Re-design of the distribution network of SKIL Europe B.V.

An analysis of the design of the physical distribution network using a generic framework towards a network with lower supply chain costs

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This article describes my results of the research that I performed for the Master Transport, Infrastructure & Logistics. This Master is a relative new Master direction at the University of Technology at Delft. It is a cooperation between three faculties, known as Mechanical Engineering, Civil Engineering and Technology, Policy and Management. The idea behind this new Master is to give the student knowledge about subjects that reflects the working field of this three faculties. The Master thesis should contain subjects related to at least two of the three faculties.

I performed my master thesis at a civil company, known as SKIL Europe B.V. which produces electrically powered tools. The next paragraphs are describing my research at SKIL Europe B.V. The financial figures mentioned in this article are fictive numbers or left blank due to the confidentiality of this information.

Skil Europe B.V. was establishes in the early 1920's as a producer of the electrically powered handsaw, also known as the Skilsaw. In 1992 there was a joint venture with Robert Bosch GmbH which led to a takeover of Skil by Robert Bosch GmbH in 1996. The main office is located in Breda, The Netherlands. Skil Europe B.V. is nowadays a manufacturer of a wide range of power tools with their main factories in China.

Globalization of the market, open markets in Europe, increasing fuel prices, economic recession and increasing prices of raw materials set pressure on the market. Outsourcing of non value added activities and increasing customers demand in quality and customer service levels make that companies need to keep evaluating their strategy continuously to keep their competitive position in their markets.

One of the important processes in reaching the customers and the customer's satisfaction is due to excellence in supply chain management. The supply chain is very important for many companies in order to structure their logistic process, because the supply chain performs in most cases as the value added activity and fulfils the customers demand, but the supply chain also represents a significant amount of the costs for a company. This is also the case for Skil. The profit of Skil is under pressure and they need to keep up and eventually increase the profit.

Skil has a complex supply chain with 26 suppliers and many different inventory locations and customers in 37 European countries. The current logistic organisation has grown over the years with an increase of customers in different countries and is integrated with the Bosch organisation when Skil became a business unit of Bosch. During these years adjustments have been made on the physical distribution network to lower certain supply chain costs when it turned out that a distribution to a warehouse could be done with lower costs.

But a complete analysis of the whole distribution network from all 13 warehouses to all customers in 37 countries hasn't been made yet. What would be the outcome when looking at all these actors and factors in the physical distribution network? It should give insight in possibilities to change the whole network in order the gain cost reduction in the supply chain.

Skil divides their supply chain costs into three phases depending on the place of the product in the supply chain. The source side which is the distribution from the supplier to the main warehouse in Breda / Meer. The make side, which is the value added activity in postponement that takes place in the main warehouse. The last is the deliver side in which the final distribution takes place from the

main warehouse to the customers in the countries. Because this research aims at the possibilities of an alternative lay-out of the physical distribution network the focus of this research is on the outbound side of the supply chain. This last phase represents the biggest amount of supply chain cost in Skil's logistic organisation, about ...% of the Total Net Sales.
To lower the supply chain cost Skil wants to adjust their physical distribution network for the future, (period of 3 to 5 years). This means that it will need decisions mainly on strategic level.
This research uses a generic framework to analyse the physical distribution network of Skil in order to look for a possible ways to lower the supply chain costs. It gives an indication of possible ways to locate-allocate warehouses and customers of Skil. It gives no solutions on tactical or operational level of actions to be taken to lower the costs, but it gives a strategic direction of (re-) designing the physical distribution network in order to lower to supply chain costs and to meet the service level requirements of Skil
The objective of this research is to ***re-design the physical distribution network for Skil Europe B.V. for the next 3 to 5 years, towards lowering the logistic costs.***
To propose an alternative physical distribution network design is it important to gain knowledge about the current logistical structure of a company. Many authors already discussed possible ways to analyze a physical distribution network. But these theories didn't cover completely the wanted analysis for this research. The core aspect to analyze a company is in the most theories the same only the connection between the information after the analysis with the use of the location-allocation theory was missing. Therefore a new generic framework (*see Figure 1*) is made, based on these theories, which can and will be used to analyze an organization. A stepwise research based of this generic framework provides the necessary information that is used as an input to come up with a possible physical distribution network design with the lowest supply chain costs.
This generic framework is used as a criterion in this research. The steps given in this framework are executed to analyze the organization of Skil and gain the information needed to propose an alternative design. It can also be used for

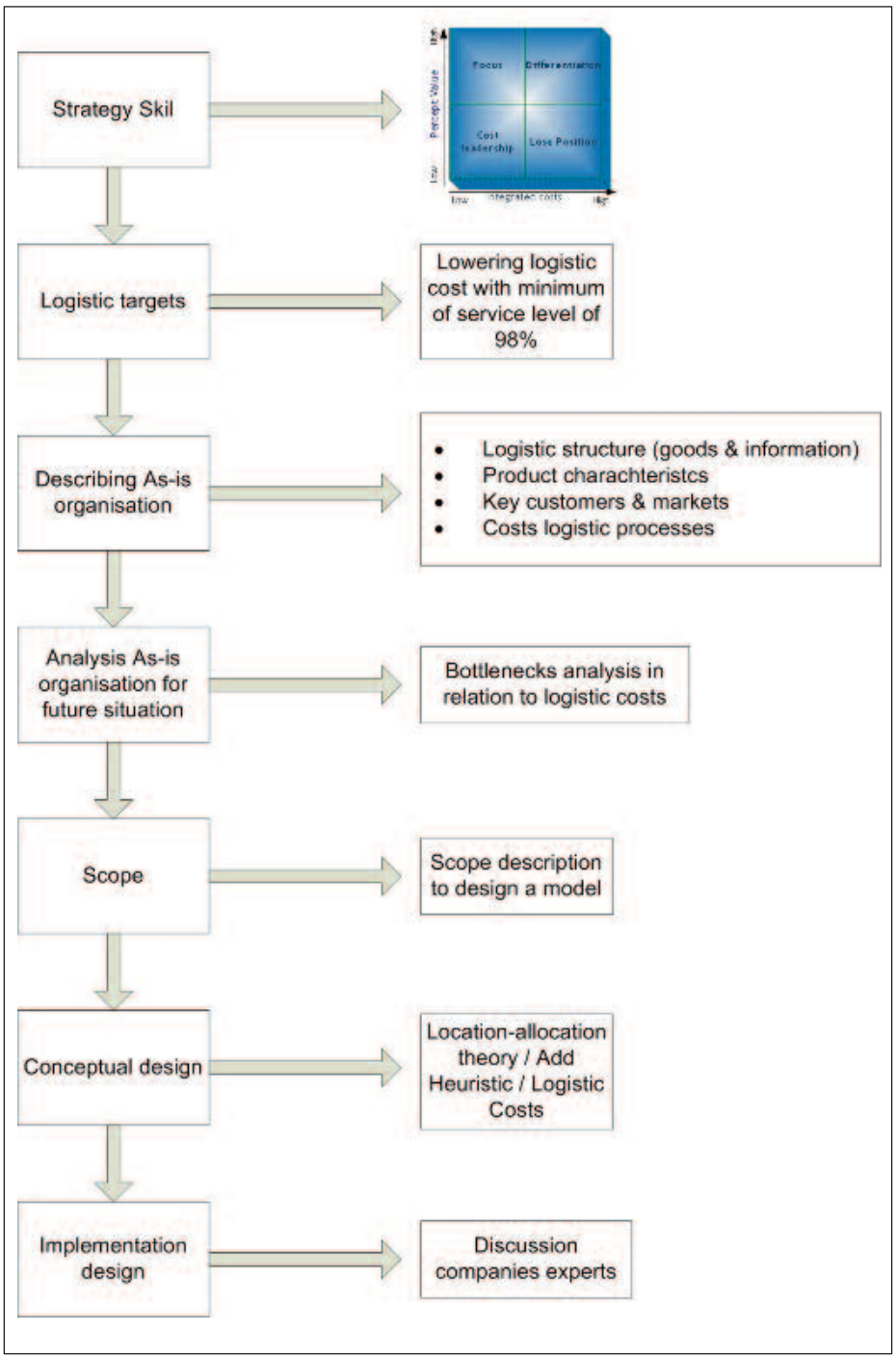

Figure 1 Generic framework to analyze a design of a physical distribution network

other companies to better understand the organization in depth in order to gain a clearer overview of their logistical procedures. When looking for a alternative network design this information is needed to be able to change aspects of the organization in order to adept to the future
First it will be important that it is clear what the corporate strategy is of the company because this will be the starting point in structuring the logistic basic form. The competitive strategy matrix of Porter's is used to get the strategy clear. Skil uses a strategy which lies in between the focus and differentiation. This is remarkable because the theory gives that the best way of getting a good market positioning for their products a clear corporate strategy must be chosen. In this case Skil doesn't make a clear choice regarding the integrated costs. They don't want to be the lowest because that will mean less service or lower marketing budgets. But it can't get higher costs because than they will enter the Bosch tool markets. The logistic target Skil has, is to eventually get a service level of 98 % with a significant decrease in the supply chain costs in 2011.

The next step is to get a clear overview of the as-is organization. Skil uses different warehouses in Europe to distribute their products from the main warehouse in Breda / Meer to the customers in the 37 countries. These warehouses are affiliated to the customers in the countries. Skil keeps inventory in these warehouse at a level that the service level will be met. Therefore the Customer Order Decoupling Points (CODP) are lying at these warehouses. The products between the warehouses are transported by a carrier which uses mainly truck loads. The transport of products is divided in rough distribution (warehouse to warehouse) and fine distribution (warehouse to customer) and done in all cases by a 3PL. Due to the fact that the lead times are rather long (65 – 75 days), the CODP lies that far in the logistic chain the costs and the service level target is 98 %, it means that a lot of costs are at transport and inventory. The strategic value of the product of Skil and their complexity aren't that high, which means that Skil is keen on meeting the customers demand.
The supply chain cost for the physical distribution network are calculated by using general calculation methods. A calculation model has been made in excel using different equation for different activities. These activities are the basis of making supply chain costs more transparent within a network. An overview of the cost drivers derived from theory research and applied on the situation of Skil is generated (*see Figure 2*).

With use of this costs diversion within Skil equations to calculated the costs are formed based on the main Equation 1. These equations are making it possible to calculated the different costs within the physical distribution network.

From research it can be concluded that the biggest share of costs is in the fine

Physical distribution Costs
TC = T + I + W
TC = Total costs in physical distribution (euro/year)
T = Transport (euro/year)
I = Inventory cost (euro/year)
W = Warehouse & handling cost (euro/year)

Equation 1 Physical distribution costs

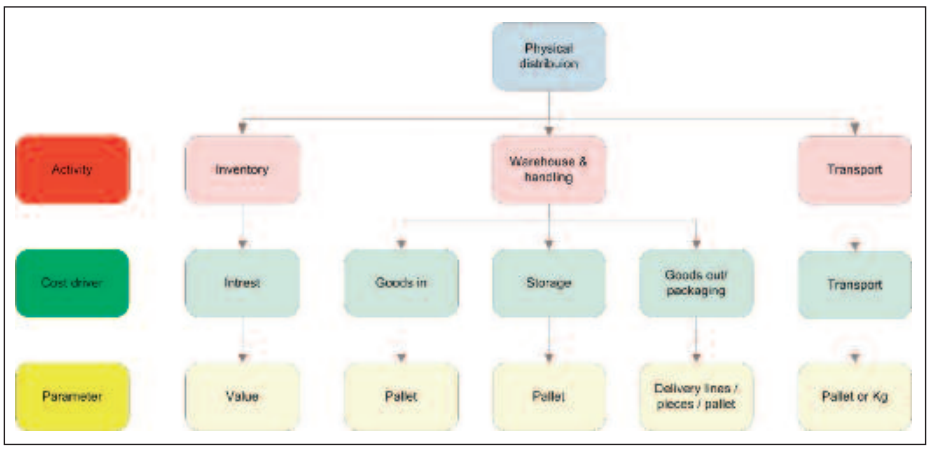

Figure 2 Cost drivers overview for Skil (derived after field and desk research at Skil)

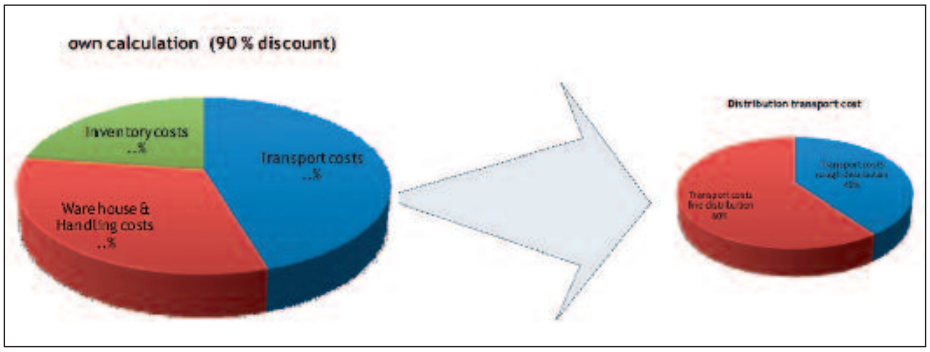

Figure 3 Diversion logistic costs

distribution of the part numners from the local warehouses to the costumers in the countries
To validate the calculation model a comparison is made with the costs calculated by the financial department of Skil. From this comparison can be concluded that mainly the fine distribution costs are showing a big difference. This can be explained due to the fact that normally Skil gets a discount for the fine distribution rates or the prices used in this research from UPS vary much from the real prices that are charged at Skil. When taken a fine distribution discount of 90 % on the current rates of UPS the prices are more in line with the data calculated by the financial department. The diversion of the costs with this discount rate can be seen in *Figure 3*.

A more in depth analysis of the costs gives more insight in possible ways to lower these costs and what will be the subjects for further research. From this analyse it became clear that few cost savings can be achieved by using operational decisions, like changing pallet stacks or shortening the lead times. But the transportation cost are the biggest share of the total supply chain costs. This activity can be influenced by changing the physical distribution network. But by changing this network also the costs for inventory and warehouse & handling will be influenced.

The bottleneck in this research that it is not clear what the results on the supply chain costs will be when changing the lay-out of the physical distribution network.

The change of the layout of the physical distribution network gives an alternative design. This alternative design is made by using a location-allocation model. This model is constructed to optimize the logistic structure of Skil in terms of costs. For the situation of Skil a model is constructed which uses the ADD heuristic. It is a model that will fits the best for this research to look for alternative designs in order to lower the transportation and facility costs. The ADD heuristic is one of the most widely known heuristic and is still strong foundation for much of the location theory research done. Although in case of heuristic no guarantee exists that it would find an optimal solution, using exact methods is not a feasible option either. First, exact solution methods require

more knowledge of linear programming and more sophisticated programs to solve those problems. Secondly when the problem becomes too large exact methods may not be computationally feasible.
For the situation of Skil the ADD heuristic will be a strong and usable tool to solve easily location problems if there are relatively few possible locations. The ADD heuristic is a location-allocation model that also could be used for other companies. The only change that will be needed is that the input variables have to be adjusted to this other company.
The target for this model is to: Optimize the transportation and facility costs for a centralized physical distribution structure through mitigating local distribution centres to a few distribution centres in Europe.
The important input parameters needed to minimize the transportation costs and warehouse costs are the demand of part numbers and from these derived the number of parcels and pallets or weight of a shipment between or within a country. The relation between the parameter in the model are given in *Figure 4*.

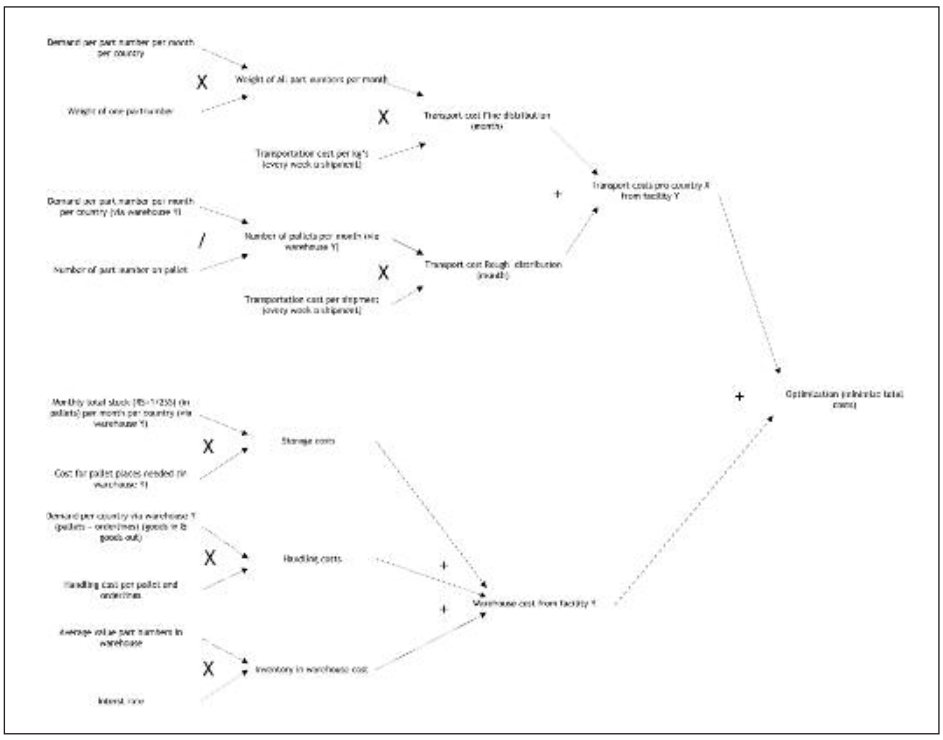

Figure 4 The relation between the parameters of the model

The relation diagram is used to calculate all costs of the physical distribution network. The model is designed in excel in which the demand of the part numbers pro month pro country will be the input. By opening and closing warehouses (one at the time) and allocate countries to these warehouses the costs can be calculated. When the steps are executed the warehouses are sorted in a decreasing order of total savings. For every step a warehouse will be assigned to a country (allocate). This allocation is done based on the lowest total cost of the open warehouse when distributing to that specific country.
When looking at the original situation of the layout of the network compared to a calculated 'optimized' lay-out of the network, with fine distribution rate discount of 90 %, the following result is obtained (see Figure 5)

	Optimum Model	Orginal situation
Transport Costs	52%	..%
Warehouse & Handling Cost	19%	..%
Inventory in warehouse cost	29%	..%
Transport costs fine distribution	89%	60%
Transport costs Rough distribution	11%	40%
Total Cost	2 17.870.261	2 28.935.719

Figure 5 Comparison optimum model with original situation

The total cost decrease and the share of the fine distribution costs increases a lot. This means less warehouses and more fine distribution from the warehouse in the Netherlands.
To be sure that the ADD heuristic gives a good solution a validation is made of the heuristic. From this validation can be concluded that the ADD heuristic will give the lowest total costs for all situation when adding warehouses to the network to obtain the lowest costs, but the sequence of adding warehouses differs between the between the two used methods.
To look how robust the network is and what has the biggest or least impact on the network when changing the parameters a sensitivity analysis is performed. With this sensitivity analysis the consequences for the network design, in terms of costs, is analyzed when the input parameters of the model are changed. The model has two categories of control variables. These are: the demand of part numbers of each country and the costs aspects.
The demand of the part numbers are changed by using a forecast of each individual part numbers based on the demand pattern of the year 2007 and 2008. Two forecasts are made. The first one is when the demand of part numbers increases with 20 % to a total net sales of ……. million euro's. The second is when the demand of part numbers decreases with 20 % to a total net sales of …. million euro's.
The costs aspects are divided into transportation costs and warehouse costs. Within these costs another diversion is made between the different cost drivers. This is done to gain a complete understanding of the costs developments in the model when changing parameters in the model. To vary the parameters the fine distribution rates were set a starting point. These turned out to produce the biggest impact on the network. So this parameters was changed ten times every time with 10 %. This is done to have a full understanding of the effects of this major parameter. Because steps of 10 %

were taken for this parameters a look has been made to the change of absolute values of this rate. To be sure that the changes of the different parameters were in line with each other these absolute changes must be kept more or less the same. This meant that the other parameters should change also with 10 % with the exception for the interest rate. This should change with 2 %.
For the year 2008 34 different scenarios are analyzed and for the situations that the demand increases or decreases with 20 % 26 different situation are analyzed. From these different analyses the following results from the change of the costs parameters are obtained. When the prices of the parameters increases the total costs of the network increase and vice versa. The warehouse in Latvia will always be redundant and the warehouses in The Netherland, Poland, Romania and Hungary are always needed in the network. The other warehouses are depending on the rate of the fine distribution. The number of warehouses needed highly depend on the fine distribution rate. The rates for the warehouse costs don't have a big effect on the relative differences of the decrease of the total costs in a network. The change of fine distribution rate sorts the biggest effect on the decrease of the total network costs when adding warehouses. It turns out that when adding a warehouse in most cases only the customers in the same country are allocated to this warehouse. An exception in all cases is the warehouse of in The Netherlands.
From the analysis of the change in demand can be concluded that an decrease of the demand has an negative effect on the KPI supply chain costs. An increase of the demand has a positive effect of this KPI. This means that the network costs benefit when the total demand is increased.
A lot of analyses' are done in this research. A new generic framework is developed which can be used in general to analyse a design of a physical distribution network. A calculation model in excel is developed to calculated the lowest supply chain cost of the physical distribution network by adding each time a warehouse. Eventually a complete sensitive analysis is made to investigate the robustness of the network and the effects of the change of parameters to the network. In this case it meant that the parameter of fine distribution has a major effect on the layout of the network and therefore also on the supply chain costs of the network.
At last the conclusions that are drawn for this research are that:
Implementing operational changes, like increasing pallets load, will have a positive effect on the supply chain costs.
Changing the rates in a way that the activities will become cheaper the total network costs will also be lower.
The warehouse of Latvia is not necessary in all alternative designs.
In the physical distribution network the warehouses of The Netherlands, Poland, Romania and Hungary are always needed.
Changing warehouses rates have less effect on the costs and lay-out of the network than changing transport rates
The warehouse in the Netherlands takes the most fine distribution to the country. The other warehouses are used mostly for only domestic shipments
Increasing the demand will lower the KPI Supply Chain cost.
It is very important to know exactly the fine distribution rate to decide to change the layout of the network.
The new introduced generic framework to analyse the design of the physical distribution network is useful tool. This tool provides a clear overview of the procedure to follow from starting to analyse a company in order to suggest a possible (re-) design of physical distribution network with lower supply chain costs.
This research has no clear end solution and it gives a very good starting point for further research at Skil. Therefore the recommendations for Skil are:
Further research is absolutely necessary for the subject of the fine distribution costs to be able to make a good decision how to change the layout of the physical distribution network.
Further research on operational decisions can contribute to lower supply chain costs.
Further research on how the big fluctuation in the demand pattern can be smoothened is needed to gain extra cost reduction over the complete supply chain.
Further research is necessary to investigate if the combination of the logistic targets of 98 % service level and the supply chain costs of < .. % (Total Net Sales) can be reached for the physical distribution network of Skil.
Divide the different cost activities as a subject each when further research will be performed by others for the benefit of time.

Arno Brinkman begon zijn loopbaan in 1994 op de KMA. Na afronding van KMA-I (studierichting Materieellogistiek) is Arno ingedeeld bij de Technische Dienst en geplaatst als Plv-pc Hrstpel 100 B&TBat (310 DS/AS Hrstcie). In 1999 vervolgde Arno zijn opleiding met de KMA-II module waarna hij functies heeft vervuld bij achtereenvolgens 13 Hrstcie, 41 Hrstcie en op het OTCLOG.
Tussen 2005 en 2010 heeft Arno zijn ingenieursopleiding gevolgd aan de TU Delft (Premaster WTB, Master Transport, Infrastructure & Logistics).
Aansluitend aan zijn studie is Arno op 9 februari 2010 ingedeeld bij de Technische Staf onder gelijktijdige bevordering tot majoor. Arno is geplaatst bij de DMO, afdeling W&M sectie Lichte Manoeuvre Systemen, als Systeemmanager Fennek.
Arno is getrouwd met Anouk Brinkman-Steitner en is woonachtig in Breda. Samen zijn zij trotse ouders van een zoon, genaamd Nick. In zijn vrij tijd leest Arno graag een boek en doet hij aan volleyballen.