, and the average decrease in forecast error is 21.2%.

For RQ 2, the inventory control book by Axsäter, (2006) was the main source for the calculations of reorder points and safety stock. The new inventory control tool provided in this project is a clear improvement over previous practices by the company, since an inventory control tool that provides automatic reorder points/safety stocks by considering the desired service level and batch size and reading the output coming from the forecasting tool was not available in the company previously. This new tool will reduce total safety stock values by 59% which translates to 279,783,5 €/year.

**Summary**

This thesis applies the existing scientific approaches in the field of spare part management to create a new forecasting and inventory control tool, improving the methods previously implemented by the company. This solution improves automatization, lowering the efforts in production planning, provides more output information and can also be adapted by other companies.

**References**

**Methods:**


**Demand categorization and forecast:**

Altay, N., & Literal, L. (2011). *Service Parts Management, Demand Forecasting and Inventory Control.*


**Inventory control:**