Inventory management in a customer landscape with diverse requirements on flexibility

A case study at Atria Sweden AB

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2019-06-17

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The role of inventory management is of increasingly large importance in the supply chains of modern organizations. There are large improvements to be made in inventory costs as well as facilitating service goals of companies towards their customers. Utilizing a scientific method for inventory control can be very advantageous for the organization. This paper presents an inventory management model that was developed during this master thesis project. The goal of the model is to manage the analyzed products and facilitate set service goals with as little inventory as possible.

Introduction
It is easy to be confused as a manufacturing manager these days, they are overwhelmed by manufacturing tools and philosophies from books, web sites, courses and other sources. Many manufacturers often describe their own manufacturing using buzzwords such as MRP, JIT, TQM and BRP. The issue with this development is that these buzzwords attempt to sell a single solution for all situations. It is of value for manufacturing managers to view their processes holistically. This allows for a logical foundation for problem solving in operations and production management (Hopp and Spearman, 2008).

Atria Oyi is a Finish food industry company, their market is divided into four areas: Atria Finland, Atria Sweden, Atria Denmark & Estonia and Atria Russia. The focus of this work is Atria Sweden, a food manufacturer with their core focus on meat products, cold cuts, convenience food, poultry products and vegetable & fresh delicatessen products. Of these products the cold cut category is manufactured for both the Swedish and Danish markets with certain brands dedicated to each of the two markets. More specifically this study will focus on Atria’s factory in Malmö. As a manufacturer of food products, Atria has high customer requirements on their products regarding shelf-life and service levels.

Despite the proximity, Swedish and Danish markets are different in terms of customer requirements. Additionally, Atria uses different manufacturing strategies for these two markets. Swedish products are handled with a make to stock (MTS) strategy, Danish products are handled mostly with a make to order (MTO) manufacturing strategy. The reason being, Swedish demand is more frequent and forecasted much more accurately than demand from the Danish market. One problem that occurs with the MTO strategy is that occasionally orders exceed manufacturing capacity. Atria wants to increase their flexibility in order to meet their targeted service levels for the Danish market.
Thus, the purpose of this study will be to investigate the current production planning and inventory management processes at Atria’s factory in Malmö and suggest improvements. The goal is to better meet the targeted service levels with as little inventory as possible.

**Methodology**

This study was performed in two steps; Process Analysis and, Operations Research Modeling. The process analysis steps were used to identify where improvements can be made for flexibility and operational performance. Then the operations research modeling approach is used to analyze the current performance and then improve these identified areas and provide a useful model for the company.

The process analysis was conducted by mapping the manufacturing and inventory management processes. Qualitative data was gathered for this analysis mainly using semi-structured interviews and observations.

The operations research modeling approach was based on the six phases described by Hiller and Lieberman (2010). These six steps are: Defining the problem and gathering data, formulating a mathematical model, deriving solutions from the model, testing the model, preparing to apply the model, and implementation. However, the two last steps are considered outside of the scope of this master thesis. Therefore, only the first four steps will be followed.

**Theoretical Framework**

For this project, scientific literature in operations research, production management and inventory management will be used.

When applying an operations research model, there are four major concerns; feasibility, optimality, sensitivity and implementability. Essentially questioning if it is plausible, if it is the best solution, if the unknown happens – what then, and lastly if the acquired solution is possible to implement (Eiselt and Sandblom, 2013).

In most supply chains there are measures to counter the inherent uncertainties of demand. Safety stock continues to be the most common measure. However, uncertainties in demand can directly be reduced by increasing the information shared through partners in the supply chain (Karaesmen, Buzacott and Dallery, 2002). Often there is some form of information on future demand often through forecasts or through supply chain contracts. Advance order information refers to early commitments to orders from customers this type of early information enables companies to achieve better service performance and keeping lower inventories.

In order to correctly place the inventory of each product the customer order decoupling point (CODP) is commonly used (Hoekstra, Romme and Argelo, 1992). This point refers to the place in the supply chain where value adding processes switch from being based on forecasts to being based on customer orders (van Donk and van Doorne, 2015).

This study proposes the implementation of an (R, Q) inventory policy. When using an (R, Q) – policy an order is made as soon as the inventory position (IP) reaches the reorder point (R). A replenishment order is sent to raise the IP to a level above R. The size of the replenishment order is the order quantity (Q). The replenishment order may also be the smallest number of integers of Q in order to reach an IP larger than R (Axsäter, 2006).

The service level measurement used in this master thesis is fill rate. The definition of
fill rate is “the fraction of demand that can be met immediately from available stock” (Axssäter, 2006). It is common that this service measurement is calculated assuming a normal distributed demand. However, for this thesis the demand will be assumed to be continuous and gamma distributed.

**Empirical Data**

Atria has set service goals for all their products of 98%. This study analyzed 8 products designated for the Danish market and the three different storage locations in Malmö. Products are stored in three stages in the manufacturing process, these are; raw material, semi-finished goods, and finished goods.

Information regarding the lead times and production processes of these 8 products were gathered through semi-structured interviews and Atria’s historical demand, inventory and production data. While most of the products pass through similar manufacturing steps, the total lead time for the products vary between 3-10 days. Additionally, the analyzed products have differing shelf-lives depending on where they are in the supply chain. Generally, products have a significantly longer shelf-life in the raw material warehouse and in the semi-finished goods warehouse. All products are allowed in the finished goods warehouse for a maximum of 5 days.

**Conclusions**

After mapping the process of each of the Danish products the CODP could be placed for each of the products. The results show that all but three of the studied products should be manufactured directly from customer orders or MTO. This means that Atria should have the required flexibility to handle most of the Danish products with an MTO strategy but not all of them. The three other products need to be manufactured with an MTS strategy where they are stored in the semi-finished goods warehouse. This also means that these products must have an inventory management policy that allows them to achieve the set service goals of 98%. Therefore, these three products were further analyzed with the semi-finished goods warehouse. Analysis of these three products showed that only one of them had managed to satisfy the set service requirements while the other two fell short of this goal.

A mathematical model was developed, in order to calculate the resulting fill rate (service level) of the products. This model was developed assuming a continuous gamma distributed lead time demand for the three analyzed products. The model resulted in values of R (with values of Q obtained as the mean historical replenishment order from Atria) to implement in order to reach the set goal of 98% service for these products. This result was also tested using a historical simulation in Excel. The historical simulation was set up to test “What service would be achieved in 2018 if this inventory policy were implemented”.

The results from the historical simulation showed that the mathematical model accurately predicted the resulting service levels. A sensitivity analysis was also conducted which tested the model with several optimized values of R and Q. The sensitivity analysis strengthened the conclusion that the mathematical model is robust and could predict the service levels. The historical simulation did not use a forecasting model. Therefore, the values of R would remain static during the simulated year. While the targeted 98% service were reached in the simulation, the static values of R would mean that service would be worse during certain periods of the year when demand is higher. And service levels would be higher during periods with
relatively low demand. If this model were to be implemented at Atria, it is recommended that the mathematical model is used in conjunction with a forecasting tool and updating the level of R periodically. This would raise the value of R if demand is forecasted to be high and lower the value of demand is forecasted to be lower.
References


