Verhogen van betrouwbaarheid halffabrikaat leveringen aan Akzo Nobel Herkenbosch

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Afstudeerverslag van:	Aernout Zwinkels Student nr.: 326259
Bedrijfsbegeleider:	Dr. G.D. Welch
Universiteitsbegeleiders:	Dr D.A. van Damme Dr. ir. H.P.G. van Ooijen Dr. ir. S.D.P. Flapper
Bedrijf:	Akzo Nobel Functional Chemicals bv Amersfoort
Universiteit:	Technische Universiteit Eindhoven Faculteit Technologie Management

Abstract

This master thesis has analysed the intermediate shipments between two production sites. Both sites depend on these shipments and the reliabilty appeared to be lower than wished. A low reliability causes unnecessarry logistics costs and missed orders in the market. This report describes solutions for increasing the reliability by technical solutions, simplifying the order- and information process and redesigning of the logistics concept.

Executive Summary

Introduction

This report describes the results of a master thesis, carried out for Akzo Nobel nv. During the thesis the focus has been on increasing the reliability of intermediate flows between production sites in North America and The Netherlands. This has resulted in economically acceptable reliability by redesigning the logistics concept. Defining the optimal solutions for the three subsystems of physical distribution can stepwise create this redesign. These three subsystems are the means of transportation, warehouse location and inventory level. The results are of particular interest to the logistics managers at the aforementioned production sites and at the office in Amersfoort

Company Description

Akzo Nobel nv is a multinational company who manufactures health care-, coatings- and chemical products on a global scale The Akzo Nobel organisation is structured into the groups Pharma, Coatings and Chemicals. Within the last-mentioned group, Functional Chemicals is one of the business units This project was carried out for the Chelates and Micronutrients business within Functional Chemicals.

This project has a contribution to cost control by focussing on the logistics costs and proposing improvements.

Problem

The end products are produced in North America, The Netherlands and Asia This has effect on the physical flow of goods By shipping intermediates from one production site to another, the production capacity at the sites is used as efficiently as possible This project will focus on the intermediate flows ABB, CDD and EFF from North America to the Netherlands. The sites depend on each other and therefor the intermediate shipments should be reliable. Figure 0-1 shows the dependency. The flows can be grouped as follows:

- ***Compulsory***. The Netherlands needs ABB as raw material for Product 44-P, CDD for capacity reasons and EFF for production of N-35 for the European market;
- ***Optional*** North America needs The Netherlands due to a push effect of the raw material BBG Akzo Nobel desires to use as much of raw material BBG as possible. Each quarter the optional stream is evaluated

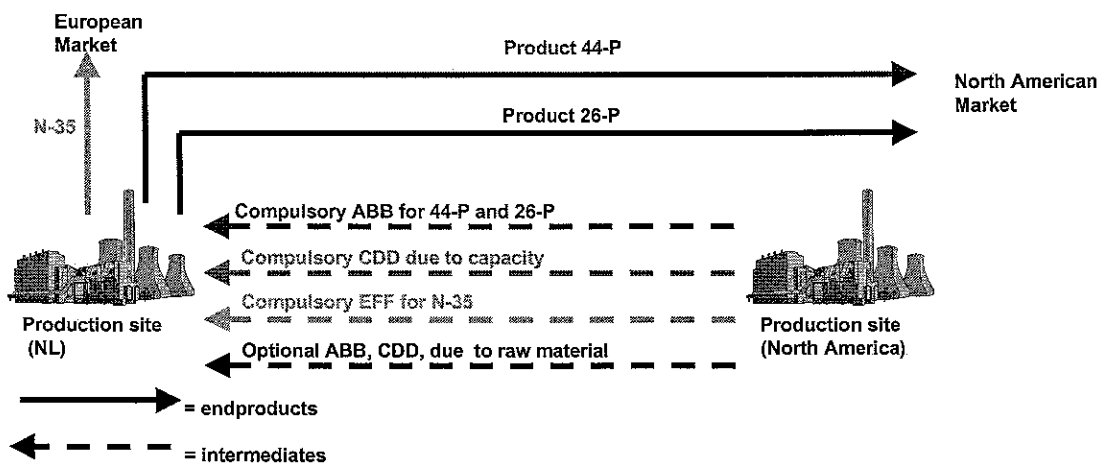

Figure 0-1 Dependency in flow of goods between North America and The Netherlands

In terms of volumes, a lot of intermediate shipments take place between North America and The Netherlands. Table 0-1 shows the budget volumes per year as well as the number of containers that is needed for shipping those volumes From the table it can be concluded that the volumes change significantly with time, primarily because the market is a dynamic one. Changes in the market demand will effect the logistics chain and secondly because North America's capabilities to produce certain intermediates change with time.

Table 0-1 Budget volumes intermediates and number of container shipments

Year	ABB [ton]	CDD [ton]	EFF [ton]	SXX [ton]	VVA [ton]	Total shipments [# containers]
2000	3.600					236
2001	4.400	4.800	750			610
2002	1.500	800	1.500	600	600	326

This project is based on the intermediate flows ABB, CDD and EFF in the year 2001. Concerning the logistics reliability, the focus was on the elements "on time" and "the correct quantity".

In the first half of 2001 the reliability of intermediate shipments was at a low reliability of 64 percent. Low reliability causes problems in The Netherlands. The logistics planner must undertake ad hoc actions, like changing production planning, building up and using inventory and arranging local raw materials. Even these actions can not guarantee that production always has the correct raw materials in time. These actions cause extra logistics costs and can even cause missing orders. The problem of this project can therefor be defined as follows:

The reliability of intermediate shipments from North America to The Netherlands is lower than wished. This causes unnecessary costs in the logistics chain and customer orders to be missed.

After the problem has been defined, the **goal of the project** can be formulated:

Increase the reliability of intermediate shipments to an economically justified level. This should prevent unnecessary costs in the logistics chain and prevent orders being missed.

Assignment and project approach

The assignment is to propose solutions for increasing the reliability of intermediate shipments to an economically justified level. In doing this assignment, several steps have to be undertaken. Figure 0-2 shows these steps in-between goal and result of this project.

As a start the consequences of the low reliability are mapped and the areas of influence for the reliability are identified. From there on possibilities can be generated for increasing the reliability. A new logistics concept is one of these solutions, which needs this research.

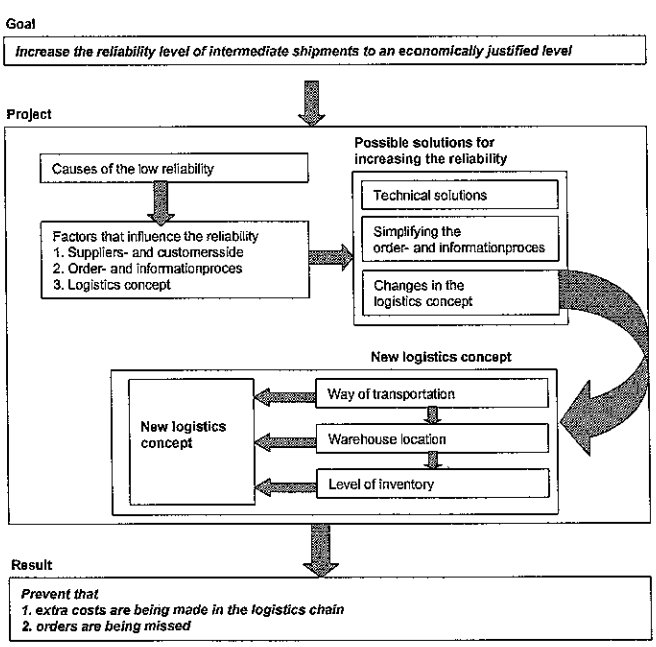

Figure 0-2 Project approach in-between goal and result

Consequences of a low reliability

Figure 0-3 shows the causes of a low reliability. Under the column "problem", the unreliability of shipments has been categorised into three groups Shipped quantities can be higher or lower than ordered. In case it is lower, then it can even be lower than compulsory In the column "reaction" the ad hoc changes in production planning are given. Production can be technically limited or e.g. changed over to local raw materials.

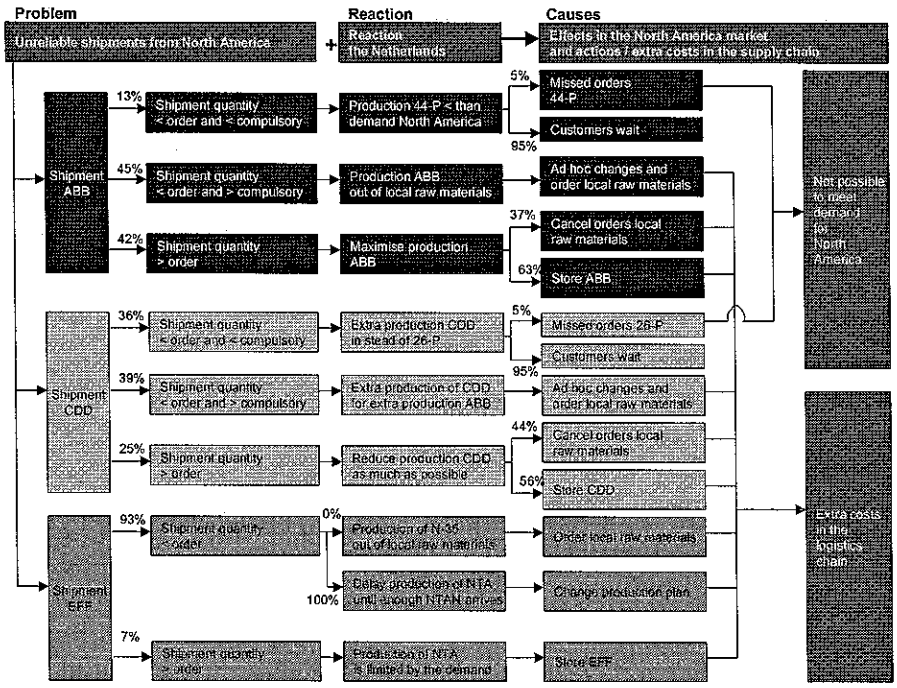

Figure 0-3 Consequences of a low reliability

A low reliability has several consequences, which are given in the last column in figure 0-3 The financial consequences of the unreliability in intermediate shipments are extra costs in the logistics chain of $ 130 000 per year and missed net sales of $ 20.000 per year in North America.

- Extra costs in the logistics chain are caused for 50 percent by ad hoc actions by the logistics planners in North America and The Netherlands and for 50 percent by unnecessary inventory and storage costs in The Netherlands;
- Missed net sales are caused in the first place by Product 44-P when the shipped quantities of the necessary intermediate ABB are lower than necessary for production of the required quantity of Product 44-P. In the second place, there are missed sales of Product 26-P when shipped quantities of CDD are too low because The Netherlands has to produce it's own CDD. That blocks production of Product 26-P

Factors that influence the reliability

There are factors on both production sites during the order- and information process and during the physical distribution, that influence the logistics reliability of intermediate shipments, but they can not all be used pro-actively for increasing the reliability.

Production site North America

- Raw materials availability, with exception of Raw material BBG, is not a problem;
- Push effect due to Raw material BBG can not be influenced when conversion into intermediates for The Netherlands is economically justified;
- Production possibilities can be influenced, but require technical solutions like expanding production capacity. This is not within the scope of this project and would require high investments which have a pay back times of more than 10 years;

- Market demand in North America can not be influenced due to dependency on third parties.

Production site The Netherlands
- Pull effect CDD (due to capacity) and ABB (due to Product 44-P) can not be influenced, it only emphasises the dependency between the production sites;
- Local raw materials availability is not a problem They can be used as fallback in case of low reliability;
- Production possibilities are a tool for being flexible when unexpected changes in intermediate shipments occur, but they are technically limited;
- Market demands in Europe and North America can not be influenced due to dependency with third parties

Order- and information process
The order- and information process has a negative impact on the reliability due to delays.
- The order process has too many stages (The Netherlands → Chicago → North America → Chicago → The Netherlands) and is therefor too complex for weekly repeated orders;
- The information process uses a diversity of communication tools. Data is doubly filled in and parties are informed at a (too) late stage.

Both can be influenced for increasing the reliability.

Physical distribution
The means of transportation, warehouse location and level of inventory have influences on the reliability. All three subsystems can be improved for increasing the reliability.

Possible solutions for increasing the reliability

The reliability can be increased from 64 to at least 80 percent by technical adjustments, simplifying the order- and information process and by redesigning the logistics concept.

Technical adjustments
Figure 0-1 showed that ABB is shipped to The Netherlands in order to produce Product 44-P for the North American market. A logical solution would be to invest in production possibilities for Product 44-P in North America It will reduce the intermediate flow and therefore increase the reliability. This technical solution is not designed in detail but will require an investment of approx. $ 2 million The pay back time of this investment will be more than 10 years due to the relatively low savings in physical distribution .

Simplifying the order- and information process
The order process can be simplified by introducing a rolling plan for shipments of intermediates. Table 0-2 gives an example of such a plan. A rolling plan is based on the budget volumes, which are known at the beginning of each year. North America gives every week a rolling plan with a scope of 6 weeks The first mentioned week contains the exact quantities to be shipped the next Saturday The five following weeks contain quantities to be shipped. The quantities contain compulsory and optional material. Compulsory is a fixed quantity. The Netherlands has to receive it Optional quantities are given with an agreed spread. Week 48 has a wide spread The nearer this week becomes to delivery week, the narrower the spread will be (see week 44). The spread is agreed between the logistics planners in North America and The Netherlands. Take for example week 44 from table 0-2. The expected total volume intermediates is 180 tonnes. The spread is maximum 30.8 tonnes (two times 15.4). So North America can guarantee with 83 percent reliability that the shipments of week 44 contain 180 tonnes. The Netherlands has 25 days before these quantities physically arrive. So reasonable time left to anticipate to this reliability within the production plan.

Simplifying the order- and information process into a 1:1 relation between the two production sites is motivated by the following characteristics of the flows:
a. internal supplier – customer relationship;
b. only three different types of intermediates;
c. orders are on Full Container Load level;
d physical distribution is always the same route;
e. volumes are known for the whole year

Table 0-2 Example of a rolling plan (scope 6 weeks) of intermediate shipments North America → The Netherlands

Product	Wk 43 [tonnage]	Wk 44 [tonnage]	Wk 45 [tonnage]	Wk 46 [tonnage]	Wk 47 [tonnage]	Wk 48 [tonnage]
Compulsory ABB	30 8	30.8	30.8	30.8	30.8	30.8
Compulsory CDD	17.5	17 5	17.5	17.5	17.5	17 5
Compulsory EFF	15.4	15 4	15 4	15 4	15.4	15.4
Optional ABB	46.2	46.2 ± 15.4	46.2 ± 15.4	46.2 ± 15.4	46.2 ± 15.4	46.2 ± 30.8
Optional CDD	69.6	69.6	69.6 ± 17 5	69.6 ± 17 5	69.6 ± 17.5	69.9 ± 35

The information process can be simplified by taking this order process as a base. Figure 0-4 shows the way information can be exchanged based on the simplified order process. The Netherlands places each quarter an order in SAP for North America with quantities for intermediates which are required each week. Every week North America changes the order in SAP and sends a rolling plan to The Netherlands. Both sites will use the same SAP system. When quantities are known, the bill of lading can be made. ICL is able to make one bill of lading for North America – The Netherlands

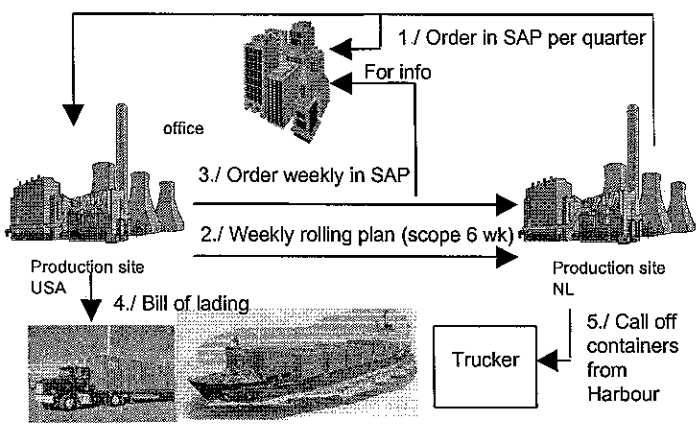

Figure 0-4 Simplified information process with rolling plan

Redesign of the logistics concept

A new logistics concept for intermediates from North America to The Netherlands can be designed by following four steps (figure 0-5). These steps can be taken when the budget volumes are known or when there are changes in the intermediate flows The first step is data collection and forms the base for calculations in steps 2 till 4. Within those remaining steps choices will be made for the three subsystems way of transportation, warehouse location and inventory level

Means of transportation
Redesign of the logistics concept will start by making choices about the means of transportation. In the first place because transportation costs are dominant within physical distribution. In the second place because it determines the transport route which is the base for a decision on possible warehouse locations.

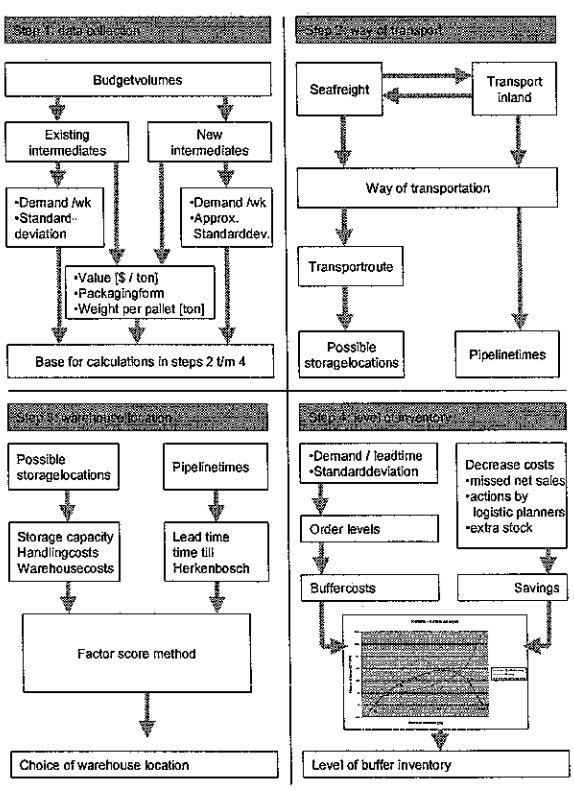

Figure 0-5 Steps in redesigning the logistics concept

For choosing the most economic way from A to B, Akzo Nobel works with an expeditor. For this project discussions were held with the expeditor about the route North America – The Netherlands. The route is covered by inter-modal transport by truck from North America to Richmond, by ship to Antwerp and by truck to The Netherlands These three parts of the route have been investigated. For the sea freight route, ICL offers the lowest rates and the most advantages for combinations with transport by road. For the road route, the first part is a bottleneck due to a weight restriction for container trucks in North America. By substituting container trucks for normal trucks, the first part is no longer a bottleneck . The normal truck can carry 24 pallets to Richmond, 20 pallets will be handled into a sea container and the other 4 pallets will be stored in a warehouse in Richmond. This results in:

- a saving of 134 container shipments per year, representing $ 325.000;
- extra costs in the warehouse (handling, storage, inventory) of $ 10.000 per year

Warehouse location

For making choices on where to place the buffer, the "weight-factor score" method has been used. The results of that method are given in table 0-3.

Table 0-3 Weight-factor score method for choosing the warehouse location

Factor		Factor gewicht	Factor score (keuze uit 10, 8, 6, 4, 2 respectivelijk zeer goed t/m zeer slecht)			
			X	Y	Z	B
F1	opslagcapaciteit	10	2	10	8	6
F2	transportijd	35	2	4	8	10
F3	handlingkosten	40	6	4	10	6
F4	magazijnkosten	15	4	4	10	4
Gewogen factorscore			390	460	510	710

There are four warehouse factors are relevant in the decision and therefor receive a certain factor weight:

F1 10 % for stock capacity, due to the relative low investment of a warehouse;
F2 35 % for lead-time from the warehouse to the Netherlands. The closer the better;
F3 40 % for handling costs because handling covers half of the buffer costs;
F4 15 % for warehouse costs because it covers that percentage of the buffer costs.

From table 0-3 there can be concluded that Antwerp has the highest score. A buffer in containers saves handling- and warehouse costs, which is of great advantage, but also the short distance from Antwerp to The Netherlands is an additional advantage. Using containers for buffer storage is possible during the free demurrage time of 15 days All containers have been called off in the past with an average of 7 days. So using Antwerp as a relative small buffer is economically the best option.

Level of inventory

Unreliability in shipments can be buffered by placing an inventory between North America and The Netherlands, but the level of the inventory should be calculated. For reaching the economically justified level, the buffer costs of a higher reliability should be balanced with the savings that can be gained by the higher reliability (figure 0-6).

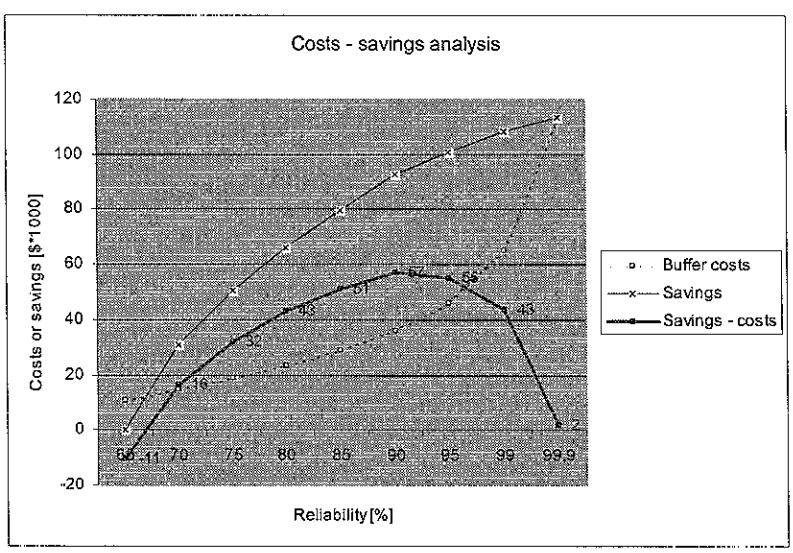

Figure 0-6 Buffer costs versus savings at different levels of reliability

- Buffer costs contain handling, storage and inventory costs The higher the reliability, the higher the level of inventory (buffer);
- Savings are gained by a decrease in missed orders (Product 44-P and Product 26-P), in actions (by the logistics planners) and in unnecessary stock in The Netherlands (caused by low reliability)

Figure 0-6 shows that 90 percent reliability is economically justified. The extra costs of having a buffer are in balance with the savings gained with that higher reliability. The buffer should contain 87 ton ABB, 81 ton CDD and 11 ton EFF. When having this buffer, orders will no longer be missed (net sales $ 20.000) and logistics costs will be reduced $ 57.000 per year

Conclusions and recommendations

This thesis shows that a redesign of the logistics concept between North America and The Netherlands can increase the reliability of intermediate flows to an economically justified level. This prevents in the first place that unnecessary costs in the logistics chain will be made and in the second place that customer orders will be missed.

By analysing the problem it can be concluded that the reliability of shipments:

C1 is at a current low level of 64 percent;

C2 causes in the first place $ 130.000 extra costs in the logistics chain and in the second place $ 20.000 missed net sales of Product 44-P and Product 26-P in North America;

C3 is influenced by several factors at both production sites, but these can not be used precautionary for increasing the reliability;

C4 ex North America should be accepted when generating solutions for increasing the reliability towards The Netherlands.

The reliability can be increased:

C5 from 64 to at least 80 percent by technical solutions, by simplifying the order- and information process and by changes in de logistics concept;

C6 by investing in production possibilities for Product 44-P in North America. This solution is not engineered in detail, but will cost approx. 2 million and will not outweigh the savings in physical distribution;

C7 by simplifying the order- and information process with a rolling plan and a 1:1 relation between North America and The Netherlands. Every week North America gives a rolling plan with the quantities of intermediates to be shipped This plan has a scope of 6 weeks and an agreed spread per week;

C8 to an economically justified level of 90 percent by making choices within the three subsystems of a logistics concept:
- Means of transportation - $ 315 000 can be saved when doing North America Production plant→ Richmond with a normal truck;
- Warehouse location - buffer in Antwerp saves handling and warehouse costs. The intermediates are close to the user (The Netherlands);
- The buffer resulting in savings due to higher reliability, less stock in The Netherlands, less ad hoc planning and no missed orders, which are $ 57.000 higher then the costs of the buffer in Antwerp. On top the result is that customers' orders will no longer be missed

The main recommendations are:
- Create a workgroup 'within four steps to The Netherlands' Members are logistics managers and planners. There are three main triggers to do this, physical distribution of the intermediates ex North America costs $ 1 5 per year, the 610 Full Container Loads contain $ 40.000 working capital each and the unreliability results in unnecessary costs. The four steps in redesigning the logistics concept between North America and The Netherlands generates logistics improvements No investment is required and it leads to an economically justified situation;
- Introduce the simplified order- / information process. The rolling plan makes this process much more clear. Introduction can be realised by visits of the logistics planners from the two production sites to each other Seeing the causes and results of unreliable shipments at each others plant will give a good understanding and can form the rolling plan;

- it is important to have a mechansism for implementing these changes structurally embedded within the agreed working protocols