

# Make or Buy Analysis on Partial Outsourcing of Inventory Management

Case: Nordkalk Corporation, Lappeenranta

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Abstract <p>The subject of the thesis was doing a make or buy analysis on partial outsourcing of a central warehouse for MRO goods, based on a real life case. The aim was to reduce the workload related to replenishing the inventory, and reducing inventory cost. The client of the thesis was Nordkalk Corporation, and more specifically their unit in Lappeenranta. Nordkalk Corporation is an international producer of limestone-based products. In Lappeenranta they have a quarry, processing facilities, factory service, and a sales office, and the central warehouse exists to support the activities of all the aforementioned.</p> <p>The analysis was based on general and inventory-specific outsourcing theory. Focus was held on three common inventory outsourcing models: continuous replenishment program, consignment stock, and vendor managed inventory. Nordkalk's existing situation was studied, and comparison was made against considerations emphasised in the theory.</p> <p>Several issues were found in Nordkalk's procedures when considering the advised prerequisites for outsourcing. On this basis the development suggestion was to not outsource. Instead, plans were created for improving internal procedures to improve the situation, and to better prepare for potential future outsourcing.</p>		
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Tiivistelmä  <p>Opinnäytetyön aiheena oli make or buy –analyysin tekeminen yleistarvikekeskusvaraston hallinnan osittaisesta ulkoistamisesta tosielämän tapaukseen perustuen. Tavoitteena oli vähentää varaston täydentämiseen liittyvää työmäärää, sekä laskea varaston arvoa. Työn tilaaja oli Nordkalk Oy Ab:n Lappeenrannan toimipiste. Nordkalk Oy Ab on kansainvälinen kalkkikivipohjaisten tuotteiden valmistaja. Nordkalkilla on Lappeenrannassa kaivos, tuotantolaitoksia, tehdaskunnossapito ja myyntipiste. Keskusvaraston tarkoituksena on tukea edellämainittujen toimintaa.</p> <p>Analyysi perustui yleiseen sekä varastokeskeiseen ulkoistamisteoriaan. Fokus pidettiin seuraavassa kolmessa yleisessä varaston ulkoistamismallissa: continuous replenishment program, consignment stock ja vendor managed inventory. Nordkalkin nykyinen tilanne kartoitettiin, ja sitä verrattiin teoriassa korostettuihin pohdintoihin.</p> <p>Nordkalkin toimintatavoista löytyi useita ongelmia verrattaessa niitä ulkoistamisen ennakkoehtoihin. Tämän perusteella ulkoistamista ei suositeltu kehitysehdotuksena. Sen sijaan luotiin suunnitelmat joiden avulla sisäisiä toimintoja pystyttäisiin parantamaan, ja samalla luotaisiin paremmat edellytykset mahdolliselle myöhemmin toteutettavalle ulkoistamiselle.</p>		
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## 1 Introduction

The topic of this thesis was the comparison of improving an entirely self-operated central warehouse for MRO items and spare parts to implementing partially outsourced models to improve the efficiency of the warehouse's functioning. The focus was on the management of fast moving low-cost items with minor strategic importance. The inventory management process was covered from purchasing up until the point of the items being collected by the end-user. The client of this thesis was the Nordkalk Corporation's unit in Lappeenranta. The author worked for the Nordkalk Corporation at the time of writing this thesis, and had worked for Nordkalk Corporation for a total time of nearly two years. During the time of writing he worked as a purchaser, and he has also worked as a warehouse worker.

The client was engaged in this project because their internal environment was facing changes, and potential solutions were being sought for in order to adapt to the challenges of the new situation. At the same time the aim was on reducing costs, so attention had to be paid to the presumed costs of the potential solutions.

Outsourcing has been increasingly noticed globally as a worthy part of business strategy. It is used as a way to maintain or develop competitive advantage through improvements in strategy and operational effectiveness. Outsourcing has shown potential in achieving cost reduction as well as efficiency and effectiveness improvements. (Weele 2009, 160–161.)

### 1.1 Nordkalk Corporation

Nordkalk Corporation is an international producer of limestone-based products. The company quarries and refines limestone mainly for the uses of other industries. Their products are used in various final products, for example in papers, metals and building materials to mention some. The company is the leader of its field in Northern Europe, totalling a turnover of 357.8 million euros in 2013. Overall, the Nordkalk Corporation employs some 1050 people, operating in more than 30

locations in 9 different countries. The company has its biggest Finnish production site located in Lappeenranta. The site has been operational since 1910. It includes a quarry, processing facilities, factory service, and a sales office. (Nordkalk Group in brief 2014.)

## 1.2 Purpose and Goal

Nordkalk's central warehouse in Lappeenranta holds a large number of MRO goods to enable effective and efficient operation and maintenance at their site. The upkeep of the stock of goods, however, is rather laborious as it is carried out currently, requiring one of the site's two purchasers to dedicate a significant part of his working hours to managing its replenishment. The purchasing department in Lappeenranta has recently faced changes as their former long-time inventory purchaser has retired, and he has been replaced by a new purchaser. In addition to this, the second purchaser will also be retiring at the end of this year. The recently replaced purchaser is concentrating on keeping up the inventory, while the other focuses more on services and acquisitions of a more strategic nature. Purchasing as a function has recently been spread from the site level to the division level, which means that purchase orders within Finland are divided among all the Finnish purchasers. The company's intention is to continue the purchasing activities in Lappeenranta with only a single purchaser, which would mean that keeping up the inventory should become less time consuming.

The goal of this thesis was to determine whether Nordkalk could manage their situation by making internal improvements, or would buying support from an external party be a more viable option. This was done by analysing and evaluating different outsourcing models, and comparing them against possible improvements that could be reached without engaging in an outsourcing relationship. The purpose was to examine which model was expected to provide the client with a solution that results in optimal balance between cost and operational efficiency.

### 1.3 Research Problem

The research problem was to define whether or not Nordkalk should buy inventory management assistance in Lappeenranta from an external supplier. Nordkalk has already implemented some of this kind of small scale outsourcing models at their other sites in Finland. In Lappeenranta only office supplies are currently managed by an external party. After determining whether collaboration would be a feasible solution or not, an implementation plan was to be made in order to provide the client with concrete suggestions on how to improve their current operations in a way that would result in the desired outcomes.

### 1.4 Research Methods

The research methods in this thesis were mainly qualitative. Many aspects related to the make or buy decision of such outsourcing considerations were difficult to quantify, so qualitative research played an important role in the evaluation. Interviews were used to collect the data in addition to which the author's extensive knowledge on Nordkalk Corporation, due to his work history in the company, was also used in this study.

### 1.5 Research Constraints

The research was constrained within the make or buy decision that Nordkalk was facing. The focus on the inventory was constrained to fast moving low-cost items, despite the fact that the inventory also comprised higher value items. The discussed inventory outsourcing options focused on those which were perceived to be achievable for Nordkalk at their current environment in Lappeenranta. The development suggestions focused on improving Nordkalk Corporation's Lappeenranta unit, rather than the company's activities on a general scale.

## 2 Outsourcing

Weele (2009, 162) describes outsourcing as “the transfer of activities that were previously conducted in-house, to a third party”. As businesses have become increasingly competitive with time, companies have identified outsourcing as a source of improvements in the quality and efficiency of their processes. This has led to clearly increasing growth rates of outsourcing in Europe, America, and Asia.(Weele 2009, 161.)

### 2.1 Reasons for Outsourcing

Outsourcing is often seen primarily as a money-saving tactic, but sights should be directed beyond that, because even at higher cost outsourcing can result in superior performance (Booty 2006, 257). The reasons can be split into more concrete tactical reasons, and more intangible strategic reasons. The following reasons are based on those described by Weele (2009, 164) and Emmett (2011, 219).

#### 2.1.1 Tactical Reasons

##### **Cost Reduction**

The most evident reason for engaging in outsourcing is to seek for cost reductions. These reductions can be reached if the supplier performs the activities with such efficiency that they are able to sell the service at a lower cost than what could be reached internally by the client. Cost reductions can be the result of higher operational efficiency, but they can also arise from the reduced need for control over the activities by the client.

##### **Freeing Resources**

Engaging in outsourcing allows the client to utilise resources, such as workforce that it used to have tied in the outsourced process, in its other processes. Resources may

also be released in the form of capital invested in the function. This release of capital can act as a helpful cash infusion if necessary. Releasing capital constitutes a beneficial change in accounting by moving capital away from the balance sheet, and into the profit and loss statement as variable costs. This also enhances some business ratios due to the reduced capital employed. (Booty 2006, 218.)

### **Improving Performance**

Outsourcing can be used as a source for additional capacity. There are basically two reasons for reaching for these kinds of improvements: Firstly, the client may not be capable of performing at a sufficient level to be competitive and, therefore, needs additional capacity to run his business. Secondly, the client may simply wish to increase his existing capacity in order to expand his business so as to be capable of offering more of his product to consumers.

### **Improving Management**

Outsourcing moves some or all of the responsibilities of managing a function to the supplier. This means that the function will also be under the supervision of someone else, which will allow the client company to focus its management better on other functions. Through outsourcing the client company will have access to fully trained personnel that has all the required tools to perform the outsourced processes, which can ease management.

#### 2.1.2 Strategic Reasons

### **Improving Focus**

Outsourcing less strategically important functions allows a company to focus its efforts on maximising the benefits achieved through its core competences. Fewer resources will be required to manage the non-core activities, and all expertise can be dedicated to the highest value activities. In this way more time can be released to developing these key activities.

### **Improving Capabilities**

Process and product quality improvements can be sought for by outsourcing for expertise. Suppliers may possess better abilities in carrying out a function, which can result in significantly higher quality results. The supplier may also be able to perform the outsourced tasks in a more efficient way, which could result in more beneficial cost structures and thus better value for money.

### **Gain Access to Resources**

Suppliers may have access to resources that are not accessible to the client. Through an outsourcing relationship the client may indirectly gain access to these resources, and in that way be able to utilise them in his processes. Various benefits could result from this kind of trade, as the enhanced resources could increase the quality of the final product or enable more efficient production.

### **Flexibility**

Flexibility can be achieved because the ownership of the function is no longer completely in the client's hands, thus allowing easier adaptation to changes and difficulties. For example, holidays and sick leaves will be less of a problem, because the supplier has the responsibility of providing the agreed processes. (Booty 2006, 218.) Aid could also be found for seasonal changes in activity, to which fixed self-owned assets are difficult to adapt. However, this flexibility may come at the cost of control over the function.

### **Risk Sharing**

When all the functions within a process are not owned by the client company, the amount of capital at stake in the case of misfortune will be reduced. Therefore, buying a function from a supplier may be a good choice if investments are required in an uncertain situation.

## 2.2 Outsourcing Decision

The decision to outsource a function should be based on the function's strategic importance to the company, as well as the company's own ability to compete against suppliers in light of that specific function, as shown by Figure 1. In most cases the client company's outsourced function should score low in both of these variables in order for it to be beneficial to choose outsourcing as a solution. If the strategic importance of a function is high, the company should not move the control of it to an external party. If the company does not possess the competence to execute such an important function by itself, it should seek to form a partnership that goes beyond outsourcing. In case the company has competence to perform a function that is not of strategic importance, it should hold the function in-house as long as its performance level is acceptable. Finally, if a function scores high in both strategic importance and competence, it is a core competence and, thus, the basis of the whole business. (Weele 2009, 165.)

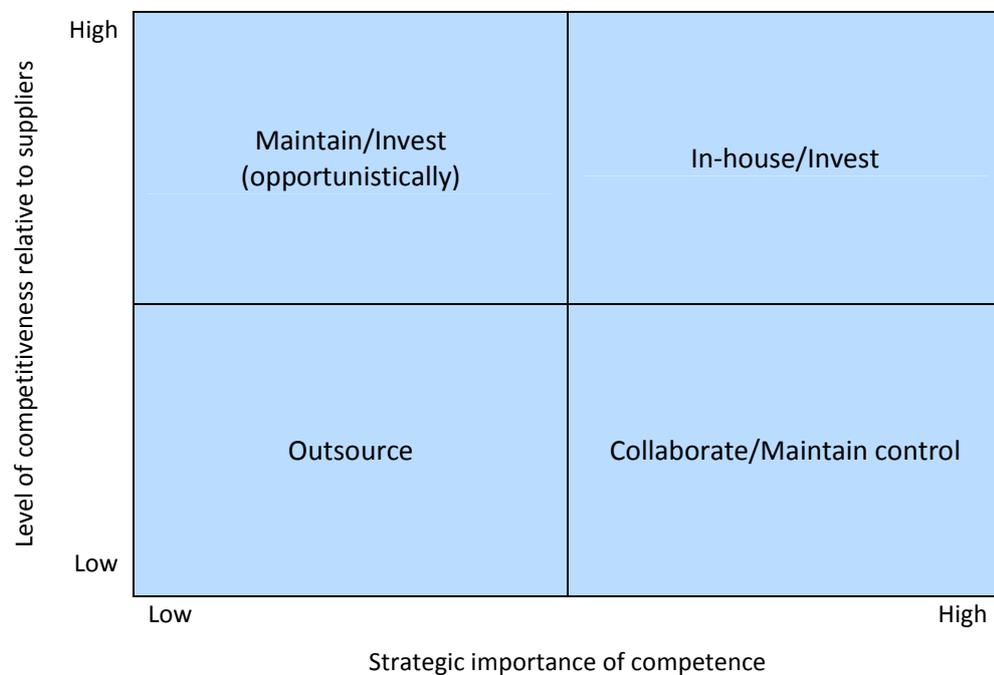


Figure 1 The outsourcing matrix (Weele 2009, 165, modified)

## 2.3 Types of Outsourcing

### 2.3.1 Turnkey Outsourcing

Turnkey outsourcing is the most complete form of outsourcing. It refers to a form of outsourcing where a function is completely under the control of an external provider. This does not only mean the execution of the activities, but also managing them. (Weele 2009, 162.) Turnkey outsourcing frees the client from a majority of the efforts that it would normally need to exert in order to keep a function running, thus allowing it to utilise the otherwise tied resources on more central tasks. Such an arrangement draws a clear line for the responsibilities concerning the function.

### 2.3.2 Partial Outsourcing

Partial outsourcing is exactly what its name states: outsourcing only a part of a function. In this case activities are transferred to the supplier, but the coordination of the function still lies in the hands of the client. The weakness of these kinds of partnerships is the ambiguity of responsibility concerning the results. Both parties have an effect on how the function is carried out, so it may be difficult in some situations to determine who caused certain results to occur. (Weele 2009, 162.)

## 2.4 Outsourcing Models

Outsourcing can be divided into different models, which are based on the desired outcomes for the client, as well as the level of sourcing maturity present in his organisation. Simpler short-term models have less potential of resulting in significant benefits, but do not require high sourcing maturity. More complex long-term models, on the contrary, have more potential of bringing higher yields but require more maturity. (Subramanian and Williams 2007, 1.)

Sourcing maturity is a measure of how developed sourcing is as a function within an organisation. This can be reviewed in terms of the goals, payoff expectations, impact,

and awareness concerning sourcing. Goals and payoff can range from short-term tactical results to long-term strategic results. Impact is considered in terms of how broad the effects of actions are within the organisation, ranging from small localised groups to the whole organisation. Awareness considers the understanding of the effects of sourcing expertise within the organisation. (Subramanian & Williams 2007, 6.)

Subramanian and Williams (2007) describe their ideas on outsourcing models on the basis of project outsourcing, but the descriptions also translate well to non-project-based processes.

#### 2.4.1 Ad-hoc Staff Augmentation

This model is the simplest form of outsourcing. In this model the service provider will only provide the client with skilled resources as an aid, but not take any accountability or risk for their performance. The client will be fully responsible for the processes, and he will instruct the provided staff on what they should do. This works as a simple solution to ensure that resources are available when they are needed, and through that it provides some cost flexibility. (Subramanian & Williams 2007, 2–3.)

This model is suitable for companies that have little experience in outsourcing, because it requires little maturity to implement. However, gains from this model are quite insignificant and difficult to achieve in other than small scale implementations. What limits the gains is that the service provider has no say in how his resources are utilised, and neither does he have any responsibility concerning the outcomes. (Subramanian & Williams 2007, 2–3.)

#### 2.4.2 Out-Tasking

Out-tasking is a model where the client shifts some tasks within a larger project or process to a vendor or vendors. In out-tasking the client still holds onto the ownership of the process in-house, which means that the overall control and management remain with him. The service provider is given responsibility for the completion of

the tasks that he is expected to perform within the parameters that have been agreed upon between the two parties. (Subramanian & Williams 2007, 4.)

Out-tasking is a fairly straightforward solution and, therefore, does not require particularly high sourcing maturity from the client. It may serve as a solution in cases where some specific tasks within a process can easily be outsourced, and it is easier to implement with tasks that are not closely interdependent with the rest of the process. This model is generally suitable for fulfilling short-term needs, but it can also be used in longer term solutions as a way to strategically outsource specific skills. However, as the goal of every company should be to continuously increase their sourcing maturity, out-tasking is not an efficient long-term solution due to its limitations in control and monitoring mechanisms. (Subramanian & Williams 2007, 4.)

#### 2.4.3 Project Based Outsourcing

Subramanian and Williams (2007, 4) describe project based outsourcing as a solution where the service provider takes a complete project under his management. The service provider will take care of all the tasks required to carry out the project, and he will bear full responsibility for the project that he has been given. In project based outsourcing the client will still bear the broader business related risks, while the rest lies on the service provider. Since the risks are shared between the parties, the rewards are too. (Subramanian & Williams 2007, 4.)

Since the service provider manages the whole project, the client will not be supervising the execution of the required tasks, but he will rather just monitor the outcomes. To enable this kind of cooperation the two parties will create a service level agreement that defines the metrics for the outcomes, and the service provider's results will then be benchmarked based on their agreement. (Subramanian & Williams 2007, 4.)

In project based outsourcing the service provider has the full freedom of deciding how to carry out the required tasks, which allows him to optimise the execution from his point of view. This will most likely increase his efficiency, which can result in in-

creases in quality and reductions in costs. Moreover, because the risks and rewards are shared, it is beneficial for the service provider to aim high with his tasks. (Subramanian & Williams 2007, 5.)

Because of the sharing of responsibilities and rewards, mutual trust is required to implement such a model. A certain level of collaboration is inevitable when dealing with this scope of outsourcing, and this means that the client has to be comfortable with giving up the control of his processes. (Subramanian & Williams 2007, 5.)

#### 2.4.4 Managed Services

The managed services model shifts the management of a complete service from the client to the service provider. In this model the service provider carries full responsibility for the service at the business level, meaning that he will be held accountable for all the effects of his performance. This kind of collaboration requires broad service level agreements that measure the service provider's performance on numerous parameters. The length of managed service agreements tends to be long due to the required strategic relationship between the related parties. (Subramanian & Williams 2007, 4.)

This outsourcing model requires a high level of sourcing maturity because of the significant amount of trust required in keeping up the partnership, and the potential benefits are corresponding. With the service provider having full control and responsibility of the service for a long time, he, as well as the client, can achieve significant benefits through improving the service by developing its execution. These improvements may come in the form of higher productivity and/or quality, as well as decreases in costs. (Subramanian & Williams 2007, 4–5.)

A key part of the managed services model is communication. When a complete service has been separated from the client's business, it is important that the two parties keep each other informed about their activities and developments. Without efficient governance and communication mechanisms there is a chance that the client

will lose the transparency of the outsourced service. (Subramanian & Williams 2007, 5.)

## 2.5 Levels of Logistics Outsourcing

Logistics outsourcing can be divided into four different levels, which are split into two higher levels on the basis of their general nature. The higher levels are execution level and planning level (see Figure 2). Execution level refers to the level of activities where some concrete tasks that relate to handling goods are being performed. Planning level comprises of activities that go beyond goods handling, such as control and planning. (Hsiao, Kemp, van der Vorst, and Omta 2010, 77.)

Execution level	1. Transportation / Warehousing
	2. Value added activities
Planning level	3. Logistics planning and control
	4. Complete distribution network

**Figure 2 Levels of logistics outsourcing (Hsiao et al. 2010, 77).**

The lowest level of logistics outsourcing, level 1, is transportation and/or warehousing outsourcing. This is an execution level outsourcing option, since it only includes the basic materials handling functions. Level 2 also goes under the execution level. It includes outsourcing value added activities to the logistics service provider, which makes it an option that is more applicable for manufacturing supply chains than others. These value added activities include simple, non-strategic manufacturing process parts, such as packaging and labelling of goods. (Hsiao et al. 2010, 77–78.)

Level 3 is the lower level of the planning level. This level includes logistics planning and control activities related to inventory and transportation management. The tasks related to this level include such as sales forecasting, stock control and transportation route planning and scheduling. The final and highest level of logistics outsourcing, level 4, is outsourcing the complete distribution network. At this level the client

gives the service provider full strategic power on the planning and control of the complete distribution network. This means that the service provider will decide upon matters like the supply chain structure, warehouse structure, inventory distribution, and transportation network and modes. (Hsiao et al. 2010, 78.)

## 2.6 Potential Risks and Disadvantages

When shifting activities from an internal structure to an external provider, a variety of potential negative scenarios is to be avoided. Full internal control is changed to a contract-based agreement where both parties will attempt to maximise their benefits from the trade. This gives rise to potential risks that may vary from financial losses to losing essential intellectual property. An increased amount of discipline and organisation, as well as caution is required from the client in order to avoid these risks. (Weele 2009, 165–166.)

### 2.6.1 Power Balance

When engaging in a collaborative relationship a company needs to understand its position when it comes to control over the mutual agreements. Firstly, it is clear that the client will become dependent on the provider because the provider becomes a part of his system. This will generally be advantageous for the provider. The length of the contract, as well as the number of assets and employees transferred to the provider have effect on how powerful the provider becomes. Most often the power balance does easily shift in favour of the provider, so one should carefully evaluate whether the resulting lack of power is worth the expected benefits. (Weele 2009, 166, 175.)

The client should also realise that he will no longer have similar control over the function as before. When performing a function internally, there is more flexibility in regard to the requests and demands that one can make concerning the implementation of the function. However, an external provider may be less responsive when placing requests that he is not expected to fulfil based on the contract. Because of

this the related functions should be organised with such forethought that special requests need not to be made. (Weele 2009, 166; Booty 2006, 220.)

### 2.6.2 Technical Risks

Technical risks contain the risks concerning the actual way that the outsourced function is carried out. Basically the question is whether or not the provider has the resources and the willingness to create sufficient functionality and performance. The degree of technical risk relates to the difficulty of defining the performance levels quantitatively, because easily quantified criteria are also easier to demonstrate and, therefore, to promise and request for. In order to not alter the provider's performance, the client should aim at not restricting the provider from carrying the processes out as they wish. This is preferably achieved only by setting requirements for the output of the process. (Weele 2009, 174.)

The problems with technical risks are how to monitor the provider's performance, and how to keep up with the function internally. It may be difficult to ensure that the provider's employees are capable of performing the function at a certain level and that they will be able to keep up their performance. Development will also most likely constantly take place in the provider's field of expertise, but the client may not have guarantees that the provider will develop his performance correspondingly. The client's own challenge is to maintain the required knowledge to keep up the function internally in case the co-operation is eventually terminated. Since the client will most likely not exert much effort on developing the outsourced activity, a lack of innovation may arise within the function. (Weele 2009, 174; Booty 2006, 220.)

### 2.6.3 Commercial Risks

Commercial risks refer to the dangers that lie within the costs of the co-operation. Naturally, the client is paying the provider a margin for their services, but hidden costs may arise or exist within the cost structures. In order to moderate these risks the client ought to look into the provider's cost structure profoundly in order to be aware of their key cost drivers, as well as their core cost parameters. These are im-

portant factors to understand because, overall, the client will have less control over the costs than with an internal function. (Weele 2009, 174; Emmett 2011, 220.)

Costs may also turn out to diverge if the provider's performance deviates from the originally agreed level. This could occur in the form of extra costs if the performance is greater than expected and lower costs if they fail to reach their goal. In order to reduce these deviations the client should consider establishing an incentive system for rewarding good performance and penalising deviation. (Weele 2009, 174.)

Finally, commercial risks also relate to the threat of losing intellectual property. Loss of intellectual property via the provider could result in declining competitive advantage and, thus, reduction in profit. It is therefore essential to include a confidentiality agreement within the outsourcing contract if such a chance exists. (Weele 2009, 174.)

#### 2.6.4 Contractual Risks

Contractual risks are based on the question whether the mutual contract has been made in sufficient detail so as to cover all possible scenarios. Certainly the most important details are the performance expectations for the parties. These expectations should be well defined, and the coverage of the agreed performance indicators for the service provider should be extensive enough to determine their level of performance. It is also important to take into account the possibility of changes or difficulties occurring during the contract period. It should be agreed upon what kinds of arrangements are made if, for example, the scope of the work should be adjusted. If the performance of the provider is insufficient compared to the expectations, the client should be able to penalise the provider for its underperformance without jeopardising their future co-operation. In addition, there may be a need for the contract to cover issues related to subcontracting, as the provider's activities may reach beyond the relationship with the client. (Weele 2009, 175.)

## 2.7 Outsourcing Success Factors

### 2.7.1 Justification and Commitment

Before engaging in outsourcing a company should identify its reasons for considering outsourcing as a solution. Outsourcing should not be used as an easy way out to try and solve issues that are internally present in the company. The company should first analyse its internal organisation in order to point out possibly achievable benefits, underlying risk factors and the threats of resistance toward outsourcing. If these factors end up favouring outsourcing, it should be seriously considered.

Once outsourcing has been implemented, the company should be committed to it. Despite the fact it is beneficial to attempt to keep up with fundamental knowledge on the execution of the outsourced function, the client should not constantly be prepared to transfer the function back in-house. Hasty decisions should be avoided if problems arise in the external environment or within the function. Outsourced functions should be non-core activities, and they ought to be treated as such. (Weele 2009, 176.)

### 2.7.2 Supplier Selection

Because outsourcing relationships tend to be long-term, it is crucial to select the right supplier for the task. In terms of the actual performance of the function, potential suppliers should be analysed on the basis of their technical and managerial capabilities. Both of these elements are of great importance when it comes to performing the agreed processes at a sufficient level and in a controlled and reliable manner. Looking beyond the concrete execution of the processes, similar spirit within the supplying company should also be sought for. If the vision, strategy and culture of the supplier are along the same lines with the client, their co-operation could turn out to be more effortless and productive than between less similar companies. (Weele 2009, 176.)

### 2.7.3 Contract Formulation

To start an outsourcing relationship with a supplier, the client needs to negotiate a contract with him. Both parties will wish to maximise their benefits from the trade, but the aim of a good contract should be to come up with a solution that is fair for each party. Formulating a contract that leads to a win-win situation will support maintaining a long-term relationship. Therefore the overall goals of the exchange relationships should be born in mind when setting up its rules. (Weele 2009, 176.)

An outsourcing contract should be a service level agreement (SLA) that is based on the set overall goals. An SLA determines the performance level that will be expected from the supplier. This is done by setting a number of measurable performance indicators that can be translated into objectives that should be reached. The supplier's performance will then be measured on the basis of these indicators, and compared against the criteria that have been decided before the start of the contract. (Weele 2009, 171.)

The contract should include arrangements for everything that will take place between the two parties, including, for example, procedures and communication as well as the termination of the agreement. Procedures will mostly differ based on the type of service being outsourced, but something to be agreed on in every case is the procedures to be taken in case the objectives of the agreement are not met. This should be some form on penalty that will encourage the supplier to keep up his performance. This can, of course, also be countered by offering rewards for exceeding certain objectives. (Weele 2009, 176.)

Communication is an important part of the contract in outsourcing. By agreeing on regular communication throughout the organisation, it can be made sure that the client and supplier stay on track with how their cooperation is working and developing. This is important for managing the relationship between the parties. (Weele 2009, 176.)

### 3 Make or Buy

Make or buy decisions should be based on either one or both of two approaches: Transaction cost approach and strategic approach. The transaction cost approach focuses on the idea of minimising the cost of each transaction in contract based trade between two parties. Transaction costs are considered beyond the price of the transaction, also containing the costs of establishing and enforcing a contract, as well as the costs of managing the relationship of the parties. The transaction costs are dependent on three major factors: transaction frequency, transaction-specific investments and external and internal uncertainty. Frequency of transactions obviously affects the costs by determining the number of transactions that will be carried out during a period of time. Transaction-specific investments refer to other investments beyond the transaction itself that are necessary for enabling the transaction to happen, which could be, for instance, the cost of creating a mould for casting. Finally, uncertainties concerning the exchange can make it difficult for the parties to agree upon fixed prices for their contract. If the level of uncertainty is high, it will be difficult for the supplier to promise low prices. (Weele 2009, 168.)

The strategic approach concentrates on the idea that a company should seek to focus its efforts on its core competences, while non-core activities could be outsourced. Core competences are the elements that create unique value to a company, and therefore a company should focus on maintaining and developing them instead of its other functions. The approach does, however, consider outsourcing all non-core activities as a feasible solution only if the markets for them are reliable and efficient. (Weele 2009, 168.)

### 4 Collaborative Inventory Policies

Different collaborative inventory policies are, overall, quite similar to each other when it comes to the benefits that are being sought for. They all seek to improve service levels and to decrease inventory costs. The sources of these benefits are based on profounder exchange relationships between the buyer and specific suppli-

ers, which assures sales and, consequently, encourages the suppliers to offer upgraded services.

The terminology concerning collaborative inventory policies is somewhat ambiguous due to the fact that authors express dissimilar interpretations of the terms (Marquès, Thierry, Lamothe, and Gourc 2010, 548). In this thesis a distinction is made between three different models: Vendor managed inventory (VMI), continuous replenishment program (CRP), and Consignment Stock (CS).

#### 4.1 Vendor Managed Inventory (VMI)

Vendor managed inventory, or VMI, is a term that is commonly used to represent nearly any collaborative inventory policy, or is considered to be synonymous with many of the other terms (Marquès et al. 2010, 549). Here VMI is considered as described by Claassen, Weele, and Raaij (2008, 406), who state that “[i]n a true VMI setting, the supplier is given the freedom to plan its own production and decide upon the replenishment schedule as long as the agreed customer service levels are met.”

VMI is the most complete form of collaboration between a buyer and a supplier when it comes to inventory management. In VMI the buyer shifts the responsibility of inventory management to the supplier, while only defining the minimum and maximum stock levels himself. The supplier will have full control over the replenishment planning of the inventory, which allows more efficient and effective replenishment, but also shifts the liability for costs resulting from stock-outs to the supplier. (Zammori, Braglia, and Frosolini 2009, 167.)

In order to enable efficient and effective functioning of VMI the buyer needs to provide the supplier with detailed and timely data on actual and forecasted demand of the supplier's items. This information lets the supplier plan his own activities in a way that allows better optimisation of the supply chain. (Zammori et al. 2009, 167; Claassen et al. 2008, 407.) This is because the information that is available to the supplier is no longer limited to what is shown by the buyer's purchase orders. If the supplier

utilises this information only to allow effective replenishment of the buyer's stocks, but does not make the most of it in planning his own production or replenishment, the model may be referred to as vendor managed replenishment (VMR) instead of VMI (Holweg, Disney, Holmström, and Småros 2005, 175).

When looking at the inventory items that are managed through VMI, it is common that the supplier is only responsible for a limited range of items. Suppliers often possess specific knowledge of a certain assortment of goods that they specialise in. This enables them to forecast and manage the flow of their products better than a purchaser who is responsible for a large variety of goods. (Claassen et al. 2008, 407.)

The potential benefits of VMI come in the form of increases in efficiency and, consequently, reductions in costs. Efficiency improvements result from the fact that the process of forecasting is eliminated from the two parties' supply chain link because of extensive information sharing. This elimination reduces uncertainty and distortion in decision making, while also reducing the delays existing in information flows. These improvements may enable a reduction of inventories, better stabilisation of supplier procurement and/or production, more optimised transportation of goods, and reduction of lead times. Overall the transparency of the supply chain becomes greater. (Claassen et al. 2008, 407.)

Finally, VMI may also reduce the magnitude of the so called bullwhip effect. The bullwhip effect is an undesirable phenomenon that may occur in supply chains that are driven by forecasts. When there is uncertainty on the demand, inaccuracies start building in the forecasts. These inaccuracies create variation between supply and demand. This variation then accumulates when moving upstream along the supply chain. This effect results in excessive inventories, increased costs and longer lead times. (Claassen et al. 2008, 407.)

## 4.2 Continuous Replenishment Program (CRP)

The concept of a continuous replenishment program, or CRP, is similar to that of VMI. In CRP the responsibility for the replenishment of the buyer's inventories is also shifted to the supplier, but the shift is not as drastic as in VMI. On the basis of Yao and Dresner's (2008, 362) definition, CRP is similar to VMI in that timely information on consumption and incoming demand is communicated to the supplier so as to enable better replenishment planning, but in CRP the final replenishment decision making power stays with the buyer.

In CRP the supplier will utilise the incoming downstream demand data, but he does not possess the authority to replenish the inventory without the buyer's consent. When the supplier identifies a need for replenishment, he communicates his replenishment requisition to the buyer, who then needs to approve the request before replenishment is carried out. In this way purchase orders from the buyer to the supplier still take place, but the monitoring and planning is done by the supplier instead of the buyer. The goal of this is to enable more frequent replenishment of the buyer's stocks. (Yao & Dresner 2008, 362.)

The benefits of CRP are more or less the same as those of VMI. In CRP the supplier does not have full control over the replenishment, which will reduce his ability to optimise everything as thoroughly as in VMI. The buyer has the benefit of having some control over the replenishment, which also allows him to stay on track with the inventory management planning that the supplier is carrying out.

## 4.3 Consignment Stock (CS)

Consignment stock (CS) is a policy that is, overall, identical to CRP, but the ownership of the goods is different. In a CS policy the supplier places his stock of agreed products within the buyer's warehouse, but the goods' ownership remains with the supplier. It is not until the goods are used by the buyer that the supplier charges the buyer for them. (Persona, Grassi, and Catena 2005, 4973.)

The benefits of this kind of policy, of course, include those of CRP, but some additional benefits rise from the shifted ownership. Firstly, the buyer benefits from the fact that the inventory under the policy is no longer under his ownership, which means that it will no longer appear on his balance sheet. In addition, he will no longer be carrying the financial opportunity cost for the inventory. This is overall beneficial because the financial component of the inventory costs tends to increase as goods move downstream in a supply chain. (Gümüş, Jewkes, and Bookbinder 2008, 503; Valentini and Zavanella 2003, 217.)

In addition to the benefits rising from the improved information exchange from CRP, the supplier benefits from the fact the operational holding costs of the physical inventory shift to the buyer. As the costs are divided like this, neither party is responsible for all the costs of the goods at once. (Valentini & Zavanella 2003, 217.) Furthermore, the supplier also benefits from the fact that he can hold a lower average stock levels at his own inventory, which allows a more efficient use of the space of his premises (Persona et al. 2005, 4972).

CS policies may also be used together with VMI. This combination will result in a VMI setting where the ownership of the goods is done according to CS practices. This should alter the cost structures of the basic CS policy because responsibilities are altered. (Gümüş et al. 2008, 504.)

#### 4.4 Information Sharing

It is of utmost importance to share inventory status and transaction information between the parties of collaborative inventory models. This information sharing is commonly done by using electronic data interchange (EDI) or via the Internet. EDI refers to the process of electronically transferring standard documents from one party to another in agreed-on formats (Bendoly and Jacobs 2005, 110). EDI is a good way of transferring information because using a standard format makes the data inter-

change simple and efficient and also reduces the chance of mistakes (Schneider 2012, 9).

The internet provides an easily accessible channel for transferring different kinds of information between parties. Online stores are a commonly available way of transferring information between buyers and suppliers via the internet. Online stores are becoming an increasingly common channel for purchasing goods even in business to business trade.

## 5 Current Situation

### 5.1 External Users of Nordkalk's Central Warehouse

Nordkalk shares its production site with several other companies, and all of these companies have access to Nordkalk's central warehouse. Nordkalk's own consumption of the warehoused items is significantly higher than the other companies', but nevertheless the other users' presence has some significance in this study. The external users may withdraw items like Nordkalk's employees, but a margin will be added to each item's price.

#### 5.1.1 Suomen Karbonaatti

Suomen Karbonaatti Oy, also known as SKOY, is a producer of calcium carbonate based coating pigments and filler substances for the paper and cardboard industry. The company's main owner is Nordkalk Corporation. SKOY uses Nordkalk's products as raw materials in its production (Suomen Karbonaatti Oy 2014). SKOY has their own warehouse at their premises, but they also occasionally buy products from Nordkalk's central warehouse. Their share of the external consumption in 2013 was about 43%.

### 5.1.2 Paroc

Paroc is a producer of stone wool, but it does not utilise Nordkalk's quarried minerals or products in their production processes. Paroc and Nordkalk used to operate under the same owner, Partek, until they were split in the 1990's. Paroc has their own warehouse at the site, but on some rare occasions they buy items from Nordkalk's warehouse. Their purchases formed about 10% of the external sales in 2013. Paroc has announced that they are shutting down their factory in Lappeenranta during the next few years because it will no longer be profitable for them to carry on with their operations there.

### 5.1.3 Astepa

Astepa Oy is a maintenance service provider that also used to be a part of Partek until the 1990's. Astepa operates within the same premises with Nordkalk's technology department. Astepa and Nordkalk have continuous cooperation in maintenance operations, as well as in local goods transportation. Astepa has their own warehouse, but they also utilise Nordkalk's warehouse for their own purposes and when they perform maintenance tasks for Nordkalk. In 2013 they were responsible for 45% of Nordkalk's warehouse's external sales. Some of the goods that are used by Nordkalk are warehoused by Astepa, because they are more relevant for Astepa's business than for Nordkalk. These goods include technical gases and various steel products. The gases are under Nordkalk's ownership, but they are physically warehoused by Astepa.

### 5.1.4 Finnsementti

Finnsementti Oy is a producer of cement products. It is not a part of Nordkalk Corporation, but it utilises the minerals that are extracted from Nordkalk's quarry in Lappeenranta. Finnsementti has their own warehouse in the same building with Nordkalk's warehouse, and they rarely buy items from Nordkalk.

## 5.2 Information Technology

Nordkalk's main information technology application is their IFS Applications ERP system. The ERP system connects all the functions that are relevant for the warehouse to operate in a single environment. These include basic data of all the warehouse item, item transaction data, purchase orders, cost accounts, work orders, etc. The system allows users to browse through current and historical inventory related data, which helps tracking the use of each item.

The ERP system is coordinated with an invoice handling system by BasWare. Invoices are matched with their corresponding purchase orders in the ERP system, and the values of inventory items are based on the invoices. The invoices are not matched automatically, so this needs to be done manually by the financial department. The system is intended to be used in a way where every invoice has an identical purchase order in the ERP system, which is why incoming invoices should only include the lines of a single purchase order.

## 5.3 Warehouse

Nordkalk's central warehouse is located close to the centre of the site, which puts it within less than a kilometre from most maintenance targets, and about 3 kilometres from the furthest ones. The warehousing space has a floor surface of 2244 m<sup>2</sup> on 2 floors, and out of this area approximately 70% is in Nordkalk use. The layout of the storage space can be seen in Figures 3 and 4. About a third of the space is consumed by production spare parts. The area is holding about 4300 items, out of which 1870 had been consumed during the year 2013. The average total value of the items held at the warehouse was approximately 1.3 million euros in 2013. The MRO items held at the warehouse contributed only about 10% to this value. Production machinery spare parts of high importance and/or with long delivery lead times contribute most to the value and the large amount of unconsumed items, but a significant amount of rarely used MRO items is also held in inventory.



Figure 3 Centre hallway of the central warehouse.

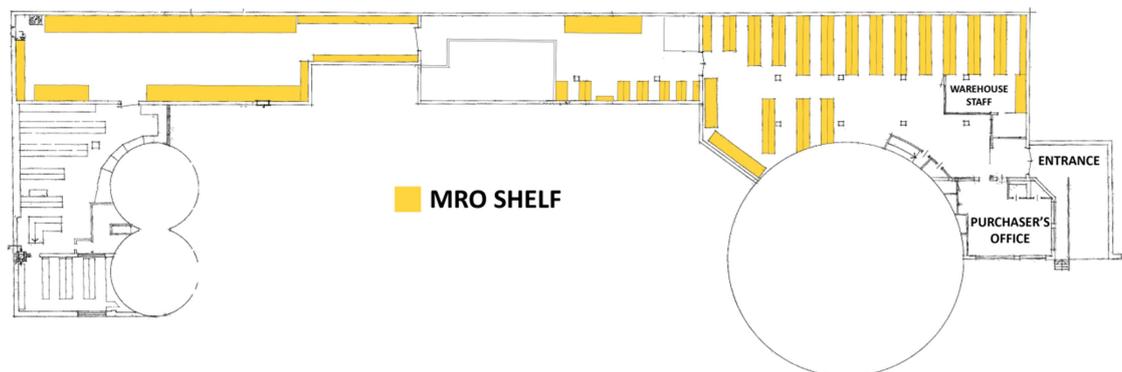


Figure 4 Map of the central warehouse's top floor, where the MRO items are located.

The warehouse contains spare parts for production machinery, and MRO items needed for everyday operation and maintenance at the site. Only very basic tools are held in stock. The following groups of MRO items are warehoused:

- Fasteners
- HVAC
- Piping
- Pneumatics
- Hydraulics
- Workwear
- Safety gear
- Office supplies
- Electrics
  - o Lighting
  - o Electric cables
  - o Fuses

- Chemicals
  - o Paint
  - o Adhesives
  - o Detergents
  - o Operating fluids
- Lubrication
- Consumable parts
- o Drill bits
- o Welding materials
- o Abrasive discs
- Basic utensils
  - o Simple tools
  - o Canisters/buckets
  - o Cleaning equipment.



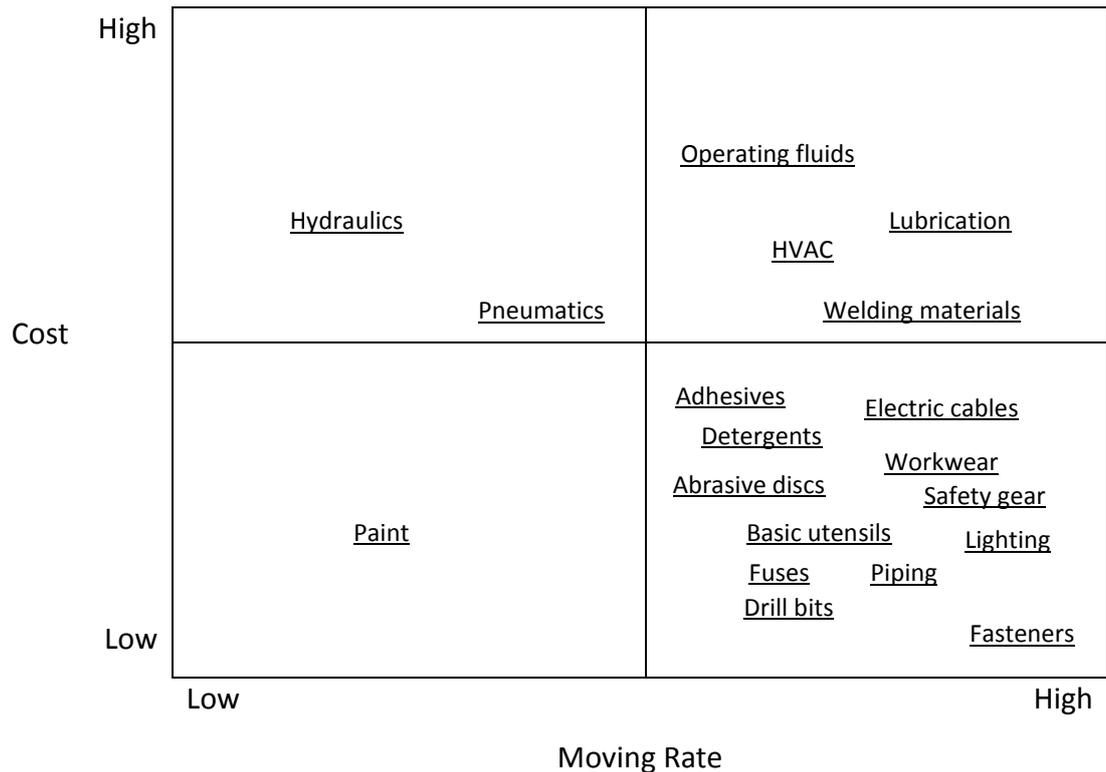
Figure 5 Various chemicals freely on a shelf.



Figure 6 Piping parts in boxes and on shelf.

The warehoused items are stored on steel shelving, either freely or in plastic boxes. This can be seen in Figures 5 and 6. The space that is available for the central warehouse is sufficient for carrying all the items that are currently in stock as they are without causing any inconvenience. The space is used efficiently, so few unused shelves or empty spaces exist.

The division of item groups on the basis of their movement rate and cost is illustrated in Figure 7. Office supplies have been excluded from the figure, as are not to be considered in this study due to the fact that they already belong under a VMI contract. From the figure it can be seen that the fast moving goods of low value include fasteners, various electric components, piping, safety gear, workwear, drill bits, abrasive discs, and some chemicals. In addition to these there are several kinds of fast moving chemicals in small packages that are divided among the groups.



**Figure 7 MRO items movement rate against cost.**

The warehouse is operated by two employees. One of these employees is more focused on the overall management of the warehouse, while the other focuses on serving customers. Both employees' activities include receiving, put-away and picking of goods, as well as inventory counting.

In addition to the mutual tasks, the more management oriented employee also handles all warehouse activities related to the site's liquid fuel tanks which are not located at the warehouse. This includes receiving fuel deliveries and manually recording and calculating monthly consumption information that is reported by the users. He also does the receiving of all the non-warehouse items' orders in the ERP system, based on packing lists that have been signed by the consignees. Generally, his days include a fair amount of work with little spare time.

The more service oriented employee generally only handles the shared tasks, and only occasionally those of the managerial employee. This means that if there are no customers, there may be little to do for the employee. This occasionally results in

working days that include little work, which leaves a considerable amount of spare time for him. The employee at this position has changed quite recently after the previous long-term employee retired, and the division of tasks has spread out to be more even than before.

## 5.4 Logistics

### 5.4.1 Deliveries

The trade term for most orders of MRO goods is FCA, leaving the responsibility of carriage to Nordkalk. The choice of the term is mainly because Nordkalk has outsourced its local goods transportation to Astepa Oy. Astepa has a driver who uses a van to pick up all of Nordkalk's locally supplied items. Ordered items are collected from suppliers twice a day, which means that delays caused by transportation are more or less non-existent. This is a reasonable schedule when considering that most suppliers are located within few kilometres from the site. Some suppliers offer the terms DAP and DDP for their goods, which releases Nordkalk from the delivery responsibility.

### 5.4.2 Item Pick Up

Excluding a few exceptions, all items are picked up from the warehouse by the people in need of them. The maintenance department has cars at their use, which makes visiting the warehouse fairly easy. Those other departments that do not have cars are the only ones who do not need to pick up their own goods, but they are rather delivered to them by Astepa.

In order to pick anything up from the warehouse the retriever of the goods needs to hand in a material request note. A material request note is a document where the retriever states his company, name, the target or destination of the goods, and where the expenses should be directed. The warehouse workers will then fill in the information concerning the items that have been picked up, including their item

codes and quantities. These documents are occasionally sent to the warehouse pre-filled, enabling the warehouse workers to collect the items for pick up, or simply saving the retriever from filling in all the information while he is at the warehouse.

## 5.5 Purchasing

The responsibility of replenishing the central warehouse's inventory lies on one purchaser. This purchaser needs to forecast the demand, plan the order quantities accordingly and order the goods.

### 5.5.1 Planning

The purchaser's primary tool for planning is the ERP system's order point system. In the system each warehouse item has a static order point, which has been determined by the purchaser. The ERP system does not calculate or redefine this point. An automatic order point-based purchase requisition creation program runs every morning, creating purchase requisitions for all the warehouse items that were consumed below their order points during the previous day. The newly created order requisitions are based on manually configured planning data, which is also static like the order point. This includes the recommended order quantity and the default supplier. Much of this data has not been properly updated by the former purchaser, so plenty of incorrect information can be found and is faced nearly daily. Due to this, the purchaser usually needs to check and adjust the default requisitions before turning them into orders. This is done by checking the consumption and replenishment history data. The data is then updated where necessary.

Usually the only information available for the purchaser is what he can find in the ERP system. This information includes the consumed quantities, ordered quantities, and the dates for consumption and delivery. In addition, the department that has consumed an item can be checked based on where the expenses have been directed. Other departments rarely inform the purchaser or the warehouse staff of incoming

abnormal consumption of MRO goods, which results in stock-outs every now and then.

### 5.5.2 Ordering

Purchase orders for MRO items are primarily sent to nearby suppliers that Nordkalk has annual contracts with. Purchase orders need to be based on order requisitions, so the ordering process is quite straight forward. The purchaser can edit all the data on the requisitions to include all the information that he wants to convey through the purchase order, so he can basically then just turn the requisition into an order and release it. More or less all purchase orders are sent to suppliers via email. Some suppliers have web stores which allow orders to be made without actually sending Nordkalk's own document to them. Overall making orders through web stores is more time consuming for the purchaser than creating and sending normal orders, but their use is encouraged by the suppliers with small additional discounts. After sending the orders the purchaser requests for, and usually receives, an order confirmation which he checks for mistakes, and attaches it to the purchase order in the ERP system.

Because of the low prices and small order quantities of many items, the purchaser should prefer to stack as many order lines per purchase order as possible. This is because many order lines alone result in total costs that are so low that suppliers could choose to charge small order extra fees, and also the resulting relative transportation costs per item would be unreasonably high. However, stacking order lines often means postponing ordering as long as possible, which increases the risk of stock-outs occurring. Because of this the purchaser constantly needs to consider trade-offs between costs and service level. Being able to order all the goods from a single supplier would make this easier, but due to the variety of goods it is difficult to reduce the amount of suppliers from where it is.

## 5.6 Invoicing

Suppliers send their invoices electronically to Nordkalk's financial department. The financial department checks every invoice, and matches them with purchase orders found in the ERP system. Consolidated invoices for more than one order are avoided whenever possible, because they are difficult to process with Nordkalk's systems. Invoices are not processed further until all the items shown on the invoice have been received on the ERP system's purchase order. The payment term has been negotiated to be 30 days net or better for nearly all the local suppliers of the warehouse items, which is important to enable confirming that the order, delivery, goods, and the invoice are correct.

## 5.7 Accounting

The costs of each item purchase made at the warehouse are directed to specific cost accounts or work orders. This means that the history data behind each item will show who have consumed them, and similarly each cost account and work order can be tracked to see which items have been used. This makes it easier for the financial department to track where costs are building up from. It also assists purchasers with planning replenishments because, for example, a certain maintenance work order may turn out to be the reason behind above average consumption.

## 5.8 Communication

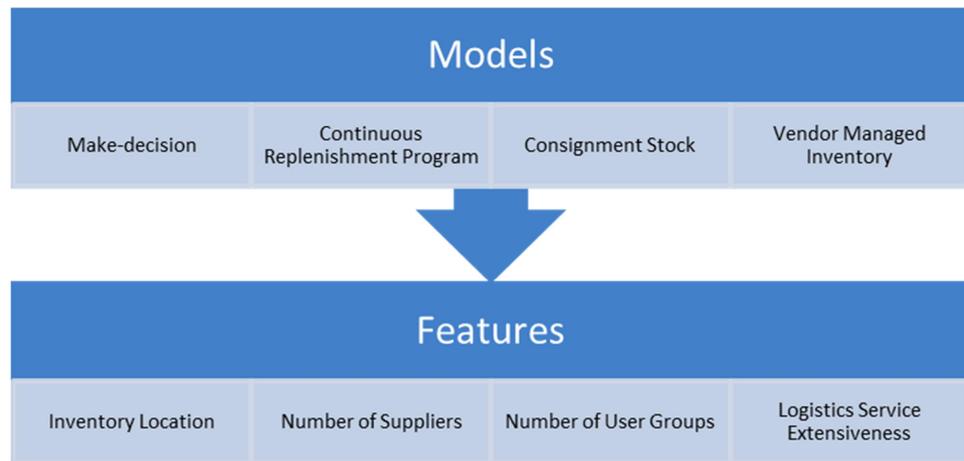
Communication within Nordkalk's site and with suppliers is quite scarce. When it comes to MRO goods, the maintenance department rarely informs the warehouse or the purchaser of incoming demand of inventory items. It is not uncommon that the inventory purchaser gets to know that additional pieces of an item are needed only after the stock has been emptied, instead of the maintenance department checking the stock levels from the ERP system well before starting their work.

The communication between the maintenance workers, the warehouse, and the inventory purchaser has improved during the past few years, but it still remains at a fairly low level. Since the end of 2013 the inventory purchaser has worked at the central warehouse, which has brought him closer to the inventory and its users, and made communication easier than before.

One major issue in communication is the limited use of the ERP system. Many maintenance workers rarely work with the ERP system, and therefore do not have the skills to browse through inventory related information. They have not received sufficient training for using the inventory features either. Also, not all of the foremen possess sufficient knowledge on searching items within the inventory data, which makes it impossible for them to check the stock levels even if they would wish to do so.

## 6 Solution Options

The solution options to be considered include all the collaborative models, as well as the option to merely improve Nordkalk's own operations. These models act as the basic structure for how roles will be determined between the related parties. In addition to the models themselves, there are also additional features that need to be determined in order to further define how they will be carried out. These features include inventory location, number of suppliers, number of user groups, and the purchased logistics service extensiveness. Figure 8 illustrates the decision-making process, with the models arranged according to the level of supplier involvement.



**Figure 8 Solution models and features to be determined.**

## 6.1 Models

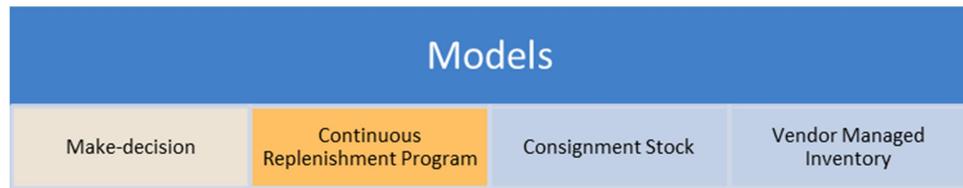
### 6.1.1 Make-decision



**Figure 9 Solution models: Make-decision.**

The most basic solution would be the make-decision. This would mean that no services are purchased from an external party for the development of the inventory practices. In this case Nordkalk would need to analyse their existing weaknesses, and seek for development ideas that would reduce their effect or eliminate them. There is potential in this option because there are several existing weaknesses that could undoubtedly be improved. These improvement areas include communication, the use of the existing human resources, ERP data, and the overall utilisation of the ERP system. Potential results of these developments would include workload reduction in purchasing and increase at the warehouse, inventory value reduction, more stable inventory levels, and more value for the ERP system.

### 6.1.2 Continuous Replenishment Program



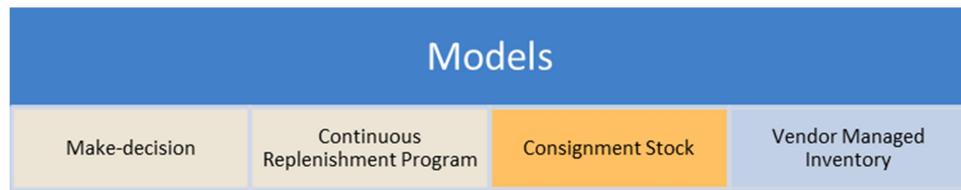
**Figure 10** Solution models: CRP.

In a CRP solution the items would stay at Nordkalk's central warehouse, but the monitoring responsibility of stock levels would be moved to the supplier. To carry out this solution Nordkalk would need to agree upon the items under the CRP policy and decide minimum and maximum stock values for each item with the supplier. Moreover, a system for communicating consumption and demand data to the supplier should be set up in order to enable easy monitoring of item flows. Agreements should also be made on the pricing policy, as well as on invoicing procedures. Once the supplier is monitoring the stock levels, he would send his order requisitions to Nordkalk's purchaser, who would check them and order the items if he approves the requisition.

The requirements for implementing efficient CRP would include developing areas that are included in the make-model, such as producing up-to-date data for the inventory items. The benefit from this work would be that the supplier would follow inventory levels and produce purchase requisitions for Nordkalk's purchaser, but the purchaser would still create the purchase orders. In this way the purchaser could spare more of his time on more significant purchases while CRP is applied. The risks of CRP lie within Nordkalk's unstable consumption of items and weak communication, which could easily lead to stock-outs.

CRP could also potentially reduce the cost of items, since the contract would assure the supplier that Nordkalk will direct their orders to him. This price reduction would contribute toward reducing costs and also to reducing Nordkalk's inventory value.

### 6.1.3 Consignment Stock

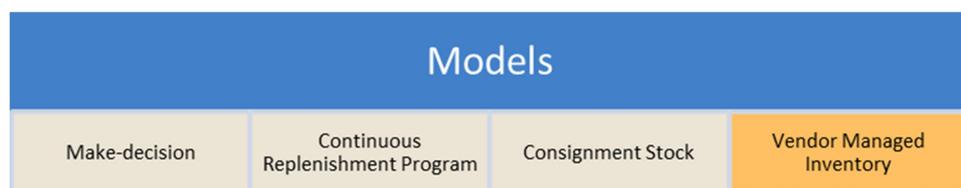


**Figure 11 Solution models: CS.**

In a CS solution the basic arrangements would be the same as in CRP, but the ownership of the goods would remain with the supplier, regardless of where they would be residing. As the items would be withdrawn from the inventory, they would be charged from Nordkalk by the supplier. In this case an agreement should be made on how the invoicing should be arranged, because Nordkalk has several requirements for following costs and processing invoices.

The overall benefits of CS would naturally include those of CRP, as it includes CRP within it. In addition to these benefits, CS would also provide a reduction to Nordkalk's inventory value, because the value of the items under the contract would no longer be on Nordkalk's balance sheet. However, it should be ensured that the price of CS is reasonable in comparison with the existing holding costs of the items that would be set under the CS. Holding the items' ownership one step higher in the supply chain would also result in lower overall financial costs for the goods, because one margin has been excluded from their prices.

### 6.1.4 Vendor Managed Inventory



**Figure 12 Solution models: VMI.**

Like in CS, the basic arrangements in VMI would follow those of CRP, but in VMI the supplier would make replenishment deliveries without the purchaser's separate consent. Managing the stock levels would be completely under the control of the supplier, which would require a thorough system for communicating accurate consumption

data to the supplier. This would move the responsibility for stock-out related costs to the supplier, as he is responsible for keeping the stock levels within the agreed limits.

Because the client would no longer monitor the inventory, the prices of the items under the policy should be fixed, in order to disallow the supplier from exploiting the arrangement. Invoicing practices should again be agreed to be such that they do not ignore any of Nordkalk's procedures.

The VMI model can also be combined with CS, resulting in a VMI setting where the supplier owns the stock. In this case the communication will face changes, because information on the stock will be at the supplier, and therefore consumption data and inventory levels should be communicated from the supplier to the buyer. Furthermore, invoicing practices would need to be reconsidered because goods would not be charged when they are delivered, but only after they have been withdrawn.

In an optimal situation VMI would release Nordkalk's purchaser completely from the replenishment of the items that are covered by the VMI agreement. This would most certainly be more costly than CRP, but it would support Nordkalk's goals better because their aim is to eliminate one whole purchaser. By combining VMI with CS the inventory value could also be shifted off from Nordkalk's balance sheet.

## 6.2 Features to be Determined

### 6.2.1 Inventory Location



Figure 13 Features: Inventory location.

There are several possibilities for locating the inventory when dealing with two parties. The most commonplace solution would be to hold the inventory at the buyer's

premises, for example in Nordkalk's case at the already existing warehouse. This way the inventory is constantly available, and its operational cost goes straight to the buyer.

The inventory could also be held at the supplier's premises. In this case the buyer would need to fetch items from the supplier when they are needed, but the physical holding costs would be carried by the supplier. The availability of such an inventory may vary, depending on the suppliers' arrangements. This option is viable if the supplier is located close enough to the buyer, and access to the inventory is sufficient for the use of it to be convenient.

Finally, the inventory could be held in a mobile solution at the buyer's site. This could be implemented for example in the form of a container that has been modified into a storage space. This storage could be under the ownership of either party, and it could be located close to the buyer. However, a storage that is not constantly monitored requires solid trust on the users, as withdrawing items is very easy. The biggest benefit of such a solution is that it can be moved easily, which makes it a good solution for short-term needs.

Considering Nordkalk's current situation and their location in relation to their suppliers, both the use of their own warehouse as well as the supplier's warehouse are feasible solutions.

### 6.2.2 Number of Suppliers



**Figure 14 Features: Number of suppliers.**

The described models can be applied to work with a single supplier, but also with multiple suppliers. Using multiple suppliers may allow leaving numerous product groups under the management of suppliers, while utilising the same storage space.

However, some solutions may require complicated information interchange arrangements to enable transferring transaction data to each supplier. Also, some solutions may require careful selection of suppliers, since it is highly unlikely that competing suppliers would agree to manage a mutual inventory.

The item groups that Nordkalk has eligible for outsourcing are such that it is highly questionable whether a single supplier could supply all of them. Therefore if Nordkalk wishes to outsource the replenishment of all of these item groups, it will be necessary to involve more than one supplier. This could increase the benefits of outsourcing, as long as the system does not become overly complicated to manage.

### 6.2.3 Number of User Groups



**Figure 15 Features: Number of user groups.**

The inventory solutions could be arranged to be such that the costs and benefits would be shared among multiple user groups. With more users the consumed volumes would be higher, and this could lead in discounts in item pricing due to economies of scale. Furthermore, if the price of the services is not tied to the amount of consumption, more benefit could be gained by maximising the use of the inventory. This solution is practical in models where the inventory is under constant supervision. However, applying this with models where transactions are more difficult to trace would require a fair amount of trust, since costs could be difficult to share in a fair manner. Also, in the case of mismatches occurring in stock levels, it could be difficult to trace the group that is responsible for them.

#### 6.2.4 Logistics Service Extensiveness



**Figure 16 Features: Logistics service extensiveness.**

The collaborative inventory solutions often offer different levels of logistics services when it comes to the delivery of the goods. The services could range from only picking the goods from the supplier warehouse, all the way to the supplier delivering the goods and performing the put-away at the buyer's warehouse. A reasonable extent of services should be considered to meet the needs of each model. Nordkalk does already have existing staff that will is not expected to be reduced as a result of outsourcing, so a high level of procured services should not be necessary. Buying extra services should only be considered if their cost is clearly below what Nordkalk currently has available.

### 7 Development Plan

When considering Nordkalk's current situation and their goals, the most important improvements are the reduction of the purchaser's workload, and reducing the amount of money tied on the inventory. Their purchaser is expected to start handling the tasks of two purchasers in future, so his existing workload should be decreased significantly. Greatest improvements for the purchaser would result from the use of VMI, which is the only model that releases him completely from the replenishment process of selected goods. However, problems could result from the fact that each line on an invoice should have a corresponding purchase order line in Nordkalk's ERP system. CRP and CS provide some assistance, but the purchaser would still need to process every purchase order line. Greatest inventory value reductions would result from a model that implements CS, since the CS items would not be under Nordkalk's ownership until consumed.

Implementing any of the outsourcing models would require Nordkalk to develop their internal activities and item data. Selecting the items for outsourcing, and producing the required data to start the collaboration would require Nordkalk to go through their item data thoroughly. This process will take time and effort, because outdated information exists within the system, and no ready values for minimum or maximum inventory levels have been set for any items. The outsourcing models also require good communication to function efficiently, which is a weak area for Nordkalk even now when the processes are handled internally. This means that communication improvements would also be required for it to be reasonable to involve a supplier in the inventory management.

As it is clear that internal improvements would be necessary in order for it to be reasonable to consider involving an external party in the inventory management process, the developments should be made at Nordkalk rather than purchased. The risks of any of the collaborative models functioning poorly are mostly coming from Nordkalk's side rather than the supplier's side, which is something that puts Nordkalk in a bad position when thinking about a contract. Resolving the situation simply by buying the service from an external party would seem like an attempt to get rid of the problem, rather than solving it. Improving the internal weaknesses could alone improve the existing situation with the inventory management, while also providing more favourable conditions for considering outsourcing. The internal improvements also have the strength that the improvements will affect all the inventory items, while the outsourcing models will only concern some of them.

### 7.1 Data Improvement

Nordkalk should start the development of their inventory replenishment system by tackling the poor quality planning data in their ERP system. The current invalid data causes their order point system to create poor quality replenishment requests, which increases the purchaser's workload, and occasionally leads to stock-outs. The goal should be to make the order points such that the purchase requisitions are created early enough to tolerate some delays, which are quite common due to the purchaser

having to wait in order to accumulate high enough order sums. The suggested order quantities should be fixed to be such that they would be in accordance with recent replenishment orders as well as with the possibly new order points. This should, of course, preferably be done without causing increases to the inventory value.

The updating should be started from the MRO items which require constant replenishment, since their purchase requisitions will be handled most often. Moreover, these items' planning data should be easiest to define, as they will have plenty of data to be analysed behind them. Items should then be worked through from the fast moving ones toward the slowly moving. Eventually the process could also be applied to spare parts, in which case assistance will be needed from the maintenance department.

The data that should be used as a basis for evaluating the current values is the transaction history that can be found for each item from the ERP system. A report for a desired time period's total consumption, average inventory value, and cycle time can also be created for each item. From the transaction history one can see what the individual withdrawal quantities are like on average and at their highest, and at what kind of rate they occur. Few items at Nordkalk's warehouse have a consumption rate that is so constant and stable that decent values could simply be calculated, so decisions should be made on the basis of each item's nature.

The information needed to define the order point for an item is its average consumption and delivery time, as well as the expected delay resulting from small order sums. The basic formula for defining the order point for an item is to calculate the average consumption during the delivery time and the expected ordering delay, and add some safety stock to not let the stock run empty (see Figure 17). The safety stock should be based on the stability of the item's consumption, in a way that stable items need fairly low safety stocks, while more unstable items need high safety stocks. This way buffers exist to withstand unexpected withdrawals.

Avg. consumption per day \* Lead time (days) + Safety stock = Order point

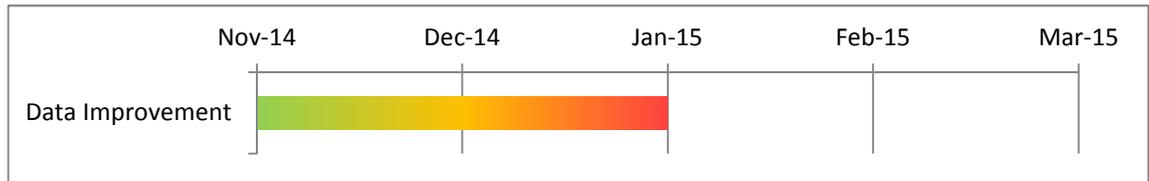
**Figure 17 Order point formula.**

The defined order quantities should be based on the consumption rates and item values. The order quantities should, of course, be at minimum high enough to exceed the order point, but they should be defined in a way that supports the replenishing process. Since the purchaser is struggling with the small purchase order sums, they should prioritise on holding items with high consumption rates and high value near their order points. This way they require frequent replenishment and, therefore, offer opportunities to purchase other items with them. This also contributes to the goal of reducing inventory value, since the stocks of high value items are set as low as they can be without being impractical.

The goals of this improvement are to decrease the amount of time required to process all the order requisitions, as well as to improve the availability of items by decreasing the delay between withdrawals and replenishment. This could potentially require increasing the total inventory value, but it could make the difference between needing one or two purchasers to keep up with all the required purchases.

### **Implementation and Follow-Up**

Since the existing planning data is a clear issue in the purchaser's work, fixing it should be started as soon as possible. Defining the new data relies heavily on the inventory purchaser, as he is the only one who possesses the knowledge on the delay times resulting from small order sums. Because of this, it is essential to define the new values before his workload increases. The second purchaser will be retiring in mid-January 2015, which means that this should be the absolute latest time for the new data to be finished and set into the ERP system, as illustrated in Figure 18. If it should be necessary, the other employees of the purchasing department should assist Lappeenranta's inventory purchaser with his other tasks while he works on improving the data.



**Figure 18 Development schedule.**

After the data has been updated, and even during the updating process, some performance indicators should be followed to see if improvements are being achieved. An indicator that can be followed without exerting a lot of effort would be the average time between the creation of a purchase requisition and it being turned into a purchase order. This would show whether or not the ordering delays are changing as the new data is being utilised. The data can be collected and analysed by the purchaser for example on a monthly basis. To ensure the validity of this data, the purchaser needs to make sure to eliminate any intentional delays from it.

A good indicator to be followed with the help of the warehouse staff is the number of stock-outs. The warehouse staff can start recording stock-out situations and communicating them to the purchaser. The difficulty in utilising stock-outs as an indicator is that they have not been recorded in the past, so it is initially difficult to see any improvements with this data. However, as more data is collected the number of stock-outs should turn into a decrease if improvements have been reached.

## 7.2 Communication Improvement

A significant source of difficulties in Nordkalk's existing practices rises from the lack of communication. Material needs are rarely reported before the items are already needed, and the maintenance staff tend not to check stock levels from the ERP system. This creates a constant atmosphere of uncertainty, because no one can predict whether or not items will be available when they are needed. The only way to improve this situation is that the maintenance department starts communicating their material needs to the purchaser as early as possible. For this to be an improvement it

should, of course, be assumed that the maintenance department is planning their maintenance activities beforehand as extensively as possible.

The basis for creating a functioning communication system should be simplicity, because it should not be assumed that any solution is accepted without resistance when nothing has been required to be done before. The simplest form of communication that is easily available for the maintenance foremen is email. Therefore email could act as the channel for conveying information between the departments. The demand information could be sent to the warehouse and/or to the purchaser depending on its nature. The warehouse staff and the purchaser are interacting face-to-face several times a day, so it is not a problem if the information makes its way only to the warehouse staff. The demand information should ideally include the inventory part number of each needed item, the needed quantity, and the planned day of withdrawal. Based on this, the warehouse staff or the purchaser could then check the availability of that specific item, and addition to the stocks could be ordered if necessary.

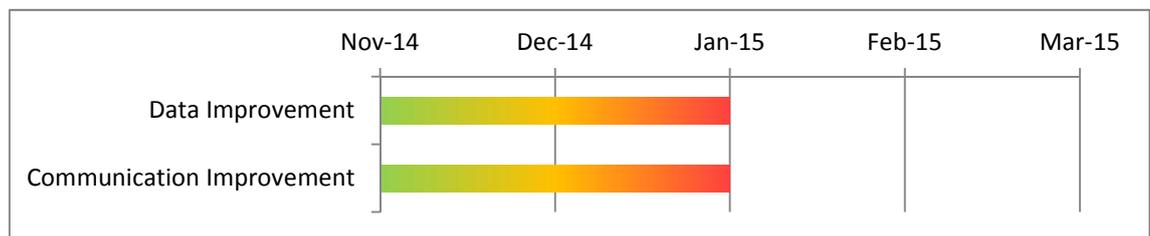
To support the communication, the maintenance department's staff need to be provided with training on how to inspect inventory information through the ERP system. This should help them with finding the items that they need from the system, and hopefully noticing insufficient inventory levels before the items are needed. Written instructions for the required functions of the ERP system need to be created and made easily available in order to promote the use of their new skills and to discourage them from going back to their old ways. With this improvement the desired results would be to reduce the number of surprising consumption peaks, and through that make replenishing stocks easier. This way items can be better held available, and stock-outs should be easier to prevent.

### **Implementation and Follow-Up**

Developing communication should be the responsibility of several departments within the company. A team with members from purchasing, maintenance, and ICT departments needs to be formed in order to create a system that would best meet the

needs of all the related parties. The inventory purchaser should be responsible for defining his needs in means of what kind of information is valuable for him and when he should receive it. The central warehouse is under the maintenance department's control, so their department's responsibilities should be defining the needs of the warehouse staff and the maintenance staff. When the needs have been defined, all the parties should mutually design procedures that make communication between them simple and efficient. The ICT department's presence should assist in forming a solution that utilises the best available technology.

The schedule for this improvement is similar to that of the data improvement. The sooner these improvements can be implemented, the sooner people will learn to adapt to them and results will be achieved. The team for this project should be set up as soon as possible, and the deadline for implementing the improvements is by the end of 2014, as shown in Figure 19. The actual time requirements for this improvement depend on the type of system that is created.



**Figure 19 Development schedule.**

The indicators for following this process are the number of material needs reported to the purchaser or the warehouse, as well as the number of stock-outs. From the number of requirement reports it can be seen if they are being made or not. This number can be compared against the number of stock-outs, since the goal of this communication is to prevent stock-outs from happening.

### 7.3 ERP System Utilisation Improvement

In order to improve the utilisation of the ERP system, its possibilities for assisting the inventory replenishment need to be examined. Automated functions related to the purchase requisition creation should be inspected to see if sufficient data can be en-

tered into the system without excessive efforts, in order to reduce the amount of work required to turn the requisitions into purchase orders. The current level of automation is at its minimum, so any improvements should be considered.

A potentially useful function in the ERP system would be the possibility of reporting material requirements through maintenance work orders. The material withdrawals are currently recorded under work orders, but this is completely done by the warehouse staff on the basis of what has already been withdrawn. This allows directing costs and recording the information on the items required to complete the task, but its planning possibilities are not utilised. The ERP system's order point system reacts to the recorded material requirements by creating a purchase requisition for items that will be consumed below their order point once the planned withdrawals are made. This function could potentially be used as an efficient tool for communicating material needs to the purchaser.

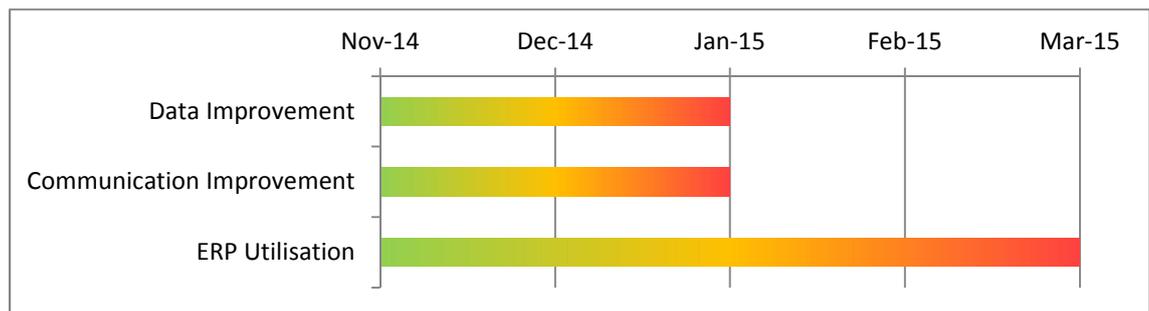
The goal of this development is to let the system do all the possible tasks that it can, while leaving only the most important ones to the purchaser. Furthermore, maximising the utilisation of the ERP system should be a major goal when considering how large of an investment it has been to the company.

### **Implementation and Follow-Up**

Exploring the possibilities of the ERP system will require cooperation between the users and the experts. The purchasing department needs to team up and discuss the system features with the ICT department's specialists, and through these discussions seek for unused features that could be employed. Members from the maintenance department should also be included in the discussions in case they will be involved in the newly planned processes.

The biggest difficulty in this improvement comes from the fact that only the ICT department possesses broad knowledge on the capabilities of the system. This makes it difficult for the users to wish for something, since they might not have a clear image of what the system can do. Due to this, the schedule for these improvements should

not be very tight. Moreover, even if usable features are found, they will require testing before implementation. A somewhat reasonable schedule for this is to start looking for possibilities now that the purchasing department still has more resources, but implementation could extend further than the other improvements (see Figure 20). Of course, the development of the ERP system usage should be a continuous process that only ends after all system functions are in use, so it should be continued with a lower priority after the intensive beginning phase has finished.



**Figure 20 Development schedule.**

#### 7.4 Warehouse Staff Utilisation Improvement

It is clear that the warehouse staff's workload is quite variable during their working hours, so they contributing for these improvements should be considered. One task that the warehouse staff could assist the purchaser with is processing the automatic purchase requisitions that are created by the ERP system. This task is not especially difficult, but rather just time consuming, which is why it is not of high importance that the purchaser handles it. Clear purchase requisitions for regularly ordered items could be released for ordering by the warehouse staff, while unclear ones could be left for the purchaser to decide.

The warehouse staff could also assist the purchaser in communicating with the maintenance department. The staff could receive the demand information, and communicate it to the purchaser if necessary. They could also record the communicated demand information on the work orders as they do now, which would communicate it to the purchaser via the ERP system. The warehouse staff are also capable of creating purchase requisitions in the ERP system manually. This function could

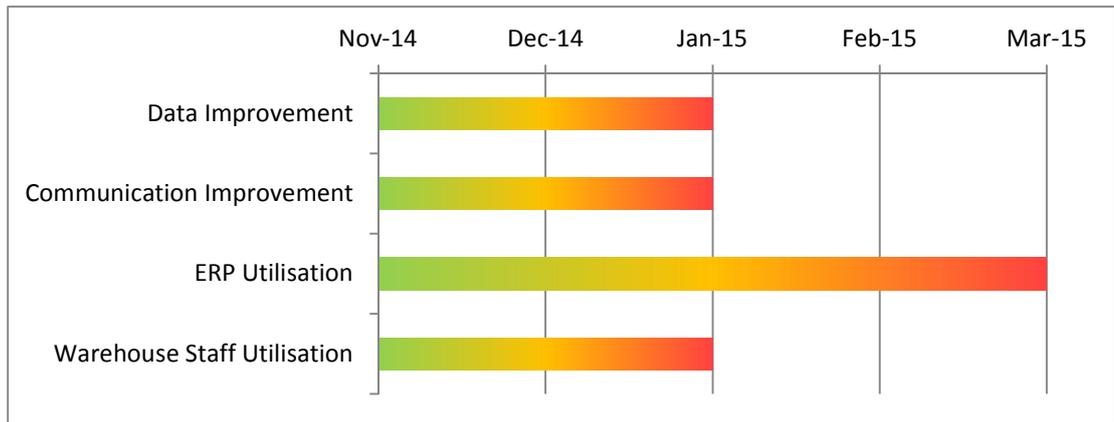
potentially be used in case they observe or hear of inventory levels being lower than desired but still such that the order point system will not react to them.

With these improvements the warehouse staff could have tasks to do during the quiet periods at the warehouse. This is good for the staff because they will have less passive time, and also for the company because presumably they do not wish to pay for anyone being idle.

### **Implementation and Follow-Up**

When considering the utilisation of the warehouse staff in purchasing work, it is important to initially ensure that the intended arrangements follow all the company rules. Having the warehouse staff observing purchasing data within the ERP system is completely harmless, but their permission to modify it needs to be inquired from the executive level. Another debatable matter with this idea is that the warehouse staff are under the maintenance organisation, while purchasing as a function is under the purchasing and technology department. Tasks should not cross the department borders, so it needs to be clarified whether this kind of arrangements would break this rule. Furthermore, it needs to be decided by the chief of maintenance as well as by the warehouse staff whether or not they will agree to implement the suggested arrangements.

If this arrangement is accepted by the related parties it should be implemented as soon as possible, since the purchasing department still has more resources available for educating the warehouse staff on requisition processing. Getting the warehouse staff to try the system soon will let them have time to find its difficulties, and help can be provided by the purchasers. The arrangement should be fully put into practice by the end of 2014, which would mean that little help from the purchaser would be needed to carry out the processing (see Figure 21).



**Figure 21 Development schedule.**

Metering the performance of this arrangement might be difficult to do absolutely quantitatively, since processing the purchase requests does not necessarily mean that they have been processed in a satisfactory manner. It could be followed how many request lines are being processed by the warehouse staff, but it should be ensured through discussion whether the processing has been acceptable or not, since that is what determines whether it is relieving the purchaser's workload or not.

### 7.5 Consumption Increase

A development that could be considered is increasing the use of the inventory items. Increasing consumption could help creating more stable consumption rates, which would be helpful when replenishing the stocks. With a more constant need for replenishment, it could even be easier for the purchaser to process all the replenishment orders, despite the potentially increased ordering frequencies. Higher consumption could also result in price decreases through economies of scale.

Nordkalk has a central warehouse for MRO goods only in Lappeenranta, from where they could consider distributing items to their other locations in Finland. Currently at many of the other locations employees need to purchase items every time that they are needed, excluding some cases where an annual order has been made to a supplier. Purchasing goods will require a purchase requisition, a purchase order, transportation or pick up, and invoice handling. Distributing items from Lappeenranta would

allow increasing the warehoused items' purchase order quantities, and the acquisition of goods at the other sites would no longer require a purchase requisition or a purchase order, but only a material request that would be sent to the warehouse. The items could then be sent to the user by mail, and a material transaction would be recorded into the ERP system. Costs would accumulate from the mailing, but they would be compensated by the reduction of time spent on processing the orders and invoices, and especially that spent on possibly driving to the supplier to pick up the goods.

A second way of increasing inventory use would be to discuss the need of each company having their own warehouse at the site in Lappeenranta. The most potential company to use Nordkalk's warehouse would be Astepa, who is already its biggest external user with 45% of all the previous year's external withdrawals. Their premises are fairly close to Nordkalk's central warehouse, and their driver visits the warehouse several times per day to deliver ordered goods to Nordkalk and to distribute their mail. The goods held in Astepa's warehouse consist of items out of which most can also be found from Nordkalk's warehouse. Unlike Nordkalk, Astepa does not look after the warehouse at all times, and their warehouse manager takes care of replenishing their inventory, as well as manually recording all the transactions. (Nieminen 2014.) By primarily using Nordkalk's warehouse they could free resources off their warehousing activities, and they could also decrease the amount of their capital invested in their inventory. Naturally, Astepa would pay a margin for the items like before, but with higher consumption quantities this margin could be decreased from where it is currently.

This development should be approached with caution, since there is the risk that the workload of the purchaser increases. Handling replenishment orders could become easier with more constant consumption, but the number of orders could increase. Therefore it is important to plan the system well before implementing it. A somewhat certain mismatch with Nordkalk's goals would be an increase in the total inventory value, as more stocks would be needed to meet the requirements of all the users. However, this increase would be countered by the savings resulting from less work being required to purchase goods, as well as by the increased sales to Astepa.

## Implementation and Follow-Up

Starting the distribution of items from Lappeenranta to Nordkalk's other sites would be likely to require the acceptance of the chief of maintenance as well as that of purchasing. The convenience and the costs of the distribution should be examined by the supply chain department, as they most likely to possess the best knowledge in how the transportation procedures should be arranged. These calculations should then be compared against the perceived amount of resources used on the item purchases. If the comparison supports the distribution, it could be taken into use. This would initially require creating clear procedures for how to order and deliver goods, and then communicating them to the other sites. Since this idea is somewhat experimental it should not be rushed with, in order to keep control of it while changes are being made in the other procedures.

Getting other companies to use Nordkalk's warehouse is an executive level decision and, therefore, the idea should be suggested to them by the executives in Lappeenranta. Implementing this kind of cooperation requires thorough planning and instructing, in order to have all the parties following Nordkalk's rules and procedures. Inventory levels and planning data may require re-evaluation if significant increases can be planned in the consumption of items.

The time scheduled for the suggested developments should be somewhat long, because careful planning should be made to avoid increasing the workload of the purchaser. Discussions about the matter could be started anytime, but implementation should be left to the time after the other developments have been finished, and Nordkalk's purchaser is left alone to support the inventory. This way it can be seen whether resources exist to support this kind of system or not. The schedule is illustrated in Figure 22.

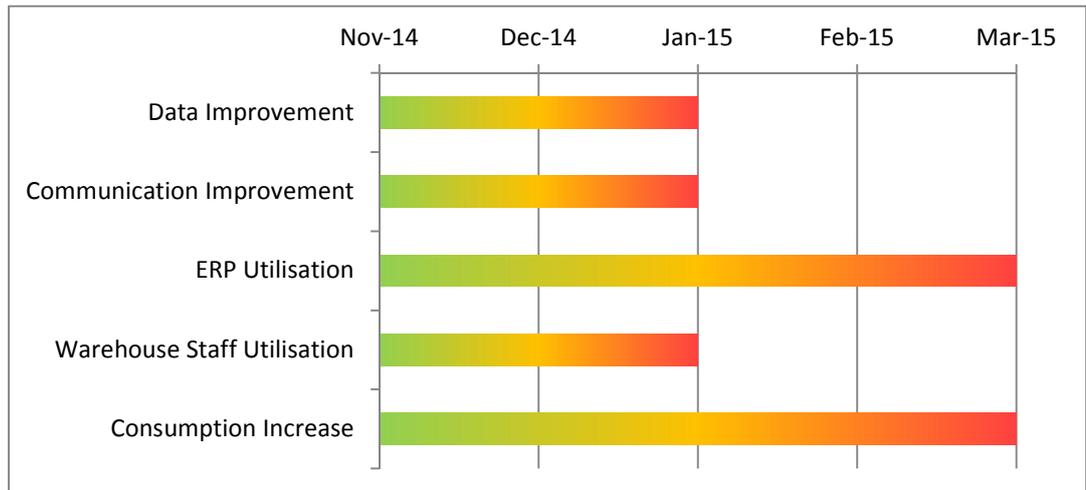


Figure 22 Development schedule.

## 8 Discussion

The goals of this thesis were to analyse whether or not logistics outsourcing theory supported the idea of Nordkalk Corporation outsourcing a part of their inventory management in Lappeenranta, and to provide Nordkalk with a solution proposal to improve their current situation. The decision not to outsource could be made with support from several theoretical aspects, and an internal development plan was created, so that the goals could be seen to have been successfully reached.

A profound theoretical framework was successfully built for the analysis. This made it possible to observe the situation from various different aspects, thus providing a good overall basis for decision-making. A clear image of Nordkalk's current situation could also be formed, which enabled trouble-free comparison of the reality against theory. The outsourcing theory does not suggest using outsourcing only as a source for cost savings, which was more or less what it would have sought to result in if Nordkalk's existing rules had been respected. A fair amount of improvement potential existed within the current process, and several of the potential improvements were such that none of the solutions could be implemented without them. Therefore, it did not seem reasonable to pay all the effort that it would require to carry out

these improvements, and then continue to outsource without analysing the benefits that would result from these preliminary actions.

Overall the gained results were good, but the lack of concrete values did undermine their reliability. Cost calculations could not be done because no prices were available for the models that could have been offered by potential suppliers. With one of the client's wishes being to reduce costs, it was difficult to predict whether this would be reached without actually having any price comparisons. However, with the theory pointing out other weaknesses of outsourcing in this situation, it was not entirely necessary to obtain these calculations at this point. A decision could be made and justified with the available information, so the results can be seen to be useful.

The results should be helpful and useful for Nordkalk Corporation, but drawing broader conclusions from them will be difficult. As the study was a case study that was tailored to the needs of a client, the results are naturally not completely applicable to other situations. However, the theoretical coverage of the thesis is such that it will apply to other inventory outsourcing situations, thus providing a solid information basis for considering similar solutions. Being able to demonstrate cost comparison would have increased the utility of the thesis.

## 8.1 Conclusion

When it comes to the future of the analysed situation, it is not certain that the proposed improvements will resolve the situation for good. With the prerequisite procedures done for the outsourcing models through the internal improvements, Nordkalk could still consider going for outsourcing if the initially resulting improvements turn out to be insufficient. It is difficult to predict the future situation, but if the same goals of purchaser workload reduction and inventory value reduction are sought for, Nordkalk should consider going for the VMI+CS model. If they can manage to set up an arrangement where the purchaser can be detached from the VMI process, the VMI+CS model should contribute the most to their goals.

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