Controlling Inventory Levels of Selected Items
Case Fiskars Group

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Inventory management has become increasingly more important for companies aiming for high-end supply chain management. In the case company as well, there has been continuous discussion about inventory level management and reduction. Thus, a study was conducted to estimate the inventory value reduction possible to be achieved in the case company by altering the inventory steering model of selected items.

The aim was to find answers to questions “Which inventory steering model is more suitable for selected items in the case company: Push or Pull?” and “How much can the inventory levels be decreased without a negative effect on availability by altering the inventory steering model?” This was done using the case study approach and simulation as a research tool.

The theoretical basis was established at the beginning of the study and deepened throughout the process.

The implementation of the study began with inventory analysis of the initial inventory status. A simulation was conducted to imitate the inventory level development after changing the inventory steering model from push to pull steering. Calculations were done based on the values given by the simulation.

The simulation was successful and provided a result for both research questions. Based on the result of the simulation and the calculation made based on it, a recommendation for future action was made for the case company.

Keywords/tags (subjects)
Inventory management, purchasing, inventory steering model, push inventory steering, pull inventory steering, case study.
## Controlling Inventory Levels of Selected Items

**Tutkinto-ohjelma**  
Bachelor's Degree Programme in International Logistics

**Työn ohjaaja**  
Juha Sipilä

**Toimeksiantaja**  
Fiskars Group

### Tiivistelmä

Varastotilanteen tärkeys on kasvanut yrityksille, jotka tähtäävät korkealaatuiseen toimintatukseen hallintaan. Myös kohdeyrityksessä on ollut jatkuvaa keskustelua varastotilanteesta sekä alentamisesta. Tämän vuoksi tehtiin tutkimus jolla arvioidaan mahdollisista varastotilanteen muuttamista varastotilanteessa sekä varastotilanteen alentamisesta.

Tavoitteena oli löytää vastaukset kysymyksiin “Kumpi varastotilanteen tärkeyden säätely on varastotilanteen hallintaan? Myös kohdeyrityksessä on ollut jatkuvaa keskustelua varastotilanteesta sekä alentamisesta. Tämän vuoksi tehtiin tutkimus jolla arvioidaan mahdollisista varastotilanteen muuttamista varastotilanteessa sekä varastotilanteen alentamisesta.”

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### Teoriapohja


Simulaatio oli onnistunut, ja tarjosi tuloksen molempia tutkimuskysymyksiä varten. Simulaation tuloksen sekä sen pohjalta tehtyjen laskelmien perusteella kohtellessaan suosituksia tulevat toimintaa varten.

### Avainsanat

Varastotilanteen hallinta, hankinta, varastotilanteen tärkeyden säätely, työntö-malli, veto-malli, tapaustutkimus

### Muut tiedot

Muut tiedot (saliassa pidettävät liitteet)
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Vocabulary

**ABC-analysis**: A classification of stored goods executed based on their importance evaluated according to the Pareto principle (Arnold, Chapman, & Clive 2012, 208).

**ADU**: Average daily usage; calculated by pointing out the maximum daily demand from a rolling lead time demand. Used in DDMRP control area calculations. (Ptak, & Smith 2016, 97.)

**DLT**: Decoupled lead time. Used in DDMRP control area calculations. (Ptak, & Smith 2016, 97.)

**EOQ**: Economic order quantity; a fixed product-specific order quantity which is calculated to minimize total costs (Waters 2004, 66).

**Forecasting**: A supply chain decision made before demand has realized. Forecasts are never accurate. (Chopra, & Meindl 2013, 190.)

**Inventory / Stock**: Used interchangeably in this Thesis. Referring to unsold items waiting for sales (Inventory 2018).

**KPI**: Key performance indicator; a metric to evaluate performance comparing to strategic goals, directly influencing their achievement (What is a Key Performance Indicator (KPI)? 2018).

**Lead time**: The amount of time between the recognition of a need for an item and its fulfillment (Gopalakrishnan, & Haleem 2015, 271).

**MOQ**: Minimum order quantity; the smallest amount of units a supplier is willing to produce of an item at a time. MOQs are defined by the supplier, and they usually depend on the production cost of each unit. (Lazazzera 2018.)

**MRP**: Material requirements planning; an inventory management system utilizing bill of materials, current inventory, and lead times to plan future material flow (Arnold, Chapman, & Clive 2012, 352).

**OC**: Order cycle. Used in DDMRP control area calculations. (Ptak, & Smith 2016, 97.)

**Optimization**: Making something as perfectly functional and effective as possible (Optimization 2018).
**Pareto principle**: A small number of items are responsible for the majority of results. States that approximately 20% of the items account for 80% of the results, 30% of the items for 15% of the results, and the remaining 50% of the items for 5% of the results. ABC-analysis is based on these figures. (Arnold, Chapman, & Clive 2012, 208.)

**Research**: A study to discover new information or deeper understanding of a matter (*Research* 2018).

**Safety stock**: The predefined level of stock intended to prevent stockouts caused by variation in supply, demand, or lead time (Rushton, Croucher, & Baker 2014, 203).

**SCM**: Supply chain management; the active management of supply chains aiming for their effective and efficient development and operation (*What is Supply Chain Management (SCM)*? 2017).

**SKU**: Stock keeping unit; the identification code for a service or product to help keep track of their inventory. SKUs are company or store specific, and the alphanumeric code often contains information about the product, such as model, color, or material. (*Stock Keeping Unit – SKU* 2018.)

**Supply chain**: The process controlling and operating the flow of goods from the suppliers to the consumer, including product development, production, procurement, and logistics. (*Emmett* 2008, 1; *What is Supply Chain Management (SCM)*? 2017.)

**Vendor / Supplier**: Used interchangeably in this Thesis. A company providing goods or services to a buying party (*Supplier* 2018).

**VMI**: Vendor managed inventory; where the supplier holds inventory at the premises of their customer. The supplier bears the responsibility of ensuring appropriate inventory levels, which requires open information sharing between the supplier and the customer. Works best for items with relatively stable demand. (*Emmett* 2008, 103.)
1 Introduction

It is not uncommon for companies to face challenges with defining optimal production and order quantities, safety stock levels, and other inventory aspects affecting on total supply chain costs and profitability. Thus, inventory management is becoming continuously more important in order to achieve first-rate supply chain management. (Talluri, Cetin, & Gardner 2004.)

1.1 Research and Data Collection Methods

When conducting research, it is vital to choose an appropriate research strategy to ensure a successful project. The strategies should be compared by their suitability and feasibility for the research in question. Some examples of different research strategies are surveys, case studies, experiments, and action research. (Denscombe 2010, 4-5.)

A survey, for instance, measures specific aspects of phenomena and aim to collect facts to test a theory. An experiment, on the other hand, aims to identify causes and reasons by observing the effects of particular factors. (ibid., 5-6.)

A case study focuses on only one or few instances of the thing to be studied. This sets case studies aside of many other mass studies. The aim of a case study is to gain specific knowledge of the matter and illuminating general phenomena by examining particular instances. (ibid., 52-53.)

1.2 Research Questions

The research questions for this Thesis are as follows:

Which inventory steering model is more suitable for selected items in the case company: Push or Pull?

How much can the inventory levels be decreased without a negative effect on availability by altering the inventory steering model of selected items?

This Thesis will not cover handling costs, which can be defined as the cost of keeping inventory for the period of one year (Andriolo, Battini, Grubbström, Persona, &
Sgarbossa 2014, 18). Rather, the Thesis will focus on inventory value and its development.

In addition, this Thesis will before all focus on analyzing inventory steering models and their impact on inventory management. The aim is not to decrease inventory levels by decreasing variation, lead times or minimum order quantities per se.

1.3 Case Company: Fiskars Group

Fiskars was founded in 1649 as an ironworks and is currently the oldest company in Finland. Fiskars Group consists of several global brands in addition to Fiskars itself, such as Iittala, Gerber, and Royal Copenhagen. (From 1649 to the Present 2017.)

Figure 1 below shows how the Fiskars Group organization is divided into two strategic business units (SBUs), Living and Functional. SBU Living focuses on tabletop and giftware items, and SBU Functional on tools for in- and outdoor chores. The SBUs are further divided into sections, which are divided again into controlling areas. Above all these functions is the president and CEO leading the company together with the Fiskars Group Leadership Team, and below is the supply chain and supporting functions ensuring efficient and smooth operations. (Fiskars Organization 2017.)

![Figure 1 Organization Structure, Fiskars Group](Fiskars Group, adapted with permission.)
Fiskars Group has products available in more than 100 countries worldwide. From Figure 2 below, it can be seen that the sales of Fiskars Group are mostly divided between Europe and Americas, with a small portion coming from Asia-Pacific. The total sales have increased since 2014, with most of the growth taking place in the Americas and Asia-Pacific markets. According to these statistics, the sales in Europe seem quite stable. (Key Figures 2017.)

Figure 2 Net sales by geography, Fiskars Group (Key Figures 2017.)

In 2017, Fiskars Group recorded 1 185.5 million euros in net sales and employed approximately 7 900 people in over 30 countries. Fiskars is listed in Nasdaq Helsinki. (Introducing Fiskars 2017.)
1.4 Background and Objectives

The aim of this study is to reduce inventory levels without negative effects on availability. In the case company, there has been continuous discussion regarding the inventory levels and how to lower them.

For many companies, inventory is one of their largest investments. Therefore, proper inventory management has a significant role in the performance and productivity of a company. Too high or early inventory levels may cause unnecessary handling and holding costs as well as an increased risk for damages. On the other hand, too low or late inventory levels can result in poor customer service, losing sales and several indirect costs from delivering orders too late. (Piasecki 2009, 7.)

1.5 Structure

This study was conducted using the case study strategy, and the research questions have been approached via simulation. If the inventory planning model had been altered in real life, the effects would not have been seen during the first months. Due to long lead times and unstable demand, the actual results of a strategy change could most likely be seen in the inventory levels after 12-18 months. With the use of simulation, the steering models can be compared immediately without the need to experiment and wait for the results in practise.

2 Theoretical Basis

In this chapter, a brief introduction to the theory of simulation as a tool in research will be presented. In addition, inventory management will be examined with more extent, including an overview to reasons behind keeping inventory, its challenges, and various inventory steering models.

2.1 Simulation

A simulation can be defined as an animated model imitating the operation of a functioning system or process. Simulation as a tool allows one to see the things happen-
ing in a process while time progresses. Since the speed of the simulation can be adjusted, it is possible to simulate long periods of action in a matter of seconds. (What is Simulation? 2018a; What is Simulation? 2018b.)

Generally, all systems involving a process flow with actions are suitable for simulation. The systems including most variation in its factors can be expected to gain more benefits from simulation than stable and predictable systems. (What is Simulation? 2018b.)

Since simulation can be made to match reality with great accuracy and they provide results in a very short time, it is possible to test the simulated process several times repeatedly and make different alterations before applying the changes in practice. This enables the possibility to estimate long-term effects of changes as well. In addition, the modifications can be made several times in the exactly same circumstances, which is very hard to do in practice. (What is Simulation? 2018b; Why use simulation modeling? n.d.)

Instead of using average values, simulations utilize non-standard distributions defining specific values for each event, and random events can be included in simulations as well. This results in outcomes representing the reality better than with the use of solely average values. (What is Simulation? 2018b.)

Simulating different scenarios can increase the efficiency of the processes significantly faster than testing the alternatives in practice immediately, since errors can be spotted and corrected already in the simulation without any physical damage or losses. Since experimenting in practice often carry a wide range of potential costs, simulation provides a highly safe and efficient method of testing changes without the risk of costly mistakes. (Why use simulation modeling? n.d.; What is Simulation? 2018b.)

2.2 Inventory Management

Stock is needed in between demand and supply, but it is often found as a safety factor as well. Inventories can be used to cover for errors or variance in for instance supplier performance and demand forecasting. (Emmett & Granville 2007, 1.)
Inventory can be divided into raw materials, work-in-process (WIP), finished goods, and consumable stock. Raw material includes also the parts and components needed to assemble the end product, whereas WIP refers to unfinished goods in need of some additional handling. Finished goods stock means the items ready to be sold, and the consumable stock refers to materials consumed indirectly during the manufacturing process. (Emmett & Granville 2007, 2-3; Monczka, Handfield, Giunipero, & Patterson 2009, 587.)

Inventory can also be built in advance to prepare for seasonal sales, or to receive discounts of larger purchase quantities. It can be used as a service via safety stocks ensuring availability as well. Inventories ensure continuity in production by preventing parts of the process breaking down due to material or equipment shortages. (Emmett & Granville 2007, 1; Inventory 2018.)

2.3 Sourcing structures

Four different sourcing structures are mainly in use: single, multiple, delegated, and parallel sourcing. Single sourcing describes the structure with only one supplier for an item, which is a situation that can be created by choice or lack of options. In case there is only one supplier to be considered when choosing suppliers, it is referred to as sole sourcing. (Cousins, Lamming, Lawson, & Squire 2008, 52.)

Multiple sourcing is described when the supply of an item is secured from multiple suppliers. Usually competition in this structure is based on pricing, and it is frequently used to enhance competition in the market. Delegated and parallel sourcing are more modern sourcing structures, involving several parties and more complex processes. (ibid. 53-54.)

2.4 Inventory Steering Models

The following chapters are to introduce and compare some popular inventory steering models. The more traditional systems, including re-order point planning, can be referred to as push systems, since they are used to build stock in anticipation of demand as a buffer between supply and demand. In pull systems, on the other hand, the actual demand for an item is used to pull the goods through the supply chain to meet the
customer demand. Push systems utilize EOQ and are proactive, whereas pull systems are reactive. (Rushton, Croucher, & Baker 2014, 219.)

Forecasting plays a significant role in Push inventory steering. In this model, companies try to predict what items will be sold and in what quantities. The aim is then to produce or purchase enough goods to cover the forecasted demand. One of the major challenges with Push inventory steering is the common inaccuracy of forecasts due to variation and unpredictability in sales. This may lead to unnecessary inventory increasing the total inventory value. However, using this model tends to ensure high availability due to the tendency of high inventory levels. (Hunt 2018.)

Pull models have less dependency on forecasting since the process always begins with a customer order. The aim is to purchase or produce only the sold quantity, minimizing the risk of overstock. (ibid.)

2.4.1 Push: Re-Order Point-Planning

As Boothe (2013) states, re-order point inventory steering involves defining a safety stock level and a re-order point for all items, suitable to their demand and lead time. All items are calculated a re-order level, and when the inventory reaches the re-order point, a purchase order should be placed to avoid stockout. They also present a common formula used to calculate the re-order point, shown below.

\[
\text{Reorder Level} = \text{Safety Stock} + \text{Average Daily Usage} \times \text{Lead Time}
\]

In this model, order quantities are fixed in addition to the re-order level, often utilizing EOQ (Order Point System 2012). An illustration of inventory development in a re-order point inventory steering model can be seen on the next page in Figure 3.
2.4.2 Pull: Kanban

Kanban is a highly simplistic demand driven inventory steering model. Instead of system data, Kanban relies on visual signals indicating the need for replenishment. This results in high suitability for instance for factories and production facilities, where the supplier of the goods or main warehouse is nearby. A crucial step in implementing Kanban is to define the Kanban quantities for the items, which defined the fixed replenishment quantity. (Kanban Replenishment n.d.)

Kanban is often implemented with the help of a Plan-Do-Check-Act cycle. Said tool ensures that data is collected, and preparations made thoroughly, followed by implementation of the plan. The operation is then checked, reviewing the results of the implementation, leading to improvements and further actions based on the analysis. (Lyles 2018.)

2.4.3 Pull: Lean & Just-In-Time

Lean inventory management focuses on reducing waste across the supply chain. The model distinguishes seven core wastes to minimize: inventory, waiting, transport, motion, overproduction, over-processing, and defects. By reducing these wastes as much as possible, the supply chain should become more efficient and cost-effective than previously. (7 Wastes of Lean Manufacturing 2018.)

Just-In-Time (JIT) manufacturing is used to minimize waste and maximize efficiency by targeting zero inventory as well. The core of JIT is to receive goods precisely when
they are needed, neither before nor after they are required. The major risk of JIT is disrupting the supply chain. In case a single item arrives late or with unacceptable quality, the entire production may be interrupted or delayed noticeably, which can lead to significant additional costs. *(Just In Time – JIT 2018.)*

Even though the key target for both Lean and (JIT) is to minimize inventory, there is often some form of safety stock in use to ensure continuity. These two inventory steering models are so similar that the terms are occasionally used interchangeably, even though there are slight differences in their viewpoint of inventory management. *(4 Lean Inventory Management Best Practices 2018; The Principles of Lean Inventory Management 2018.)*

### 2.4.4 Pull: DDMRP

Demand Driven Material Requirements Planning (DDMRP) is an inventory steering model combining aspects from several other steering models, including MRP and Lean. The implementation process consists of the five steps visible in *Figure 4 below.* *(Demand Driven MRP – The future of MRP n.d.)*

<table>
<thead>
<tr>
<th>Demand Driven Material Requirements Planning</th>
<th>Strategic Inventory Positioning</th>
<th>Buffer Profiles and Levels</th>
<th>Dynamic Adjustments</th>
<th>Demand Driven Planning</th>
<th>Visible and Collaborative Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> (Re)Modeling the environment</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4* The five steps of DDMRP implementation process *(Demand Driven MRP – The future of MRP n.d.)*
The initial step is to define inventory decoupling levels, control points, and buffer levels, which indicate the inventory levels at which further action is necessary. After establishing the limits, it is crucial to re-evaluate the positioning and decoupling levels regularly, to ensure changes both in the past and future are taken into account.

The final steps are to plan operations according to these levels and executing the inventory management accordingly. DDMRP favors continuous improvement. A visualization of the replenishment buffers and control levels can be seen below in Figure 5. (Smith & Smith 2014, 58-59; Demand Driven MRP – The future of MRP n.d.)

![Figure 5 DDMRP Replenishment Buffers](image)

The green area dictates the order frequency and minimum size of each order. The yellow area is a safety buffer for inventory coverage, calculated by multiplying average daily usage with lead time. The red area is an embedded safety buffer, which increases as the variability associated with the item in question increases. There are several different ways to calculate the areas, some of which can be seen in Table 1 below, which continues on the next page. (Ptak, & Smith 2016, 97.)

<table>
<thead>
<tr>
<th>Formula example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Green area</strong></td>
</tr>
<tr>
<td>MOQ</td>
</tr>
<tr>
<td>DLT x ADU x lead time factor</td>
</tr>
<tr>
<td>KO × ADU</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Yellow area</td>
</tr>
<tr>
<td>Red area</td>
</tr>
</tbody>
</table>

Table 1 DDMRP area formulas (Ptak, & Smith 2016, 97.)

The lead time factor and variability factor are calculated based on the lead time in days and the level of variability. The green area can never be smaller than the MOQ of the item. (Ptak, & Smith 2016, 97.)

3 The Study

At the case company, overstock is currently described with terms Slow Moving Inventory and Excess Inventory. Slow Moving Inventory is defined as stock that lasts for at least the forecast of the coming six months. Excess Inventory then again refers to the stock covering the forecasts for at least the coming 12 months. In Fiskars’s own reporting, the stock value of already delisted items is also separated to their own category, Delisted Inventory.

From inventory management point of view, the overstock categories do not differ from each other. The value of the stock does not change when it changes for instance from Excess Inventory to Delisted Inventory, it is only reported and followed separately.

3.1 Inventory Analysis

The calculations and analysis for this Thesis are done for the inventory of four controlling areas in one strategic business unit. All calculations are done using value, not quantities. Currently the existing stock is divided between the four controlling areas as shown in Figure 6 on the next page.
Controlling area A is clearly dominating the inventory allocation of the business unit in question, with the share of 71%. Therefore, area A has the most influence on the total inventory value of the business unit in question. The inventory values are currently on quite similar level for controlling areas B and D, with their combined share of 25%.

Controlling area C equals for only 4% of the total inventory value of the business unit. Since this controlling area consists of a low number of SKUs, and most of them have a VMI stock with a very short lead time, the need for keeping inventory at the case company’s premises has been minimized. This can also be seen in the following figures (Figures 7-9) indicating how Slow Moving Inventory, Excess Inventory, and Delisted Inventory are currently allocated between controlling areas A-D.
As the share of controlling area C is 0% in all the previous figures, we can draw the conclusion that it does not need special attention regarding inventory management for now. Instead of focusing on controlling area C, there are several good reasons to focus on any of the three other controlling areas. For both controlling areas A and B, the inventory seems to be divided quite similarly, with 13-14% overstock, seen in Figures 10-11 on the next page. However, focusing on controlling area A could lead to more significant results due to its dominant share of the total business units inventory as seen in Figure 6.
The following figures (Figures 10-13) represent how the inventory of each controlling area is currently divided between the stock types. The inventory is divided into Normal, Slow Moving, Excess, and Delisted Inventory.

Figure 10 Inventory allocation of controlling area A

Figure 11 Inventory allocation of controlling area B
Controlling area D would also benefit from a stronger focus, even though its share of the inventory is only 11%. This is due to its exceptionally large overstock percentage, which also mostly consists of Excess Inventory. In addition, 52% of Delisted Inventory is caused by controlling area D, so a decrease in the Delisted Inventory of controlling area D would have a major effect on the total Delisted Inventory value of the entire business unit.

The inventory management of controlling areas A and D could provide most opportunities for improvement. Some interviews were conducted to research the cause for overstock of controlling area A. It was discovered that the overstock is caused
mostly by unstable demand. For controlling area D, on the other hand, the overstock is mainly caused by large MOQs compared to the demand as well as relatively long lead times.

3.2 Inventory Simulation

A simulation was conducted to give an estimation of the results of changing the used purchasing strategy. Currently the purchases in the case company are done using Push inventory steering, and the evaluated option is DDMRP.

The different key values used in demand driven inventory steering at the case company can be seen in Figure 14 below. The inventory limits can be seen as the red, yellow, and green areas. Those represent safety stock, goods in transit (GIT), and consumption, respectively.

![Figure 14: Demand driven steering visualisation](image)

The reorder point is on the level where the green area meets the yellow area. When the green line representing actual stock reaches the level of the reorder point, a new purchase order should be placed. The yellow area shows the expected consumption during the lead time after placing the new order and before receiving the goods. On the bottom, the red area acts as a safety buffer for situations of unexpected sales or delays in delivery.
When placing purchase orders for the goods, the order quantity should be set so that the maximum stock level, which is on the top level of the green area, would not be exceeded. This means that ideally the actual stock plot would move mostly within the green and yellow areas. In the figure however, the item in case suffers clearly from constant overstock, as the green line is continuously higher than the maximum stock level.

In the simulation, all the items within the four controlling areas were changed to use DDMRP, and the individual control values were altered until the limit value was found for minimum stockouts with minimum inventory value. The items are not evaluated on SKU level in this study, only on supplier level, to maintain clarity.

The simulation tool is basing the simulation on deliveries of the previous year, from where there is daily information available regarding deliveries and inventory levels. However, the inventory levels of the previous year are based on a purchasing model relying on forecasting, which may have an effect on the results.

The simulation is using the values from the previous year to experiment how the inventory levels would have developed during the previous year with DDMRP inventory steering instead of a forecast driven model. The simulation provides decoupling points for the green, yellow, and red areas. The simulation is conducted with the stockout limit set at zero, meaning impeccable availability.

4 Results

The simulation provides graphs showing the simulated warehouse level development during the following 12 months. An example of an item for which DDMRP suits very well can be found on the next page in Figure 15.
The result of the simulation is clear: Pull model would be more cost efficient than Push for this strategic business unit. When all items from all suppliers in all the controlling areas are changed to use DDMRP, the cost savings are simulated to be as shown in Table 2 on the next page.
In case the steering model change would decrease the inventory value of the items from one supplier the percentage is negative, and if the value increases the percentage is positive. Not all suppliers benefit from changing into Pull inventory steering, and there is significant variation between the suppliers and how lucrative the change in purchasing strategy would be. For instance, while the inventory value of the items from supplier R would dramatically decrease when using Pull inventory steering, the inventory value of items from supplier S would increase substantially.

Based on this simulation, the best solution would be to keep some supplier’s items in the steering model based on forecasting, and change the strategy for only selected items. To maintain essential clarity in the supply chain functions, it can be recommended that only one strategy is applied to all the items purchased from one vendor.

The optimal inventory savings would be accomplished by changing the items of the following suppliers into DDMRP as shown in Table 3 on the next page.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>(Simulated-Actual)/Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-20%</td>
</tr>
<tr>
<td>B</td>
<td>-33%</td>
</tr>
<tr>
<td>C</td>
<td>-59%</td>
</tr>
<tr>
<td>D</td>
<td>-29%</td>
</tr>
<tr>
<td>E</td>
<td>3%</td>
</tr>
<tr>
<td>F</td>
<td>-15%</td>
</tr>
<tr>
<td>G</td>
<td>-41%</td>
</tr>
<tr>
<td>H</td>
<td>2%</td>
</tr>
<tr>
<td>I</td>
<td>-40%</td>
</tr>
<tr>
<td>J</td>
<td>65%</td>
</tr>
<tr>
<td>K</td>
<td>100%</td>
</tr>
<tr>
<td>L</td>
<td>-45%</td>
</tr>
<tr>
<td>M</td>
<td>21%</td>
</tr>
<tr>
<td>N</td>
<td>-22%</td>
</tr>
<tr>
<td>O</td>
<td>-39%</td>
</tr>
<tr>
<td>P</td>
<td>5%</td>
</tr>
<tr>
<td>Q</td>
<td>-11%</td>
</tr>
<tr>
<td>R</td>
<td>-66%</td>
</tr>
<tr>
<td>S</td>
<td>198%</td>
</tr>
<tr>
<td>T</td>
<td>14%</td>
</tr>
<tr>
<td>U</td>
<td>69%</td>
</tr>
<tr>
<td>Total</td>
<td>-21%</td>
</tr>
</tbody>
</table>

Table 2 Total results
The direct business impact of this change would be the 32% decrease in the inventory level of the business unit in question. In addition, there are indirect results that could be expected as well - such as better availability leading to better customer service, which then again could increase sales and even the market share of the case company.

### Table 3 Positive results

<table>
<thead>
<tr>
<th>Supplier</th>
<th>(Simulated-Actual)/Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-20%</td>
</tr>
<tr>
<td>B</td>
<td>-33%</td>
</tr>
<tr>
<td>C</td>
<td>-59%</td>
</tr>
<tr>
<td>D</td>
<td>-29%</td>
</tr>
<tr>
<td>F</td>
<td>-15%</td>
</tr>
<tr>
<td>G</td>
<td>-41%</td>
</tr>
<tr>
<td>I</td>
<td>-40%</td>
</tr>
<tr>
<td>L</td>
<td>-45%</td>
</tr>
<tr>
<td>N</td>
<td>-22%</td>
</tr>
<tr>
<td>O</td>
<td>-39%</td>
</tr>
<tr>
<td>Q</td>
<td>-11%</td>
</tr>
<tr>
<td>R</td>
<td>-66%</td>
</tr>
<tr>
<td>Total</td>
<td>-32%</td>
</tr>
</tbody>
</table>

5  Analysis

Evaluating overstock in Pull model is not as simple as in Push. Since the limits are set with considering the MOQ and lead time, technically when looking at the graphs it looks like the items have never overstock in case the stock graph moves within the green and yellow areas. However, in case overstock analysis should be conducted, the best way may be to still compare the stock level with demand forecasts, in case they are available.

Fiskars Group uses only single sourcing for Supply Units B-D, and mostly single sourcing for Supply Unit A as well, with a few product groups as exceptions. For Supply Units B-D it is actually mostly sole sourcing, due to the high quality requirements of the case
company. Most of the suppliers that would otherwise be fit, do not have the capabilities or willingness to meet the quality standards. This leads to some vulnerability when it comes to ensuring continuous availability, since there are no back-up suppliers in case one is not capable to respond to the buyer’s needs.

Fiskars is not a big customer to all of its suppliers, which can create challenges as well. This means that there is no significant leverage when it comes to negotiating improvements or resolving issues. It also leads to challenges when trying to decrease the production lead time or otherwise strengthen the co-operation, since the supplier may not always prioritize the case company high as a customer.

5.1 Challenging Items

The inventory management of items with stable demand, high sales volumes, sufficient MOQs and reasonable lead times is quite straightforward. When the sales volumes are high, it is usually possible to create a continuous flow of incoming goods. This and a relatively short lead time increase flexibility, which results in more opportunities of additional short notice sales.

However, in case a product has a very long or unpredictable lead time the reaction time decreases significantly. This diminishes the possibility to react to any changes in demand, which could even lead to loss of sales. Since products with very low sales volumes also usually have quite low inventory levels, there is not much room for the sales to increase without stock running out.

If the goods are purchased based on forecasting, the forecast accuracy plays a significant role in inventory management as well. In case the forecast accuracy is continuously very poor due to varying demand, the safety stock levels need to be increased in order to avoid stockouts.

In addition, variance in product quality may cause some unexpected challenges that may be difficult and slow to react to. It is not always a quick or easy process to examine what the problem is, what has caused it, and how to fix it. This might lead to low availability and even stockouts if the product quality issue is not resolved quickly, or in case the production lead time is very long.
5.2 How to Decrease Overstock

Overstock can be a significant financial burden to a company, since it is unnecessary, and creates extra costs instead of advancing sales. After overstock has formed it is usually very difficult and slow to be disposed of.

Overstock is often formed when the sales volumes of an item are overestimated. In such a case, when the sales are already slow, it can be very challenging to boost the sales of the item in question just to decrease its overstock value. It is significantly easier to prevent overstock from forming in the first place, than trying to dispose of it when it already exists. However, if the demand is unstable and the lead time is long, inventory management gets more challenging and the risk of forming overstock increases.

Delisted inventory can also be hard to minimize. When an item is removed from the selection, it is usually because it is not selling well enough to be profitable. This means that the sales are already slow and after delisting, the sales will decrease even more. If there is overstock already at the time of delisting, the remaining stock might stay in the warehouse for a very long time causing mainly additional costs alone.

The absolute easiest way to minimize overstock is to remove variance entirely. If sales were stable and there was no variance in lead times or product quality, ensuring flawless availability with minimal overstock would be quite simple and easy. Unfortunately, this is never the case, and variance can never be eliminated completely.

6 Conclusions

Based on the study, re-evaluating the purchasing model and changing most of the items of the suppliers in this business unit will lower the inventory costs. It should not be overlooked, that this is only a calculation and simulation, and they have been conducted based on the figures of the previous year. The actual results that would occur after a change like presented in this Thesis cannot be guaranteed.

Since every year is different by countless factors, the actual cost savings may be also more or less significant than calculated here. However, this gives a rough estimate of
the direction, and can be used as reasoning when considering such a change in inventory steering strategy.

The actual results can only be seen in 12-18 months, due to the long lead time of several product groups in question. This is also the reason why this cost change was not calculated from real figures but simulated based on the values from the previous year.

The simulation could have provided more specific and accurate results if the SKUs would have been evaluated individually, instead of evaluating them on supplier level. However, when using DDMRP, the control limits need to be re-evaluated regularly. Managing the inventory and purchases of the items is significantly easier when one supplier only has one type of purchasing strategy in use, rather than some items being purchased based on forecasts and others not.

6.1 Recommendation

Based on the simulation my recommendation for the case company is to update the steering model of the items purchased from suppliers listed in Table 3 to Pull inventory steering model and keeping the rest in Push model. This way, maximum inventory level reductions can be accomplished with no negative effect on availability. A comparison of the possible following actions is presented below in Table 4, which continues on the next page.

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
<td>Continuing the use of Push inventory steering model</td>
<td>Changing all items to DDMRP</td>
</tr>
<tr>
<td><strong>Impact on inventory value</strong></td>
<td>Inventory value remaining roughly the same</td>
<td>Adequate inventory value reductions possible</td>
</tr>
<tr>
<td>Impact on operational supply chain activities</td>
<td>No change, remaining clear</td>
<td>Clear</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Table 4 Action comparison

Even though my recommendation is Option 3, implementing Option 2 instead would result in significant inventory reductions based on the simulation as well. In addition, Option 2 would most likely result in more clear supply chain activities, since only one inventory steering model would be in use. All in all, neither option is bad, but to accomplish maximum inventory value reductions I would recommend Option 3.

6.2 Reflection

While working on this Thesis, I truly understood how limited my knowledge and understanding of my field is. I have gained further perspective during the process of working on the Thesis and the final courses of my studies, and I firmly believe the outcome could be significantly improved if I only started the study now. Even though the result of my study would most likely be the same, the viewpoint could be slightly different and additional aspects could be included. However, I do think the Thesis is successful, since the research questions have been answered and a result has been found.
References


