The PBF Benchmark study

the development of a Benchmark tool for spare parts distribution

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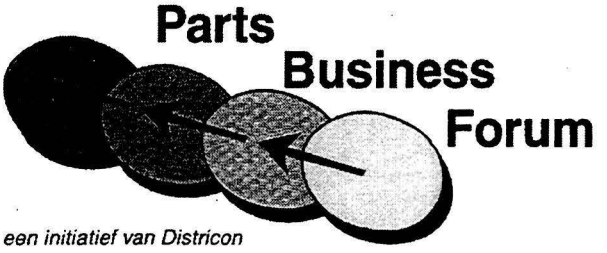
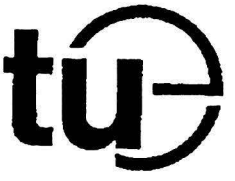
Final Report





A.P.H. Ermers
Eindhoven 1 December 1998

Eindhoven University of Technology
Faculty Technology Management
Industrial Engineering and Management Science

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Abstract

This report describes the PBF benchmark study. The study made comparison of the logistic performance of spare parts distribution possible. With the development of a benchmark tool the performance of five companies can be measured and compared. The emphasis lies on process benchmarking. The similarity between the five companies, operating in different markets, is the spare parts distribution process.

Management Summary

Introduction

The Parts Business Forum (PBF) is a foundation of several companies and Eindhoven University of Technology. It was founded in 1993 and it is an initiative of Districon Logistics Management Consultants who have their office in Maarssen. At first there was co-operation between the sales support divisions of two companies. After that managers of important companies in industry, trade and service have joined. At the moment there are 24 companies and a university in the PBF to exchange knowledge and experience about service and parts.

Inside the Part Business Forum there exists a wish to have a benchmark instrument. With this instrument the logistical performance of a member's logistic activities can be measured and compared with those of the other members. This lead to a pilot project in which first of all the possibility of comparison has been investigated. The sub goals of the project are:

1. *Get insight into measurement of the logistic performance of the spare parts distribution of the pilot companies and the costs of this performance.*
2. *Compare the performances of the companies by means of five or six universal performance indicators.*
3. *Give an explanation of the differences between the companies and initiate possible improvements.*
4. *Make the use of IT applications possible in the development of the instrument.*

In this pilot project five companies are involved: DAF Trucks After Sales, Honeywell Industrial Service Logistics Centre, IBM International Maintenance Parts Logistics, Logistic Operations Philips Consumer Service and Stork Installed Base Management Textile Printing and Coating.

Benchmarking and Performance

To explain what benchmarking is, I will give a formal definition of the term:

Benchmarking is the continuous process of measuring services and practices against the toughest competitors, or those companies recognised as industry leaders (David T. Kearns in [Camp, 1989]).

In this research not a comparison is made with industry leaders but the comparison is made between the five benchmark partners. Another difference is that the comparison is not made between competitors but between the processes of companies in complete different markets. So the definition used in this research is:

Benchmarking is the search for industry best practices that lead to superior performance [Camp, 1989].

Benchmarking the logistic performance of spare parts distribution makes a good performance measurement necessary. The question is now what good performance measurement is. In this research performance indicators are used to measure the performance. A definition of a performance indicator is:

A performance indicator is a variable indicating the effectiveness and/ or efficiency of a part or whole of the process or system against a given norm/ target or a plan [Fortuin, 1988].

The role of this indicator can be seen in figure 1, the process control cycle.

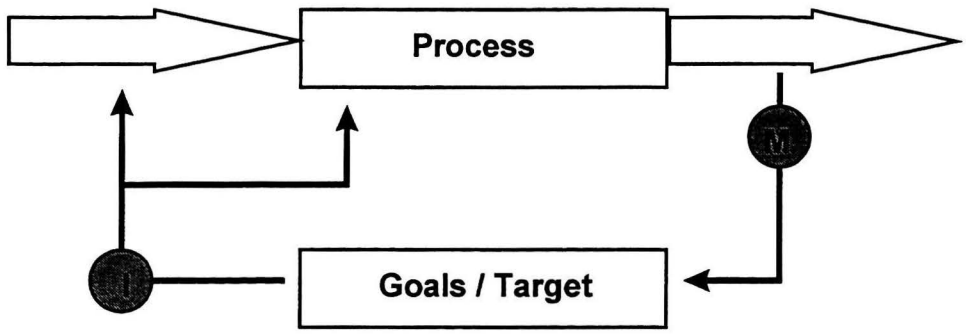

Figure 1 The Process Control Cycle adapted from [Dep. Of Energy, 1995]

In order to control the processes you need to measure them (M) by means of the performance indicators that quantify the performance. After comparing the values with a norm or target it is possible to intervene (I) in the process when differences occur.

In order to apply the right performance indicators (PI's), a few rules for defining these PI' s have to be obeyed. The indicators have individual requirements and the complete set of indicators has to have vertical and horizontal coherence. The set has to be flexible and complete.

With these requirements in mind the set of indicators can be defined. Other important requirements are the market requirements. The processes are developed according to these wishes so the indicators have to measure these wishes.

The Method

In most benchmarking projects the benchmark wheel of Andersen is used. This is not the case in this project: here a new method is used known as the Eight Step Plan model developed by the ENAPS consortium. This model is a mix of the benchmark wheel of Andersen and the Ten Step Model of Kempen and Keizer. This mix is necessary because in this way the external consultant, in this case the student, can get insight in the company and its processes before the actual benchmarking steps have to be performed. In this research process benchmarking is the subject so this insight is indispensable. After an orientation phase, in which feeling with processes is developed, the actual benchmarking steps can be performed. After describing the processes in a uniform way by means of the service business chains and the supply chains, a selection of the processes involved in benchmarking can be made. Then the logistic performance of the processes can be measured and analysed.

The values of the performance are compared in the last step and eventually this insight in processes and performance must lead to improvement.

The different steps can be seen in figure 2.

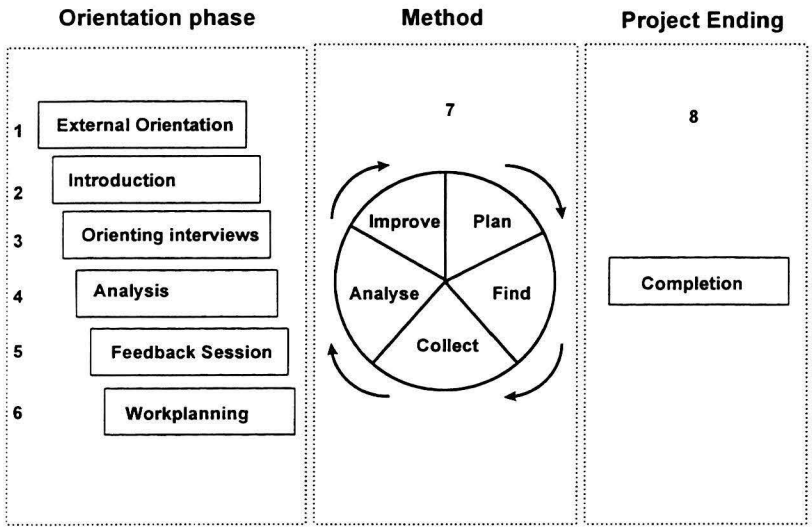

Figure 2 The ESP model [Drieling 1, 1997]

The Benchmark Partners

The five Benchmark partners are: DAF After Sales, Honeywell ISLC, IBM IMPL, LO PCS and Stork IBM Textile Printing and Coating. The characteristics of the five players in this research have been described. In the general characteristics of each company the main activities, structure and mission of the company are stated. Most of the time the service department responsible for spare parts delivery has another mission than the company as a whole.

In the Service Business Chain of each company the different goods flows are described. The performance has to be measured on identical processes, so a thorough insight into the different processes is necessary. One of the described flows has to be selected. The flow that is measured is the flow from a main stock location to a user of the part. So that is in this case the maintenance engineer, the technical service department of the end user or the authorised service workshops. Every company has different users of parts but the characteristics of the goods flow are practically the same. This makes a comparison possible.

The Supply Chain is the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer [Christopher, 1992]. Normally the supply chain covers the flow of goods from supplier through manufacturing and distribution chains to the end user. This is not the case for spare parts distribution. For a spare parts distribution centre the chain starts at the supplier, who delivers the parts to the parts organisation and from there the customer is served. To benchmark the performance of the logistic spare parts distribution another delimitation is made.

The supply chain starts at the place where the order for spare parts enters, mostly at the central warehouse level, and ends when that order arrives at the end user, via other "distribution centres". In this case the different suppliers are not looked at.

The Parts Distribution Process is shown in the figure 3.

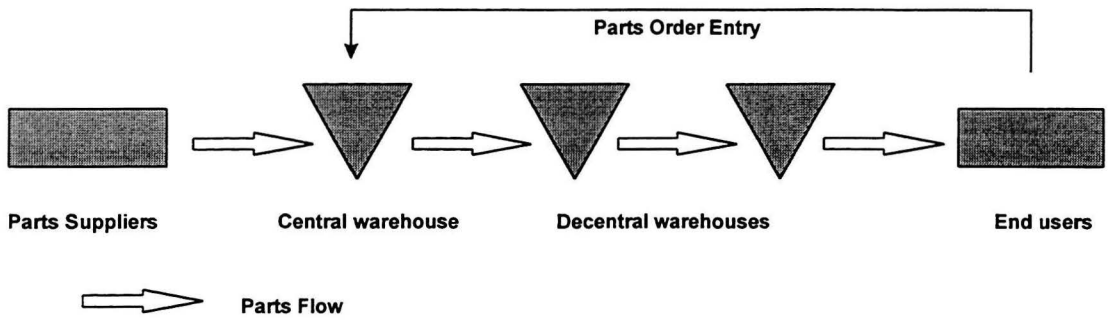

Figure 3 The Parts Distribution Process

Logistic Performance

After a description and selection of the relevant processes it is possible to develop a set of indicators that measure the performance of the selected process. An iterative process is followed in order to define the final set of logistic performance indicators. After a descriptive phase of the selected processes, the comparison of the current performance indicators, used in the companies, with the casual PI's for spare parts distribution can be made. After expanding the set with the relevant indicators, a check on the possibility to measure them, leads to a final set of PI's.

The logistic performance indicators are:

1. Order line Throughput Time
2. Product Availability
3. Reliability of Delivery
4. Reliability of Backorders
5. Quality

The Benchmark

After defining the set of indicators it is necessary that every company knows how to measure them. After this step it is possible to collect data and calculate the values of the indicators. Now the logistic performance of each company is measured. Another aspect of the benchmark study is giving the companies insight in to the logistic costs. In order to measure these costs a classification structure is used. This structure makes it possible to distinguish different sorts of costs. The following cost structure has been chosen:

- Storage: the costs of space, interest and risk.
- Handling: the costs of handling in, intern transport and handling out.
- Transport: the costs of transport from stock locations to the end users.
- Order management: the costs of procurement, control and management of parts.

- Overhead: the indirect related costs as general management, information systems, and supporting activities.

The results make a comparison of four indicators possible namely the order line throughput time, the availability of parts, the reliability of delivery and the quality. The performance of backorders could not be compared in a proper way because three companies could not measure them but only give an estimation.

A cost comparison is not possible. Only an insight in a company's own costs is given which makes a comparison in time an option for optimisation. When the financial benchmark has to be performed a lot more research has to be done. There are a lot of differences that make a benchmark of costs between companies operating in different markets practically impossible. Another point in this discussion is that it is not interesting to make a financial comparison of companies with different size operating in different markets and branches.

Conclusions

The conclusions of this research are:
- A comparison between the five companies and thus benchmarking is possible.
- Unequivocal definitions of performance indicators are needed to measure performance and compare the values. When this is done in a repeating and structural way, a benchmark tool is born.
- Every defined indicator has been measured and compared, except the indicator reliability of backorders.
- Every company is in a different phase of performance measurement, which makes a comparison of results harder.
- Every company has its pollutions of values of the indicators.
- Market requirements have a deep impact on processes and performances.
- A financial benchmark, which was not the goal of this research, is not possible with the available information.

Recommendations

In order to improve the benchmark process and the instrument the following aspects have to be looked at:

- The definitions of the indicators and the measurement of these indicators have to be improved constantly.
- The performance of backorders has to be measured by means of new definitions for indicators.
- The organisational aspects of benchmarking, like frequency of measurement and privacy of data, have to be stated in the near future.
- The number of benchmark partners have to be expanded.
- If a financial benchmark is desirable it is wise to compare in the same markets and with the same size.
- The performance of transport companies has to be investigated.
- The differences between system information and actual information have to be checked.
- A structural feedback on the results of each quarter is necessary.

Preface

In this final report the PBF Benchmark study is described. This study is the final practice at Eindhoven University of Technology. The results of eight months of research are presented in this report and will be presented at a meeting on December 9th at Eindhoven University of Technology.

This report consists of two parts. The first part can be used by outsiders and provides the university with a report that can be used for their library. The second part consists of appendices with confidential information. This information can be used by the Parts Business Forum. This report can be used by the PBF members as a manual for benchmarking projects. When new members want to join the benchmarking process, they can use this report as a general introduction, a method to follow and a tool to perform the benchmark.

The first part describes general aspects of the research project. In Chapter 1 the background and assignment are described. To support the practical research, in chapter 2 a theoretical background of benchmarking and performance is given. Then in chapter 3 the method of approach is described. In chapter 4 the benchmark partners are introduced. Also in that chapter the relevant processes and activities are described. To benchmark the performance, measurements takes place on the basis of the set of indicators in chapter 5. Chapter 6 gives an overview of the results of the benchmark. After that the overall conclusions and recommendations are stated. At the end an explanation is given of abbreviations and terms. In the section on references the books and internet sites used for information are listed.

Acknowledgement

The study Industrial Engineering and Management Science at Eindhoven University of Technology provides much time to students to acquire working experience. During the study several projects have been performed, individually or as a team, which provide the student with the needed practical experience. This graduation project is the last part of the study.

The study here presented is a pilot project performed for five companies of the Parts Business Forum. In the eight months I have been travelling from one company to another with Eindhoven as my basis. The unique experience of being involved in a project for five companies made it very special for me. The continuous variation of visiting, gathering information and structuring this information in results plus the fact that it was a pilot project, enhanced my enthusiasm and I think the enthusiasm of all persons involved.

I would like to take this opportunity to thank Ir. W. Poppelaars of DAF Trucks, Mr. R. Hofmann of Honeywell, Ir. Van Ovost of IBM, Ir. B. Neggers of Philips, Mr. W. Theessink and Mr. F. Weerepas of Stork and Ing. H. van Waveren of Districon for their support and advice. I also would like to thank my "roommates" Ir. A. van Bergen, Mr. H. van Stiphout and Mr. H. Winckens for their support and the nice environment. Furthermore I would like to thank IPL-TNO and Districon for their insights in benchmarking and all the people that made this project possible.

A very special thank goes out to Dr. L. Fortuin of the Eindhoven University of Technology for his enthusiastic support and for giving me new insights constantly. Furthermore I would like to thank Ir. B. Neggers of LO PCS for the good workplace. The basis of the project was at LO PCS in Eindhoven. And I would like to thank Drs. C. Kokke and Drs. E.B. van der Marck of Eindhoven University of Technology for their guidance and support.

I thank you all.

Eindhoven, 1 December 1998

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Chapter 1 The project

In this chapter I will describe the background of the assignment and the goals of this project. The project is an initiative of the Parts Business Forum and the core of the project contains benchmarking. Benchmarking is an upcoming subject for many businesses. It is the search for those best practices that will lead to superior performance of the company. The benchmarking process, establishing operating targets on best practices, must lead to changing operations and eventually attaining superior performance and a competitive advantage.
I will describe the background of the assignment, the assignment, the goals of the project, the delimitation and the research questions that arise with these goals.

1.1 Background

The Parts Business Forum (PBF) is a foundation of several companies and Eindhoven University of Technology. It was founded in 1993 and it is an initiative of Districon Logistics Management Consultants who have their office in Maarssen. At first there was co-operation between the sales support divisions of two companies. After that managers of important companies in industry, trade and service have joined. At the moment there are 24 companies and a university in the PBF to exchange knowledge and experience about service and parts. More details can be found in Appendix A.

The Forum's objective is to develop and gather knowledge and management skills of participating companies for the parts business as part of customer service.

Inside the Parts Business Forum there exists a wish to have a benchmark instrument. With this instrument the logistical performance of a member's logistic activities can be measured and compared with those of other members. Ideas for comparisons were the degree of service and the costs and benefits of the spare parts distribution inside the service after sales activities of the companies. As a first step in realising this wish, members filled out a questionnaire, which gave an insight into the activities of the different members and a scope of the different processes. This questionnaire was designed at Eindhoven University of Technology. The next step is the benchmark study, which is the topic of this report.

This study is a pilot project, so not all members of the PBF will be involved. The benchmark partners are the service departments of five companies. More information about these departments can be found in section 1.4 and chapter 4.

1.2 Assignment

The Parts Business Forum members want a tool to measure their logistic performance and compare these measures with each other. This process is known as benchmarking. So at the end one can see who is best in class and how they reach this performance. The assignment is:

Investigate if benchmarking of the five companies is possible. If it is possible, develop a method and an instrument that enable measurement of logistic performance and a comparison of these performances.

1.3 Project goals

The goal is: "Investigate the possibility of benchmarking, and if possible develop and implement a benchmarking instrument. With this instrument the company can get quick insight in their logistic performance and a comparison with other members of the PBF is possible".

The sub goals are:

1. *Get insight into measurement of the logistic performance of the spare parts distribution of the pilot companies and the costs of this performance.*

2. *Compare the performances of the companies by means of five or six universal performance indicators.*

3. *Give an explanation of the differences between the companies and initiate possible improvements of the instrument.*

4. *Make the use of IT applications possible in the development of the instrument.*

1.4 Delimitation

The research is done for the Parts Business Forum. This is a pilot project in which five companies are involved. These companies are:
1. DAF Trucks, Eindhoven,
2. Honeywell, Amsterdam,
3. IBM, Amsterdam,
4. Philips Consumer Service, Eindhoven,
5. Stork, Boxmeer.

Only the activities in the process of spare parts distribution are considered. Because of the different scope of activities of the companies, just their activities in Europe are looked at in this project. After this project it will be clear if benchmarking is possible and if so, the other PBF members can participate in benchmarking.

1.5 Research questions

To reach the project goals, research questions are posed and answered. The different (sub) goals lead to the following research questions:

Investigate the possibility of benchmarking, and if possible, develop and implement a benchmarking instrument. With this instrument a member can get quick insight into its logistic performance and make a comparison with that of other members of the PBF.

a. What does it take to compare different companies?
b. What is a good benchmarking instrument?
c. How is logistic performance measured and how can it be compared?

The following questions are defined for the sub goals 1 to 4.

1. *Get insight into the measurement of the logistic performance of the spare parts distribution of the pilot companies and the costs of this performance.*
   d. What are the relevant processes that have to be measured?
   e. What information is needed to make this measurement possible?
   f. What are the costs of the performance?

2. *Compare the performances of the companies by means of five or six universal performance indicators.*
   g. What are important criteria for comparison?
   h. What performance indicators can be benchmarked?
   i. What instrument can make benchmarking possible?

3. *Give an explanation of the differences between the companies and initiate possible improvements.*
   j. What are the differences between the companies?
   k. Which improvements can be initiated to achieve a better performance?

4. *Make the use of IT applications possible in the development of the instrument*
   l. Which IT applications can facilitate the implementation of the instrument possible?
   m. What is needed to use these IT applications?

These questions are answered throughout this report. In section 6.4 the questions and answers are summarised, with a reference to the relevant sections.

Chapter 2 Benchmarking and Performance

Benchmarking is an upcoming subject for many businesses. It is the search for those best practices that will lead to superior performance of the company. The benchmarking process, establishing operating targets on best practices, must lead to changing operations and eventually attaining superior performance and a competitive advantage. In this chapter I will give a short overview of benchmarking and performance measurement.

2.1 What is benchmarking?

To explain what benchmarking is, I will give a formal definition of the term:

Benchmarking is the continuous process of measuring services and practices against the toughest competitors, or those companies recognised as industry leaders (David T. Kearns in [Camp, 1989]).

So it is a continuous process. In order to be effective, benchmarking must be a self improvement and management process which has to be repeating. Benchmarking has to be dynamic. The reason for this demand is that industry leaders and industry practices constantly change. So you must be alert all the time for these changes.

The term implies measurement. There are two forms of measurement. You can measure internally and externally. In order to benchmark one has to have insight into both forms because a company can change to best practices then and only then when there is a comparison with the internal and external performance of the leader. The gap between the company and leader must lead to insight in where and how to change.

Benchmarking can be applied to all facets of a business. It can be applied to basic products and services and also to processes for manufacturing the product and processes for the support of these processes.

Benchmarking should be directed at firms and business functions within those firms that can be recognised as leaders. By doing this you can experience from the best practices available and you can make a comparison with your own. A good comparison leads to insight in the changes that have to be implied on the used processes. More details about benchmarking can be found in [Camp, 1989].

So in short this is a working definition of benchmarking:

Benchmarking is the search for industry best practices that lead to superior performance [Camp, 1989].

2.2 Performance Measurement

In order to benchmark performance measurement is necessary. This measurement must be done for all aspects of the services and practices that are compared. The performance can be quantified by means of performance indicators.

These performance indicators (PI) can be defined for all the different processes in a company. But before you can define a PI, you have to know what the meaning of such a PI is.

A definition of a performance indicator is:

A performance indicator is a variable indicating the effectiveness and/ or efficiency of a part or whole of the process or system against a given norm/ target or a plan [Fortuin, 1988].

Two elements can be distinguished using PI's. The PI itself gives a name and a definition for the aspect of the process to be controlled. Sometimes it is a direct measure with a dimension such as time, but it can also be a ratio or percentage derived from two other measures.
The second element is the numerical value of the PI, as a result of the measurements.

Performance measurement with PI's has several benefits. A few of these benefits according to the DOE Handbook are [Dep. of Energy, 1995]:

- PI's identify whether customer requirements are met.
- PI's help to understand the processes.
- PI's provide the tools to make fact based decisions and resource allocations.
- PI's identify where improvement is needed (benchmarking).
- PI's show if improvements actually are made.
- PI's reveal problems that bias and emotion cover up.
- PI's identify whether suppliers are meeting our requirements.

PI's can also show the variance of the processes, or in other words show if the process is stable. If the values fluctuate a lot, one can say that the process is unstable. Improvement of the process can take place if the process is controlled and the targets are reached. After that, improvement can make the averages better. In order to control the processes, PI's are needed. They are needed because when one wants to control the process, one needs measures to make decisions consequently. So in line with this, PI's can be seen as being part of a control cycle for controlling processes. The measures (M) are quantified by the PI's and compared with the target or goal. After this the intervention (I) can take place when the process does not reach the target. This is shown in figure 2.1.

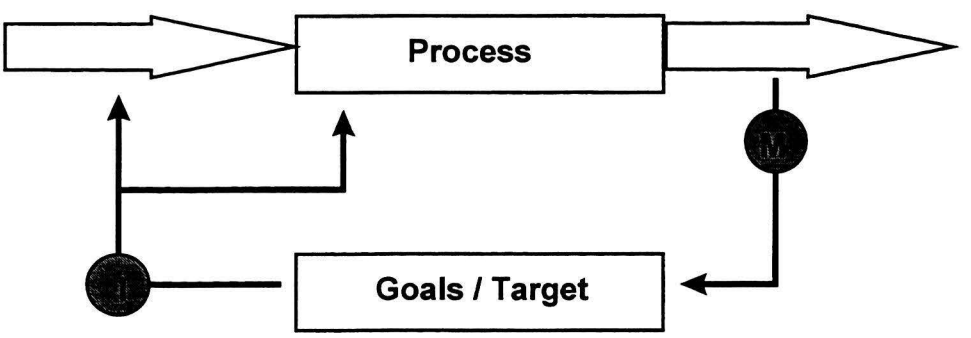

Figure 2.1 Process Control Cycle, adapted from [Dep. Of Energy, 1995]

2.3 Requirements for PI's

To have a good set of PI's there are a few rules you have to observe [Duijker , 1993] and [Fortuin, 1988]. For individual PI's a few rules have to be considered also.

The individual PI should:

- be measurable.
- be simple and easy to understand and clearly defined.
- have a target, derived from the goals of the organisation.
- be developed and used in association with the people involved.
- be derived from quantities so that the people who are responsible for the performance can influence and control them.
- be available on time, with the frequency agreed upon.

Next to individual requirements, also requirements for a set of PI's are defined [Duijker ,1993]. The set has to have vertical coherence, horizontal coherence, flexibility and must be complete.

Vertical Coherence

Indicators influence each other from management level to operational levels. Duijker describes a hierarchy in PI's. This means that PI's for a certain process must be consistent with indicators used at a higher level, describing for example the entire organisation. Another point in line with this is that PI's should be derived from the companies goals/ objectives. This can be seen in figure 2.2.

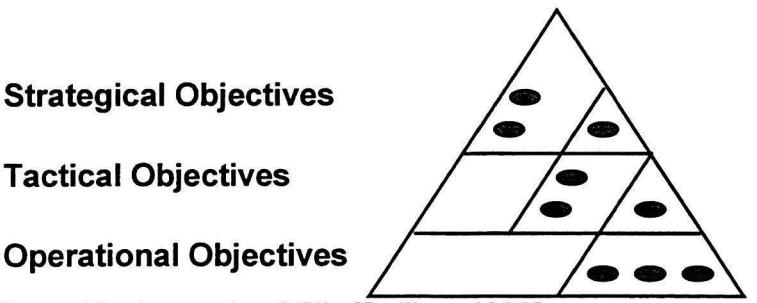

Figure 2.2 Hierarchical aspects of PI's [Duijker, 1993]

Horizontal coherence

Next there is the requirement of horizontal coherence, also described in [Duijker, 1993]. He states that every process has three types of indicators, because the processes go from supplier to customer with the organisation or process in between. The three indicators influence each other. For example when the supplier doesn't deliver, the organisation can get problems with their own lead time.
The three types of indicators are shown in figure 2.3.

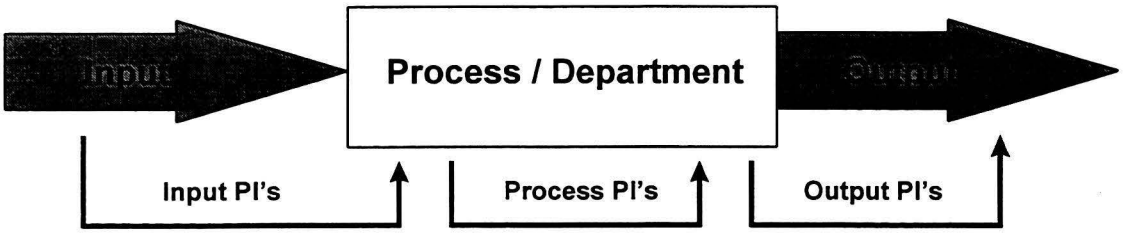

Figure 2.3 Three types of PI's [Duijker, 1993]

The three types of indicators are:

- Input indicators (external), who judge the performance of the suppliers of the process. This can be a check on delivered parts but also planning can be judged. If the planning changes many times it will have a negative effect on the efficient functioning of the company or the process.
- Process indicators (internal), who refer to the usage of resources. So in a way "costs" to realise the output are analysed.
- Output indicators (external), who judge the department in it's role of supplier. So this tells you how well the customers are being served.

Flexible
A set of PI's has to be flexible. When improvements take place, it is possible that goals and targets change. So the set of PI's to control the processes must be flexible so that new indicators can be added or existing can be dropped, without much difficulty.

Complete
It should be kept in mind that a PI is never independent. Several aspect must be measured at the same time. These aspects can be contradictory. A few examples are quality, time, costs, environment and flexibility. These different aspect are related to each other, meaning that quality can be improved but the process will take longer or costs more. So a PI should always be seen with it's "counter indicators".

Bearing these requirements in mind you can go to the next step, which is the definition of performance indicators.

2.4 A plan for defining performance indicators

In order to measure the right indicators you have to define them. The NEVEM workgroup has developed a plan to define performance indicators [NEVEM, 1987].

1. Determine the areas of responsibility and functions.
In this step the functions and activities are determined for each area of responsibility. The means of control for these functions also have to be determined.

2. Determine the organisation structure.
The second step is focused on the division of the different functions over the departments and/ or people. The level of reporting also has to be determined, so that per level the performance can be defined with regard to the goals defined for that level.

3. Determine the goals
This activity determines in regard to which goals performance has to be measured. This means that goals have to be defined and quantified.

4. Determine the way in which the goal has to be measured

With the performance indicator the real performance is measured against the target or norm of the goals of the organisation or process. So for each goal the indicator has to be defined unequivocal through the whole organisation.

2.5 Performance indicators for customer service and distribution

A part of customer service is the distribution of spare parts. This distribution has the same goal as the distribution of the initial product: getting the right product, with the right quality, on the right place, on the right time, with the right quantity against the lowest possible costs. But in order to get a good set of PI's the goals have to be a more specific.

When performance indicators are defined, one has to base them on the goals of the process. In the logistic handbook edited by Ploos van Amstel there are a few examples of performance indicators that can be used for the key elements or goals of customer service [Ploos v. Amstel, 1993].

These performance indicators are defined for seven elements:

- Product Availability: how many times is a product on stock and how many products are on stock?
- Reliability: how good can the organisation live up to the agreements of delivery time and delivery quantity?
- Order throughput time and lead time: the time between order entry and order arrival.
- Flexibility of the distribution system: the facilities of the organisation that enable a quick reaction to the specific customer needs.
- Information: the possibility to respond quickly and accurately to questions of customers
- Quality of Distribution: available procedures and the time required to correct mistakes in the distribution (wrong shipments, damaged goods, errors in documents).
- Post Transaction Support: Giving technical support and maintenance advice.

In order to benchmark, the performance indicators must be defined unequivocal for every organisation, so that the measures can be compared.

The first six elements are also key elements in the spare part distribution [Christopher, 1992], so PI's have to be defined for these elements. The last element, Post Transaction Support, is not directly related to the logistic performance of the spare parts distribution, so the PI for this element is not given. In chapter 5 the set of PI's to measure the performance of the spare part distribution of each company is given.

Chapter 3 Method of Approach

In the following part, the Eight Step Plan (ESP) model for benchmarking will be described. This model is a mix of the benchmark wheel of Andersen [Andersen, 1995], and the Ten Step Plan (TSP) model of Kempen and Keizer [Kempen, 1995]. More details about the ESP model, the benchmark wheel of Andersen and the TSP model of Kempen and Keizer can be found in Appendix B.

3.1 The ESP model

The benchmark wheel of Andersen shows the steps to make the benchmarking process, the core of this project, possible. In this way a company can benchmark its own performance with that of others. The continuous character of process improvement is shown by the spinning wheel. In order to achieve a better performance this repeating process is necessary. This is the goal of benchmarking, the process of comparing companies to make continuous improvement of processes possible. The comparison must lead to a better performance of the company.

Drieling creates a mix of the benchmark wheel of Andersen and the TSP model of Kempen and Keizer that leads to an extended workplan called the Eight Step Plan model. This mix is necessary because a thorough insight into the processes cannot be achieved by using the benchmark wheel alone. The steps of the ESP model are shown in figure 3.1.

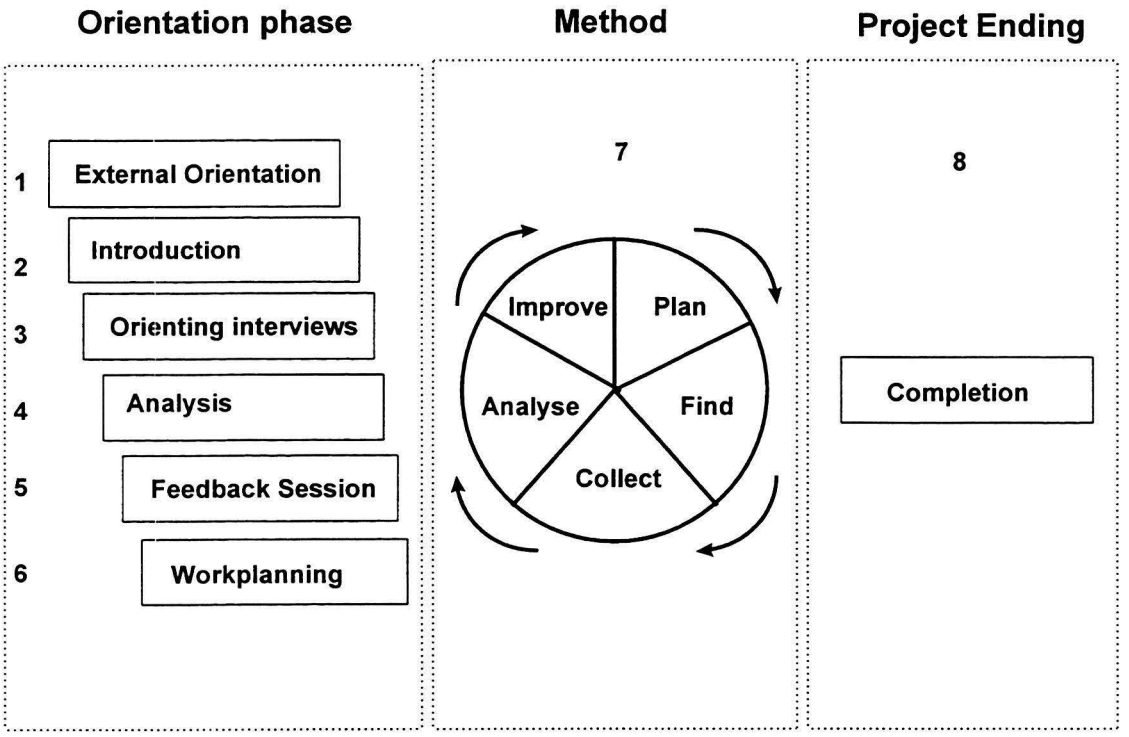

Figure 3.1 The ESP model [Drieling 1, 1997]

There are two reasons for making a mix of the benchmark wheel and the TSP model, and create an ESP model. The first reason is that benchmark approaches (like the benchmark wheel) are developed for a comparison of the company with others. So the members of the organisation can do this research themselves, by means of these methods. But when an external consultant, in this case the student, has to do this research it is necessary to explicitly take a few more steps. These extra steps concern an extensive orientation phase and a completion phase like in the TSP model. In this way the consultant can get insight in the companies that are involved. The most important aspect of this orientation phase is that the consultant gets a feeling of the processes of the companies because in benchmarking, selecting the right processes is essential for a good result. Secondly, having a formal plan makes it easier to compare several projects to each other afterwards and make sure no (important) steps have been skipped. More details of the model designed by the ENAPS consortium can be found in [Drieling 1 and 2, 1997].

3.2 The steps of the ESP model

To explain the method of approach, the steps of the ESP model are described.

Step 1: External orientation

In order to start with the project the consultant has to have insight into the market and the market position of the company. He has to ask questions about important developments in the branch, market position of the company and recent business developments.

Step 2: Introduction/ Exploratory Interview

In this step the first appointments are made and the contractor is introduced to benchmarking. Important questions are: who will be involved, who is the contractor, how will the consultant be introduced, what future appointments are made? After that the basic documents, like organisational charts and lay outs, have to be retrieved.

Step 3: Orienting interviews

In this phase interviews have to take place with the people involved, to get important data and to gain insights. Data like the important business processes, business culture, research data and opinions of people involved, are necessary.

Step 4: Analysis

Now it is important to make final agreements on the project, and by doing so the consultant has to collect all information available. Then there has to be a selection of processes used, people involved in benchmarking and there has to be an overview of supporters and opponents and specific problems to be solved.

Step 5: Feedback Session and Contracting

This is the point where we get to the actual benchmarking steps. All people involved must be present and consensus must be gained about the method of approach. The proper processes and performance indicators must be selected and then appointments have to be made about the execution.

Step 6: Work planning and project organisation

The last step of the orienting phase consists of implementing the benchmark steps in a project plan, which includes responsibilities and time phasing.

Step 7: The ENAPS Benchmark wheel

The next step will be to follow the wheel in finding performance gaps, possibilities for improvement and the implementation of the actual improvement. This is shown in figure 3.2. It is a cycle, so this implies continuous improvement. After improvement the impact has to be analysed and again the cycle can begin with the planning phase.

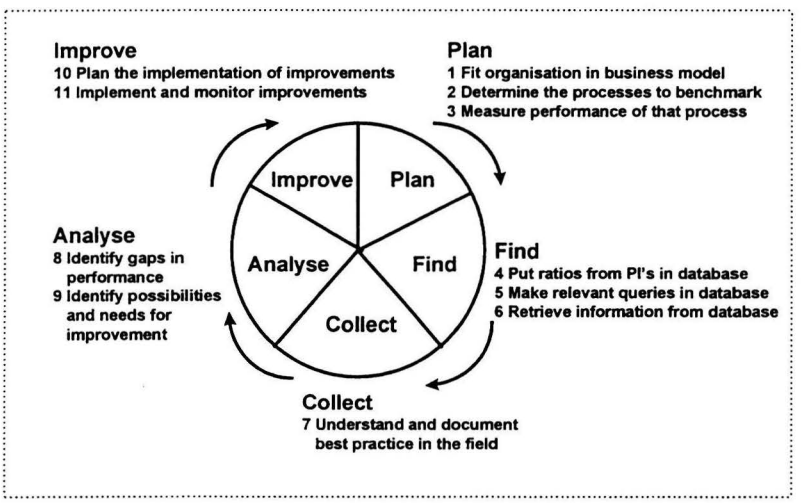

Figure 3.2 The ENAPS Benchmark wheel [Drieling 1, 1997]

Step 8: Completion

To end the project in a proper way, some activities have to be done, like writing a final report, having concluding conversations and evaluate the assignment and perhaps adjust the used method.

Chapter 4 The Benchmark Partners

The five players in this benchmark study are service organisations and members of the PBF. After a short introduction, in which the general characteristics of the companies are described, the main logistic functions of the organisations are identified. In this study different processes are benchmarked. This is a way to make a benchmark between five companies with complete different products possible. The processes of the spare parts distribution are going to be compared, so in order to make a complete comparison the start and end of these processes have to be specified. The functions and the goods flows from supplier till end user are summarised in the Service Business Chains. The start and end of the distribution processes and the supply chain management of each company are described in the Supply Chains of the different partners.

4.1 Introduction

In this benchmark study five companies are involved. The service departments of the companies are benchmarked. In the following part a general introduction is given. In short their activities and structure are described and the mission of the department is stated.

After that the service business chain of the company is described. The companies can be characterised by their different parts flows from supplier to end user. The degree in which they control the process in between gives a view of the different functions of the service organisations of the companies. By distinguishing different goods flows through the process, flows interesting for performance measurement of parts delivery can be selected. The repair stream of spare parts, although it exists, is not a topic of this research. In this survey only the distribution of parts is benchmarked. The different functions and goods flows of the companies for their operations in Europe are described in the following part and in appendix C.

At the end of each section the supply chain of the company is described. The Supply Chain is the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer [Christopher, 1992]. Normally the supply chain covers the flow of goods from supplier through manufacturing and distribution chains to the end user. This is not the case for spare parts distribution. For a spare parts distribution centre the chain starts at the supplier, who delivers the parts to the parts organisation and from there the customer is served. To benchmark the performance of the logistic spare parts distribution another delimitation is made. The supply chain starts at the place where the order for spare parts enters, mostly at the central warehouse level, and ends when that order via other "distribution centres" arrives at the end user. In this case the different suppliers are not looked at. This is shown in figure 4.1.The supply chains and stock locations of the players are shown in Appendix D.

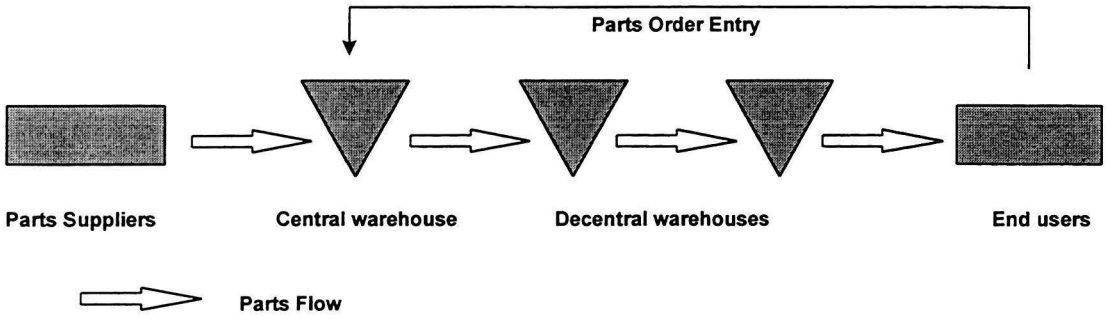

Figure 4.1 The Parts Distribution Process

The companies that are benchmarked are all distribution centres for spare parts, where there is no manufacturing. Their main activities, as described in chapter 4.2, are distribution activities for spare parts like order processing, warehousing, materials handling and transport and inventory planning and stock allocation. But transport of the parts is subcontracted by every company to specialised transport companies and for some companies the warehousing is subcontracted also. The main activity is managing the spare parts distribution and the performance of this managing is in fact benchmarked.

In order to meet customer requirements, such as delivery time, and to minimise costs of their activities, every company has its own network of stock locations and transport. The last ten years a trend for each company is to minimise costs without decreasing performance. So the search for the break even point of inventory costs and transport costs is a continuous topic of this minimisation. The solution in most cases is centralisation of stock. The reduction of stocklocations is an ongoing process for each company. This trend also applies to the service organisations in this benchmark study.

The supply chains of the companies are described in the following section. A few supply chains are still changing because of the centralisation trend. The way in which the benchmark partners manage their orders and handle the stock is described in the following part.

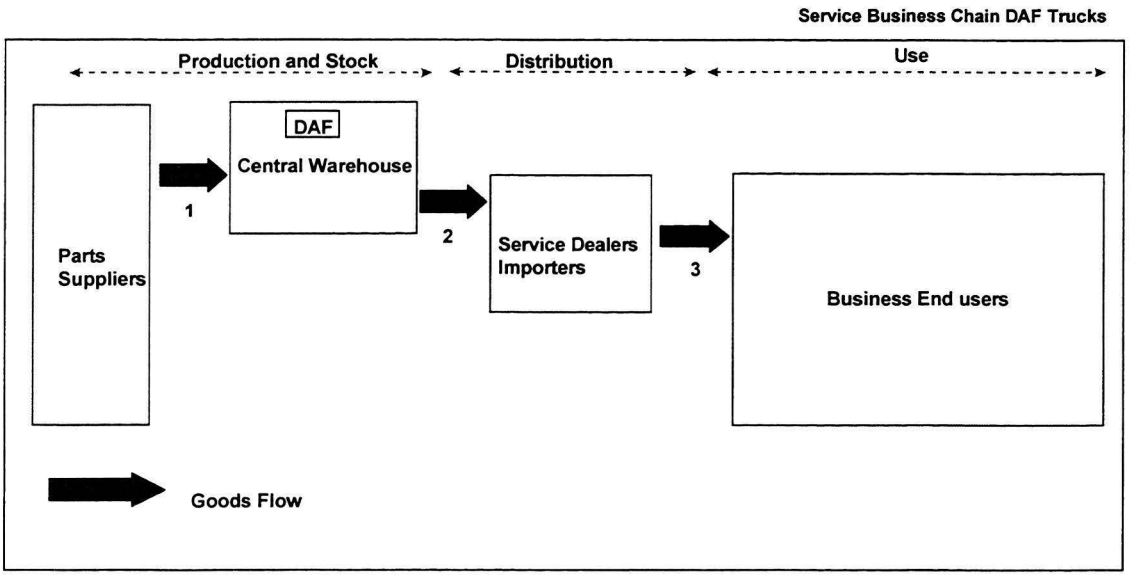

Figure 4.2 The Service Business Chain of DAF After Sales

4.2 DAF After Sales

DAF Trucks NV in Eindhoven was officially founded on March 2, 1993. The company is originated from Van Doorne's Bedrijfswagenfabriek DAF BV. DAF Trucks concentrates on the development, production, sales and service of middle heavy and heavy trucks. DAF has an exclusive contract with Leyland Trucks Ltd for the marketing and sales in Europe for the light trucks, produced by Leyland. DAF Trucks also delivers components to third parties, like axles, motors and cabins for an application in busses, special vehicles, earth moving vehicles and aggregates. In all activities management, employees of the organisation, dealers and importers focus on the demands and wishes of the customers of the company.

DAF After Sales is responsible for selling spare parts and supporting activities but the repair and maintenance of the trucks is performed by the engineers of the dealer. The central warehouses are situated in Eindhoven and Chorley (UK). The last one is mostly used for the Leyland parts, and the one in Eindhoven for DAF parts. These warehouses exchange parts. All urgent and stock orders for DAF and Leyland parts for the European continent are delivered from Eindhoven. The urgent orders for DAF parts and Leyland parts and the stockorders for Leyland parts for the UK are delivered from the warehouse in Chorley. All stock orders for DAF parts from a UK dealer come from Eindhoven and go via Chorley to the UK dealers. The main markets are The Netherlands, UK, Belgium, France, Germany and Italy.

Their mission is based on the "Total Care program" of the company. This means the provision of a complete package of products and services to minimise the care of the vehicle for the customer.

The Service Business Chain

DAF After Sales as a service organisation operates in Europe. The players involved in their service process are the Parts Suppliers, the Service Dealers and the Importers of DAF parts. These importers are situated in far countries such as Norway, Greece and Turkey. They deliver the parts to the Dealers in these countries.

The interesting logistic functions of DAF After Sales are:

- Managing the central stock for approximately 120.000 partnumbers.
- Distributing the parts to the warehouse in Chorley UK and the 1100 Service Dealers and Importers.
- Giving technical support and information to the Service Dealers.

In the service process of DAF After Sales there are three interesting goods flows. This can be seen in Figure 4.2. I will define each flow:

1. The suppliers deliver to the central warehouse of DAF in Eindhoven and the warehouse of DAF in Chorley.
2. The distribution from Central warehouse to the Service Dealers and the Importers.
3. The distribution from the Service Dealer to the Business End users.

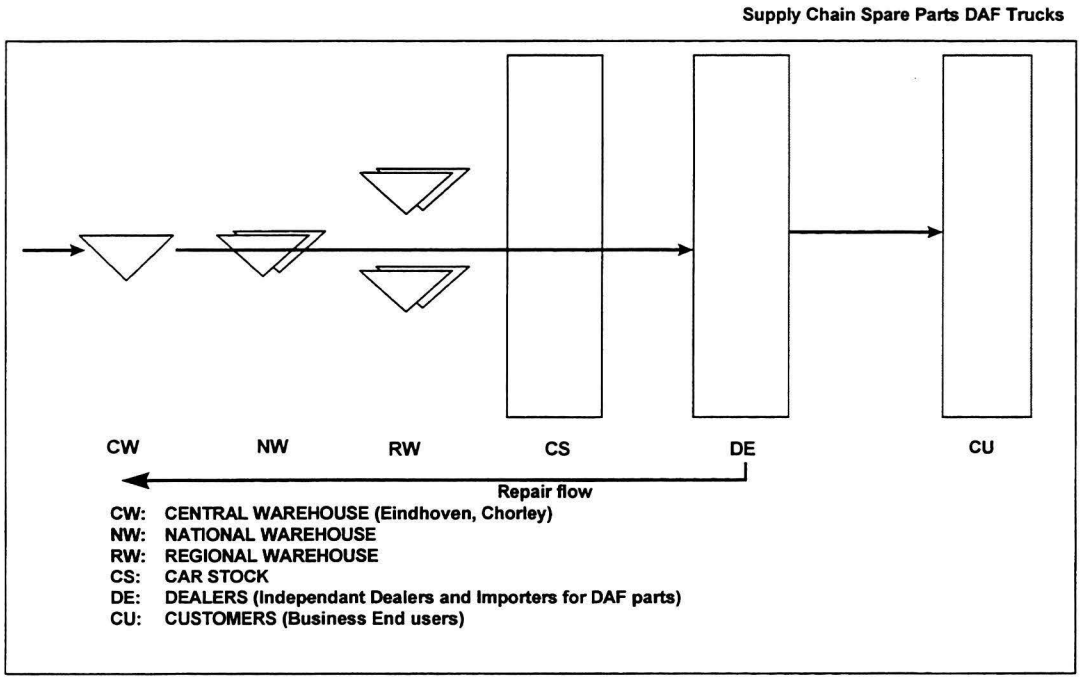

Figure 4.3 The Supply Chain of DAF After Sales

The Supply Chain

A Service Dealer or Importer can order parts in two ways. He can place an urgent order with a lead time of 24 hours or he can make it a stock order with agreed delivery time. These urgent orders have an order cut off time determined for each country in order to make the 24 hours delivery possible. In practice these lead times are approximately 12 hours. These cut off times are shown in Appendix E. The stock orders have maximum lead time of 5 days except for stock orders to the warehouse in Chorley and for Italy.

The structure of the supply chain can be seen in figure 4.3. The Service Dealers and Importers are responsible for their own stock and DAF After Sales delivers the requested parts to them from the central warehouse. So the Dealer or Importer has to order when he thinks it's necessary. DAF After Sales doesn't control the stock of the Dealers and Importers. To control the inventory in Eindhoven and process the orders, they use an order program. It contains two types of programs. The first is a forecast program and the second an order processing program. The forecasting of demand for each period is calculated by means of different formulas.

Articles are categorised in three groups. Group 1 contains articles that are hardly ever ordered, and in group 3 are the articles that are ordered often and have a regular demand pattern. The rest is in category 2. For category 1 there are no formulas to calculate the forecasted demand, for category 2 the formula is the mean average and for category 3 the formulas are single exponential smoothing for normal fast moving products and double exponential smoothing for products with a trend in the demand pattern [Silver, 1979]. These forecasts are also important for the calculation of safety stocks. The order size is calculated by means of the formula of CAMP [Bertrand, 1990]. The inventory is controlled by means of the R, s, Q system [Silver, 1979]. The orders have a replenishment time of one day or one week.

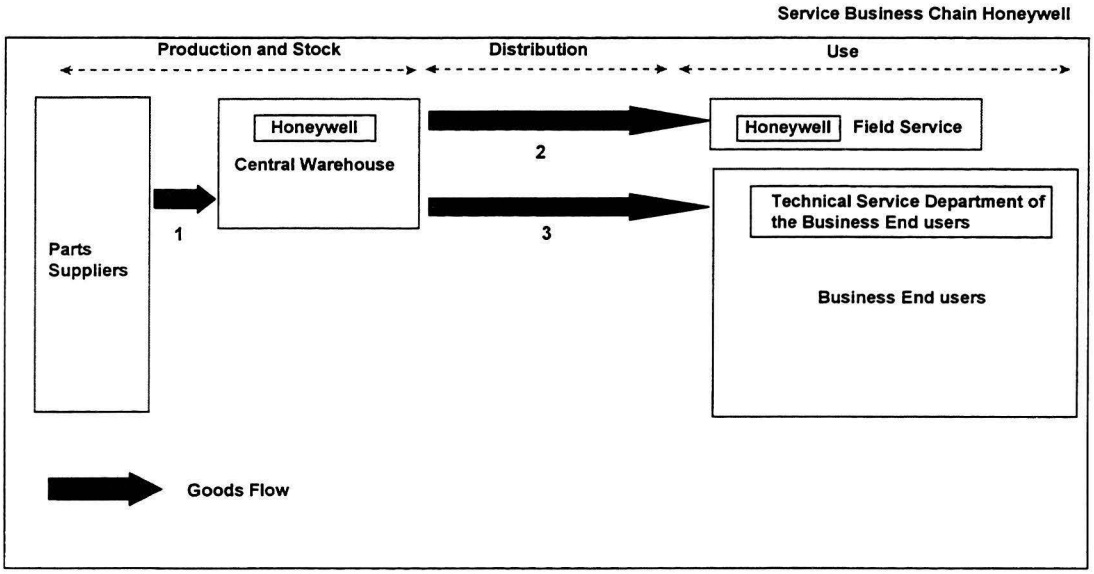

Figure 4.4 The Service Business Chain of Honeywell ISLC

4.3 Honeywell Industrial Service Logistics Centre

Honeywell is an American company, with their head quarters situated in Minneapolis, operating as an international organisation. They are world leader in cybernetics. In this field they give solutions for energy saving, environmental issues and performance enhancement without reduction of safety and comfort. There are three sectors in which they are active. The first is homes and buildings. The products for this sector are mostly used for climate control. The second is cybernetics in Space and Avionics. In this sector there are working agreements with big players like Boeing and Mc Donnel Douglas. The third sector is industrial cybernetics. Honeywell supports big companies like Shell, Exxon, BP and BASF.

The name of the department in Europe that is responsible for the spare parts delivery for the third sector is called Honeywell Industrial Service Logistics Centre (ISLC) and is located in Amsterdam. The core of their activities is to ensure the availability, delivery and quality of spare parts for contractual and non contractual end users. "The right part at the right time at the right place with the needed quality " is their commitment. ISLC is responsible for all the spare parts in Europe, the Middle East and South Africa. The central warehouse is situated in Amsterdam and Honeywell has an assembly factory in Brussels. The service contracts with the clients are all based on the 24 hours delivery time window. But in order to have a full guarantee of system up time, the client has a small stock (P1 stock) for extremely critical parts. This stock is owned by Honeywell. The technical service and maintenance is done by the technical service department of the business end user. After a good training by Honeywell, the engineers of the business end users can perform these actions by themselves. Only in a few difficult cases the engineers of Honeywell have to service the installations. So when a part is ordered, it is ordered most of the time by the technical service department of the business end user. They contact the affiliate in the country and the affiliate contacts ISLC. From there the parts are delivered directly to the business end user.

Honeywell offers their customers a full service contract. This means that Honeywell will bear full responsibility for the total service of the installation at the client's site. The delivery of spare parts is also a part of these "Umbrella Contracts". So in order to deliver the parts Honeywell has to know what the Installed Base of the customer is so that the contract parts can be identified. Honeywell guarantees a 24 hours delivery time of every contract spare part all over Europe.

Their mission is to guarantee a 24 hours delivery of contract spare parts with a minimisation of costs and a maximisation of logistic quality bearing the centralisation of stock in mind.

The Service Business Chain

The important functions of ISLC as the spare part organisation of Honeywell are:

- Managing the central stock in Amsterdam.
- Distributing the parts.
- Giving technical support and service to the Technical Service Department of the Business End users.

This can be seen in figure 4.4.

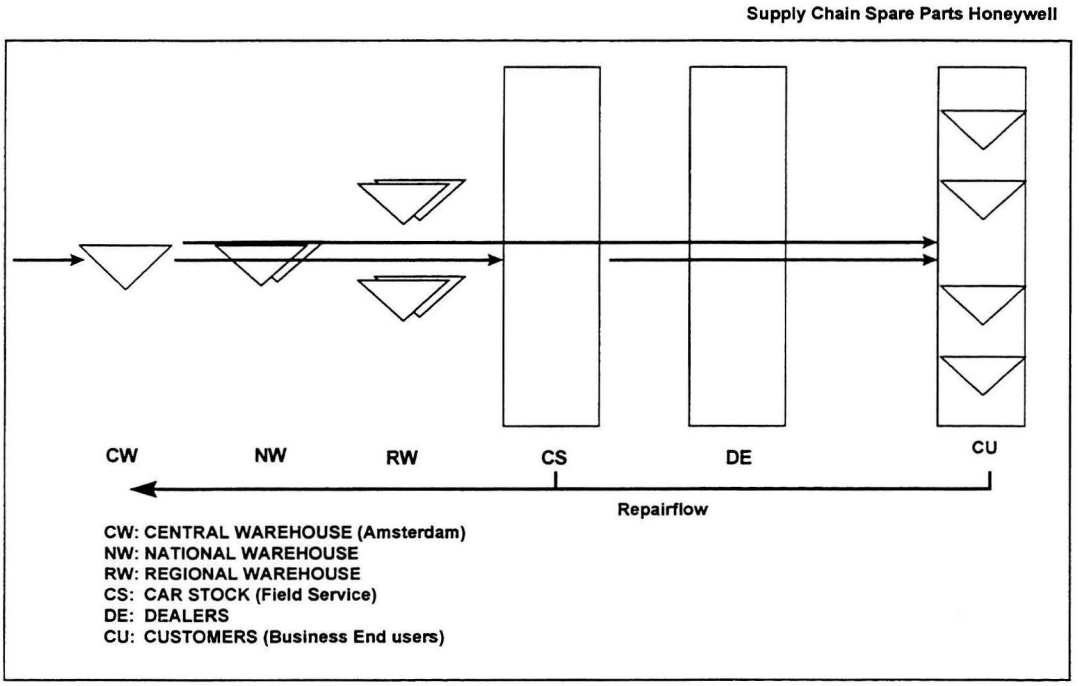

Figure 4.5 The Supply Chain of Honeywell ISLC

The interesting goods flows of the distribution of parts for Honeywell are:

1. The suppliers deliver the parts to the central warehouse Amsterdam.
2. The distribution of parts to the Field Service of Honeywell.
3. The distribution of parts to the Technical Service Department of the Business End user and supplying the P1 stock.

The Supply Chain

The customers of ISLC can place four kinds of orders:

- RA-1 orders: the contract orders who have to be delivered in 24 hours.
- RA-2 orders: urgent orders but not in the contract. These orders can be delivered in 24 hours if the requested parts are on stock. When they are not on stock they have the normal lead time of the factory.
- RA-3 orders: normal contract orders with a delivery time of five days.
- RA-4 orders: normal orders who are not in the service contract. These orders have a delivery time equal to the normal lead time of the factory.

The customers have a small inventory, owned by Honeywell, for critical spare parts called the P1 stock. This is shown in figure 4.5. These critical parts are necessary to have the lowest possible system down time. Honeywell replenishes these stocks by means of the RA-3 orders. The P1 stock plus the P2 stock for all other parts is located in Amsterdam. This stock is based on the Installed Base of each customer. So every part used in the systems of the business end user can be ordered. When a customer needs a part the affiliate in that country receives an order. Then the affiliate checks the system for this order and sends this order to ISLC.

By means of a control loop, containing Availability management, Installed base management and a data warehouse system the availability of parts is controlled [See Appendix F]. This loop will be controlled by means of a new ORACLE order management system. When there is a need for parts the system can generate the orders. So there are no cut off times, a client can place an order 24 hours a day. The system executes the order and sends it to the warehouse where the orders are picked and packed. If the parts are not on stock, the orders are then send directly to the suppliers. The demand is forecasted with the exponential smoothing formulas [Silver, 1979].

The main stock location is the central warehouse in Amsterdam. From here the customers all over Europe are delivered in 24 hours. This year a research has been done by Dijkman [Dijkman, 1998]. The topic of this research was finding the break even point between the costs of creating a strategic stock location in a certain country and the so called on board courier service of DHL, which also guarantees the 24 hours delivery. This on board courier service means that DHL gives the customer the opportunity to make a 24 hours delivery of one package possible. The costs of this transport are approximately 4000 or 5000 guilders per package. The research was done for orders from Sicily. On board courier service means that when a part is needed urgently, DHL has to send an employee by plane to Sicily to deliver the package at the client's site.

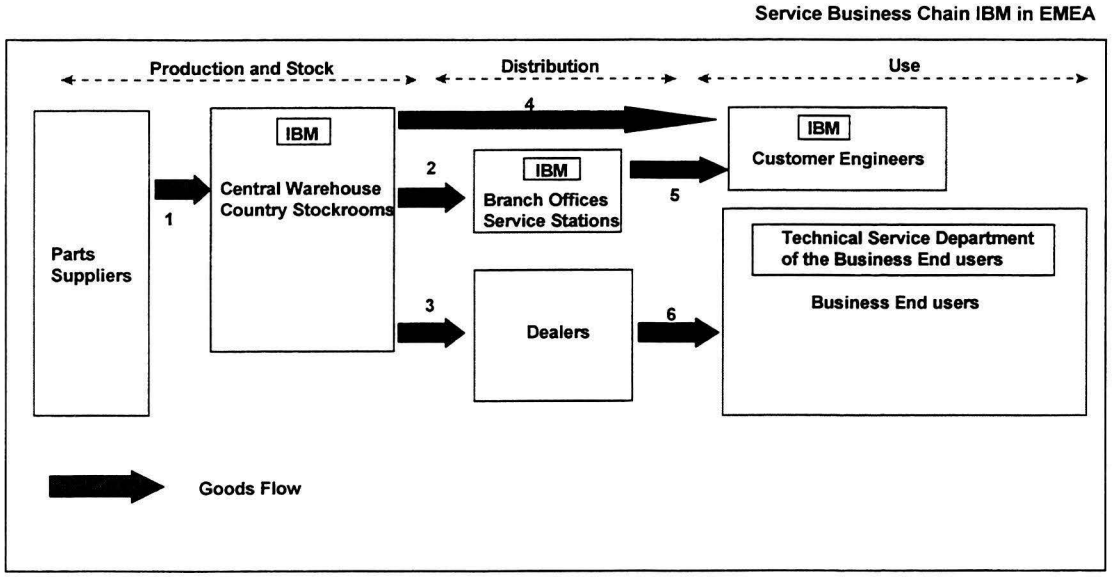

Figure 4.6 The Service Business Chain of IBM IMPL

4.4 IBM International Maintenance Parts Logistics

International Maintenance Parts Logistics (IMPL) is the division of IBM that bears responsibility in Europe, the Middle East and Africa (EMEA) for the Maintenance Parts Process and receives business direction from the general manager of Product Support Services in the European headquarters in Paris (EHQ). The international process management is carried out from Amsterdam, where also the central warehouse for EMEA is located. Each EMEA country has a central warehouse and in addition various storage locations situated in the vicinity of the customers, depending on the requested service level (total of approximately 200 warehouses). IBM is a global organisation and in order to give a good guarantee to the customers they have a lot of stock points all across the world. For the countries in Europe, the Middle East and Africa they have a main office in Amsterdam. For North America they have an office in Mechanicsburg, for Latin America in Rio de Janeiro and for Asia in Tokyo. The different parts are centrally ordered from approximately 300 IBM manufacturing facilities and vendors all over the world.

Their mission is to manage and provide Service Parts, Tools, Data, Processes, Systems and Know How to IBM Product Support Service Organisations, to enable them to achieve their business goals.

The Service Business Chain

The logistic functions for IMPL in Europe, the Middle East and Africa are:

- Managing the central warehouse (Central Buffer) in Amsterdam.
- Managing the decentral warehouses (30 Country Stockrooms), Branch Offices and Service Stations (together 140) across EMEA for quick delivery.
- Repairing parts in the Service Stations.
- Distributing parts between the Central Buffer, Customer Engineers (13.000), Country Stockrooms (CSR), Branch Offices and Service Stations.
- Supplying the Field Service of IBM with 13.000 Customer Engineers who repair at the client's site.

With the large network all over Europe and the number of Customer Engineers that have to be supplied, there are a six goods flows. This can be seen in figure 4.6. These flows are:

1. The parts suppliers deliver the parts to the Central Buffer and the Country Stockrooms.
2. The Central Buffer and the Country Stockrooms distribute the parts to Branch Offices and Service Stations.
3. The Country Stockroom delivers directly to the service dealers in that country.
4. The Central Warehouse and the Country Stockrooms supply the Customer Engineers.
5. The Branch Offices and Service Stations distribute parts to the Customer Engineers.
6. The Service Dealer delivers the parts to the Technical Service Department of the Business End users.

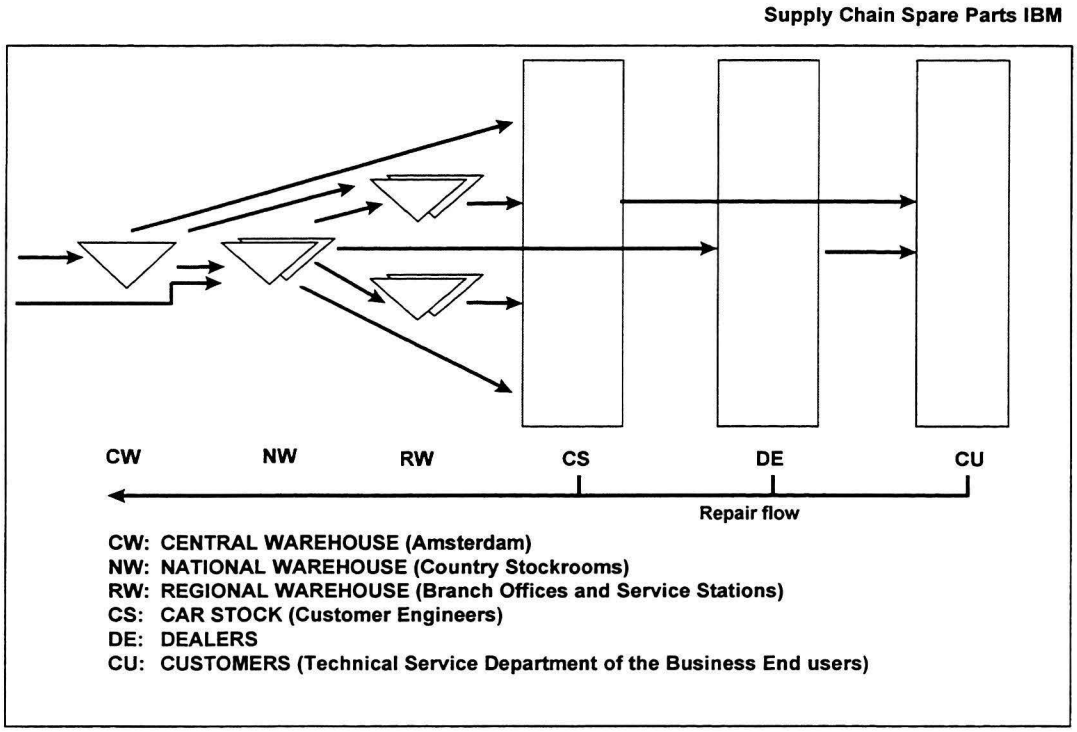

Figure 4.7 The Supply Chain of IBM IMPL

The Supply Chain

A customer engineer of IBM can place three kinds of urgency orders and there are two kinds of replenishment orders which the supporting system generates. For IMPL these orders have the code numbers 1 to 5. The customer engineer decides on what code number the order receives. Code number 4 or 5 indicates the urgency of the replenishment order.
These urgency codes are defined as follows:

- Code 1 is an order for a part that is necessary immediately because a customer down situation has occurred. 99% of the orders has to leave the warehouse in 2 hours. Speed is the most important factor.
- Code 2 is an order for a part that is necessary for corrective maintenance, so a machine or a part of the system is down. The part has to arrive as soon as possible but there has to be a good balance between speed and costs of delivery. According to service level agreements 99 % of the orders has to be distributed within the 24 hours delivery time.
- Code 3 are parts for preventive maintenance and minor system impact. The parts are needed within a few days, but the minimisation of costs of transport is more important. 99% has to be shipped in 2 working days.
- Code 4 and 5 are replenishment order for shipment between stock locations. Code 5 is for standard replenishments and code 4 gives priority to the replenishment order. 95% of the code 4 orders has to be shipped in 24 hours and for code 5 this has to be 3 working days.

There are 100.000 partnumbers in stock and 50% of these partnumbers are non IBM. This means that the service of IBM engineers not only regards IBM products but also products of competitors. The parts are stocked in 35 main stocklocations (Country Stockrooms) and 170 Branch Offices/ Support stations. This structure can be seen in figure 4.7.

To control the inventory a good communication between the different stock locations is necessary. For a replenishment order between stock locations and to the suppliers of IMPL there are three important stock levels:

1. The Critical Stock Level is the minimum stock level.
2. The Re Order Level (REOL) is the point where an order is placed.
3. The Keep On Stock (KOS) level is the maximum stock level.

These levels are calculated on the basis of the Installed Base of the customers and the removal rate of parts in this Installed Base, the historical demand and cost parameters. When the supporting system generates these orders the inventory manager can correct the orders or generate replenishments manually.

Every night the inventory status is measured and the differences are counterbalanced for all stocklocations. So when a stock location has an inventory higher than KOS this can be transported to a stock location which has a shortage.

4.5 Logistic Operations Philips Consumer Service

Logistic Operations Philips Consumer Service (LO PCS) is the Philips competence centre for service logistics. This organisation is part of Philips Consumer Electronics. LO PCS executes service logistics on behalf of the Service Organisations of the Philips Product Divisions. The Service Organisations are the owners of the Service Parts Business. LO PCS is the process owner of all service logistics processes. To generate additional income LO PCS is selling logistics services to third parties (former Philips companies).

LO PCS has three roles:

1. Global role for Philips Businesses
   LO PCS executes on behalf of the Philips Businesses the global supply chain management, the warehousing and physical distribution, the customer order fulfilment for Original Equipment Manufacturers (OEM) and Agents and all related accounting activities. LO PCS acts on behalf of the Philips Businesses as the global/ regional stock holder of service products

2. European role for Philips Businesses
   In Europe LO PCS executes, in addition to its global role for Philips Businesses the following tasks:
   - Customer order fulfilment of spare parts and accessories on behalf of the European service organisations.
   - Customer exchange services of refurbished products on behalf of the European service organisations.
   - Logistics and accounting services to support Philips Customer Care Centre tele sales to consumers of accessories on behalf of the European marketing and sales organisations.
   - The support of the implementation of integral logistics/ F&A systems for all European service organisations.

3. The role for third parties
   Same logistics services as for Philips' businesses, but all assets and costs of organisation are not in the Philips books. All financial transactions and charges for services are charged/ paid on a monthly basis to the third party. LO PCS acts under the legal entity of Philips Consumer Electronics as sales agent, purchasing agent and logistics and accounting service provider. All business risks are for the third party.

The mission of LO PCS is to support the Philips business, at the lowest costs, with world class service logistics and accounting competencies in line with the service mission of that business.

The Service Business Chain

LO PCS is the central/ regional distribution centre for spare parts and accessories for the National Service Organisations of Philips Consumer Electronics. The Authorised Dealers and Authorised Service Workshops (ASW) place their orders at the National Service Organisations (NSO). These NSO's place orders at LO PCS and from there the orders are direct delivered to the Authorised Dealers and ASW's all over Europe.

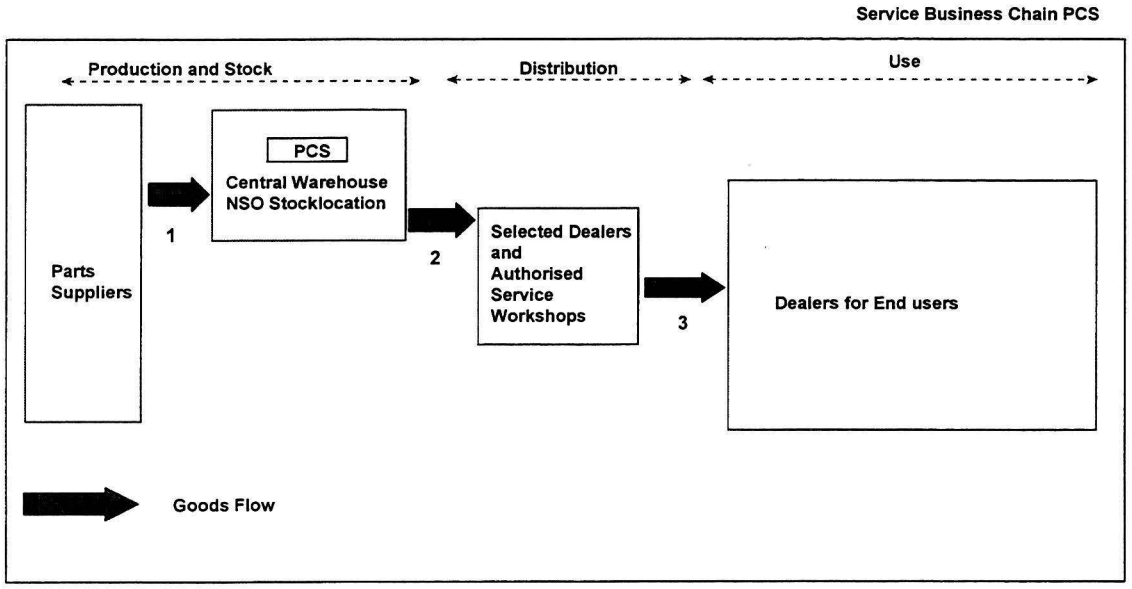

Figure 4.8 The Service Business Chain of LO PCS

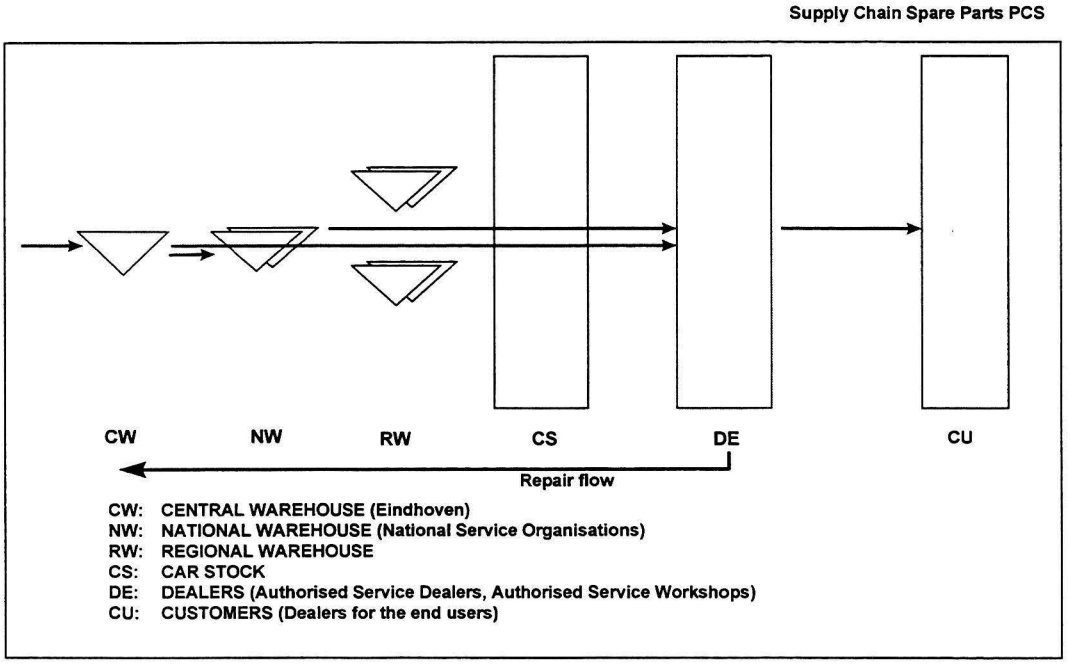

Figure 4.9 The Supply Chain of LO PCS

The functions of LO PCS in Europe are mainly:

- Managing the planning, procurement and stock for approximately 100.000 partnumbers.
- Managing the decentral stock of the NSO's.
- Distributing the parts directly to the Authorised Dealers and ASW's.

The goods flow is not very complicated with just a few players. This can be seen in figure 4.8. There are mainly three flows:

1. The parts suppliers deliver to the central warehouse in Eindhoven and from there the stock points of the NSO's are replenished.
2. The central warehouse in Eindhoven delivers to the Authorised Dealers and ASW's.
3. The Authorised Dealers and ASW's distribute parts to dealers for the end user.

The Supply Chain

The supply chain of LO PCS in Europe is based on direct delivery from central warehouse to the Authorised Dealers and ASW's. The order entry is executed by the NSO's. They send the orders by means of EDI to LO PCS and they deliver the parts directly to the Authorised Dealers and ASW's. Whenever these dealers and workshops need a part they contact the NSO. This structure of the supply chain is shown in figure 4.9.

The lead time of the order varies between 24 hours and 48 hours depending on market requirements and choices made by the NSO's in Europe. The incoming orders are send one to four times a day depending on the country. At LO PCS all the orders are processed four times a day. The lead time of an order depends on the cut off times of each country. This is the latest instant of time that a customer can place an order. At that point the order is processed in the warehouse in Eindhoven. This can be seen in Appendix E. So the speed of delivery depends on the time the orders are placed.

The inventory is managed centrally in Eindhoven. The policy of LO PCS is to have a good availability of parts (95% of all order lines are delivered from stock).The inventory is controlled by means of a statistical order management system in SAP. With this program the inventory manager can replenish the stock according to simple Camp EOQ formulas [Bertrand, 1990]. Smoothing parameters is also an option but due to irregular demand this smoothing is done by the inventory manager most of the time. When a trend or season effect occurs, the inventory manager can counter balance this difference by hand. The orders can be placed at the parts supplier every day.

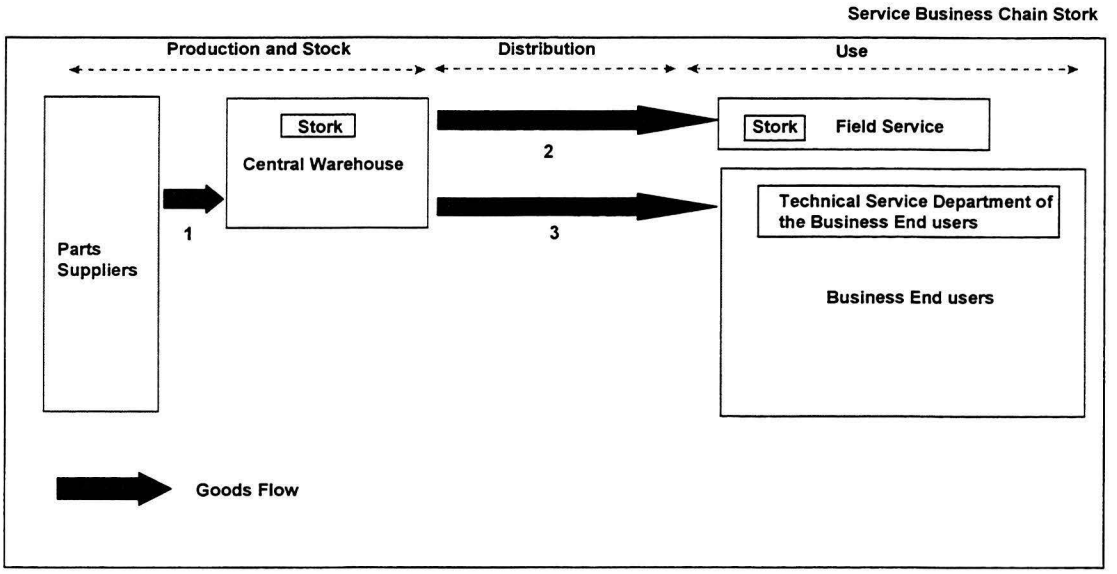

Figure 4.10 The Service Business Chain of Stork IBM Textile Printing and Coating

4.6 Stork IBM Textile Printing and Coating

Stork NV is a producer of big industrial machines in de textile and printing industry, and the food and packaging industry. Other activities are the production of industrial components, technical service and engineering and contracting. The company uses the concept of installed base management, which means that Stork knows exactly who the customer is and which Stork products they have. So the customer has a strong relation with Stork in case of requests for parts and service. In this context Stork continuously tries to lower the costs of ownership of the installed machines by giving good service speed and reliability. To solve the many differences in the countries, Stork is represented all over the world. Their policy is "Think global, act local". The company has a pro active service, which means that the clients are continuously visited and asked for their demands. In this way problems can be solved before they occur and the downtime of the machines is minimised. The benchmark partner in this project is called Stork Installed Base Management (IBM) Textile Printing and Coating. The organisation is situated in Boxmeer and they operate intercontinentally.

Stork IBM Textile Printing and Coating is part of the business unit Textile Printing and Coating and has the same mission as this business unit.
Their mission is: "development, production and selling of equipment and servicing the textile printing and coating market that leads to a structural profit".

"A structural profit means:

- A tight Cost Budget with a strong watch over this budget.
- Selling machines, spare parts and services with profit.
- Coherence of the activities inside Stork Brabant and demand a clear role inside the business unit".

The Service Business Chain

Stork uses the concept of Installed Base Management. The contact with the business end user is direct, and sometimes they are connected by means of EDI. This implies the opportunity to respond quickly to a request of the client.

The functions of the service department are:

- Managing the central warehouse for parts in Boxmeer.
- Distributing parts to the Technical Service Department of the Business End users.
- Giving Technical Support to the Business End users.
- Supplying the field service of Stork who repair the installations themselves.

There are three flows interesting for the distribution process:

1. The external suppliers deliver to the central warehouse of Stork.
2. Stork supplies the field service with the requested parts.
3. Stork supplies the Technical Service Department of the Business End users.

These flows are shown in figure 4.10.

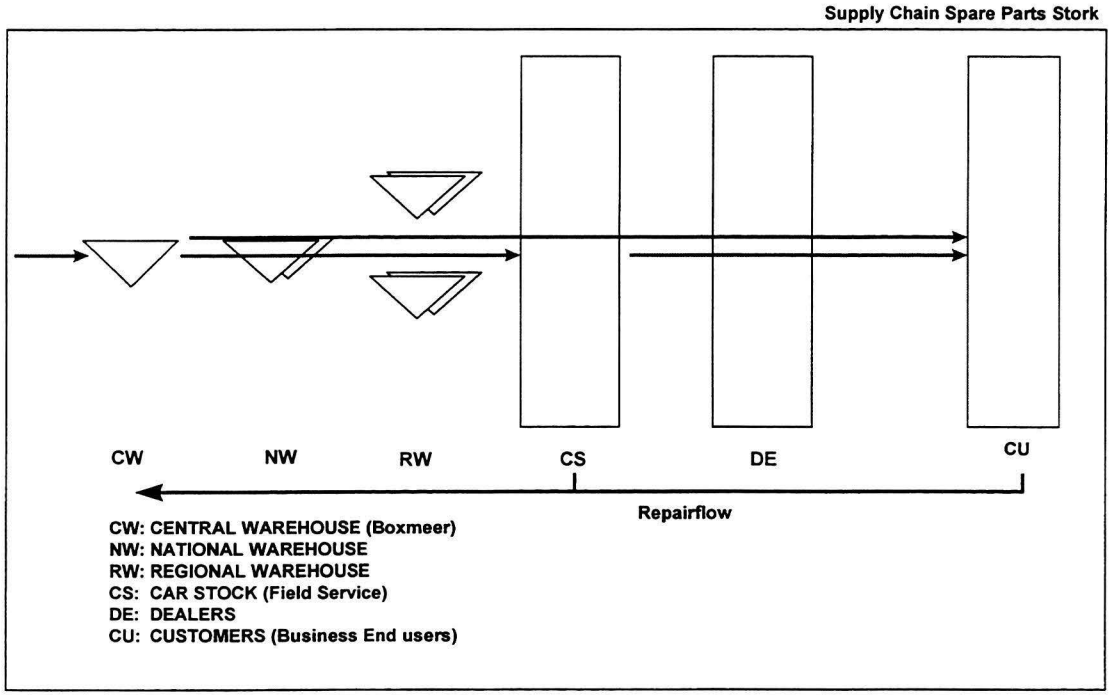

Figure 4.11 The Supply Chain of Stork IBM Textile Printing and Coating

The Supply Chain

The customers of Stork IBM can place three kinds of orders:

- Urgent orders that have to be delivered within 24 hours
- Orders that have to be delivered within 96 hours
- Orders with an agreed delivery time

When an order has to be delivered within 24 hours the client has to place this order before 16.00 hours. The cut off time for all orders is 16.00 hours. At this moment the orders are processed, picked and packed and prepared for transport. So in most cases delivery takes place within 12 hours and not 24 hours.

The inventory consists of all fast moving products plus the critical break down parts. These break down parts are directly related to a system down situation, so when a system down situation occurs these break down parts have to be on stock in Boxmeer. Most of the time these parts are on stock at the client's site and then the client places an urgent order. The complete supply chain is shown in figure 4.11.

The inventory is controlled by an ERP system called PSO. This system makes a daily forecast of the demand on the basis of historical demand and new developments. This means that when trend or season effects occur, the inventory manager has to correct the forecast by hand. The inventory manager places the orders for spare parts daily at the supplier.

Chapter 5 Logistic Performance

The core of this research is the comparison of the logistic performance of the benchmark partners. In order to succeed in comparing these service organisations with completely different sorts of parts in completely different markets, the logistic processes are benchmarked. To make performance measurement possible a few rules have to be obeyed. These rules have been described in chapter 2 and 3. The selection of the processes is essential for the selection of the set of performance indicators. These processes are described in chapter 4. Now in this chapter the selection of the processes and the selection of the set of logistic performance indicators (LPI) is made. After that the measurements of the LPI's are discussed.

5.1 Defining the indicators

In this research the logistic processes of the service organisations are benchmarked. This is a solution for comparing companies in complete different markets. The overlap between these companies is that they all deliver spare parts in conformity with market requirements. So the performance of the spare parts distribution of the players is benchmarked.

In order to come to a complete set of indicators an iterative process is followed. In chapter 2 a plan for defining performance indicators has been given [NEVEM, 1987]. This plan consists of four steps. In order to come to a complete process for defining logistic PI's in this research the NEVEM method has been expanded to ten steps. In this way all the aspects of the definition process are considered. The iterative steps of the process for defining logistic PI's are shown in figure 5.1.

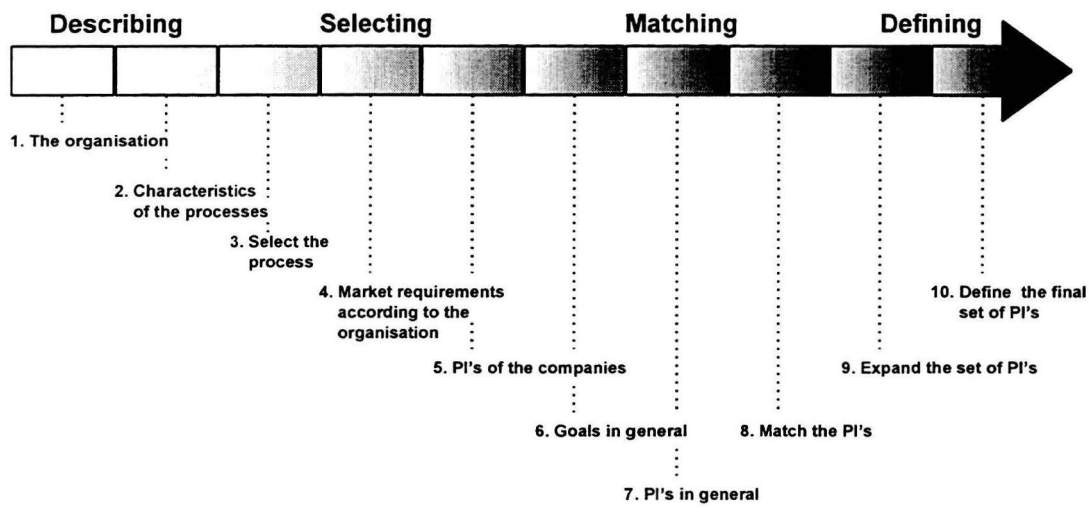

Figure 5.1 The iterative steps for defining LPI's

Logistic performance indicators have to be defined in such a way that they measure the performance of the process as good and complete as possible. In order to come to a set that makes the benchmark process possible the indicators have to be defined unequivocal for all companies. Only in this way can the values of the indicators be compared. In the following part the steps are explained.

1. *The organisation*

The first step is to get insight into the organisation. The general characteristics and the mission of the company have to be described. In this way feeling with the market is obtained and the position the company has in this market gets clear.

2. *Characteristics of the processes*

In order to make a good comparison possible, the characteristics of the processes and parts flows that enable spare parts distribution have to be described thoroughly. Only a good insight into these processes can lead to the relevant indicators.

3. *Select the process*

After a descriptive phase a selection has to take place. Because of the different requirements and characteristics of each of the parts flows, as described in the service business chains in chapter 4, now a selection of the appropriate flows has to take place.

4. *Market requirements according to the organisation*

Each organisation has done its own market researches to discover the requirements of the customer. The PI's used in the company are based on the requirements that have the biggest impact.

5. *PI's of the companies*

The performance indicators used in the companies are based on the requirements of the customer according to the company's own market researches and the mission of the organisation. In this step the PI's used in the companies to measure logistic performance have to be collected.

6. *Goals in general*

To get a complete view of customer service many other market researches exist, performed by other organisations. The outcome of these researches shows that there are more customer requirements or goals of customer service than the demands according to the companies.

7. *PI's in general*

The logistics PI's that measure these goals or requirements of the customer have to be defined in such a way that every company can measure them. There are many indicators that measure the performance of the total package of customer service of the company and they can be found in many researches. The difficulty is that it is hard to get the right ones. In this step the existing PI's have to be collected.

8. *Match the PI's*
In this study not the performance of customer service is benchmarked, but only a part of this customer service, namely the spare parts distribution. So to measure this process, the PI's in general have to be matched with the PI's used in practice. At this moment a complete list of performance indicators for spare parts distribution is obtained.

9. *Expand the set of PI's*
Now a selection has to take place on the basis of this matching. The set, used by the companies to measure the performance of the spare parts distribution will be expanded with PI's collected in step 7. A complete set of indicators with a clear coherence and a good definition is the result.

10. *Define final set of PI's*
In this last step the final set of indicators that will measure the performance is composed. Now an information check has to take place for each company. The definition of the indicator has to be formulated in such a way that it is clear for every company. The information, needed to measure the indicators, has to be available. The calculation of the indicator with the available information has to be simple.

After this last step the process of defining the final set of logistic performance indicators is complete. The result is a set of LPI's that measure the parts distribution on as many as possible logistic aspects and reflects the performance of each company in a good way.

Step 1 and step 2 have been performed in chapter 4. Step 3 will be taken in section 5.2. Step 4 to 7 are further explained in section 5.3 and the last steps are described in section 5.4.

5.2 The Parts Flow

After the phase in which the companies and their processes have been described the next step of the definition process can be taken. Now a selection has to take place. It is known that the performance of the spare parts distribution of each company will be benchmarked. But in order to compare the right process another selection has to take place. In this distribution there are many parts flows with different characteristics and to come to a good comparison, the right flows with the same characteristics have to be selected. The flows have been described in chapter 4.

The order flows with the same characteristics are selected on the basis of a few criteria. A main criterion is that the flow has to be a delivery from a main stock location to a direct user of that part. Another criterion is that the flow contains a number of order lines that is large enough to represent a significant part of the total spare parts distribution process of the company. Furthermore the orderlines have to be orderlines for urgent orders. So stock orders are not looked at in this benchmark study, as they are not critical to obtain a certain performance. These orders are controlled daily, but because of the time span in which they have to be delivered, exceptions can be made easily. The selected parts flows are shown in figure 5.2.

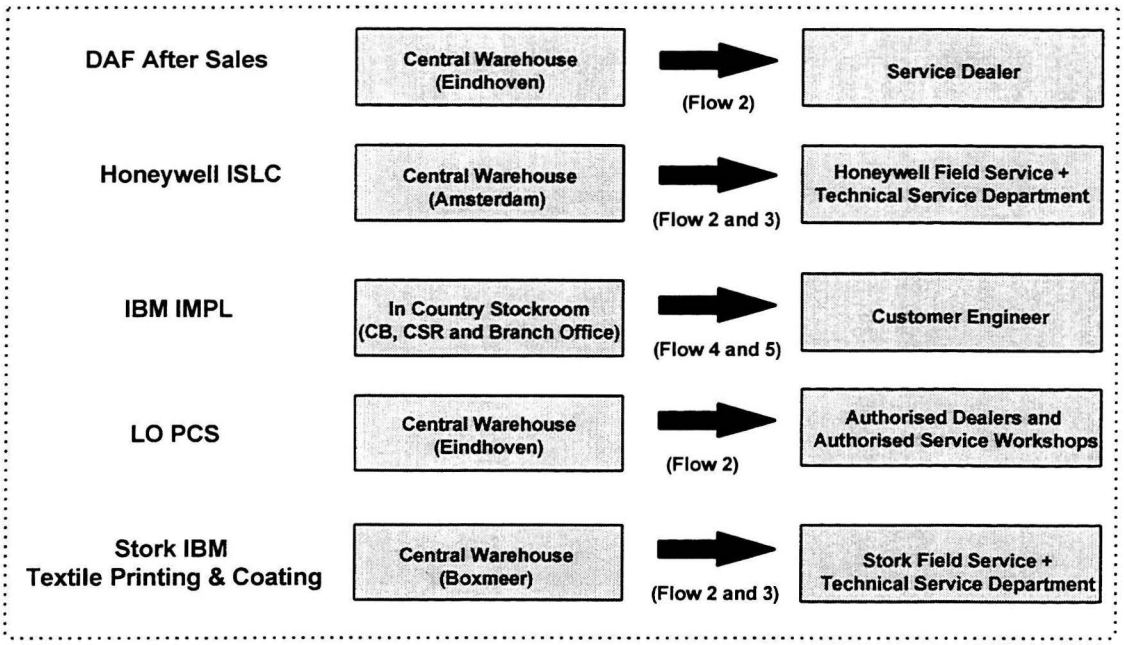

Figure 5.2 The Selected Parts Flows

5.3 The complete set

Every company has done market research in which opinions of users of the parts about the requirements of parts delivery are collected. The outcome of these researches, coupled with the mission of the organisation, leads to core elements or order winning criteria of the spare parts distribution. On the basis of these criteria, performance indicators have been defined and used in each company. The main criteria for each company in this research are:

- Speed of delivery
- Availability of parts

Quality, most of the times interpreted as complaints of customers, is also a criterion with an impact on the set of indicators, but of less importance.

To get a complete set of indicators that measures all aspects of customer service, market researches are performed by several institutions. In the logistic handbook edited by Ploos van Amstel the core elements of customer service have been identified by asking the end user [Ploos v. Amstel, 1993]. These elements have been described in chapter 3.5. The core elements are:

- **Product Availability**
- **Reliability**
- **Order Throughput Time and Lead Time**
- **Information**
- **Quality**
- **Flexibility**
- **Post Transaction Support**

After identifying the core elements of the process, the performance indicators to measure these elements are selected. The spare parts distribution is a part of customer service, and the elements that are direct related to customer service are also representative for spare part distribution, except for Post Transaction Support [Christopher, 1992]. This element is connected to the supporting activities of customer service like giving maintenance advice and article information. It is not an element that measures the performance of the parts delivery directly.

The available "performance indicators in general" for the remaining six elements can be found in [Ploos van Amstel, 1993].

5.4 The set of Logistic Performance Indicators

In order to benchmark the five players a final step is necessary: the available "performance indicators in general" as described in section 5.3 have to be compared with the performance indicators used in the companies. Now the current set of indicators used by the companies can be expanded in order to measure more aspects of parts distribution than speed of delivery and availability. If they're not already used, the question for each company is if each of the indicators can indeed be measured. Because if one indicator can not be measured, the company can not be benchmarked on this aspect. Of course the indicators that are not measured in this research can be part of the end product of the study, the PBF benchmark tool.

After checking if the needed information is available as described in step 10 of the defining process, a set of logistic PI's is composed. The result of the matching and defining is that the remaining core elements are:

- **Product Availability**
- **Reliability**
- **Order Throughput Time and Lead Time**
- **Quality**

The indicators to measure the performance on these elements or goals, and their definitions are:

1. ***Order Line Throughput Time***

The time in hours from the order cut off time or order entry time till the arrival of the parts at the customer who requested the parts

2. ***Product Availability***

The number of requested order lines per month, directly available from stock	/	Total number of requested order lines with order line throughput time as in 1, in one period

3. *Reliability of Delivery*

The number of order lines delivered on time and complete, in one period	/	Total number of requested order lines with given delivery time, and given quantity, in one period

4. *Reliability of Backorders*

The number of backorders delivered on agreed delivery time, in one period	/	Total number of backorders in one period

5. *Quality*

1-	The number of order lines delivered with a complaint, in one period	/	Total number of requested order lines with order line throughput time as in 1, in one period

The indicators are defined conform the requirements in section 2.3. The individual requirements have been met. The indicators are defined in such a way that the information needed is simple to obtain from the information system and it makes the calculation of the value of the indicator easy. The people involved have insight into the way they have measure the PI's and in what frequency.

The individual aspects are as important as the requirements for the set of indicators. The requirements for the set are:

- vertical coherence: a clear connection with the indicators used to measure complete customer service, which is the higher level, is necessary. The indicators are derived from these higher level indicators.

- horizontal coherence: the PI's all depend on each other. For example when the supplier does not deliver according to plan, the availability is low and the reliability of delivery cannot be high. The indicators show a connection with input PI's and process PI's.

- flexibility: processes change and thus performance measurement, the set of indicators has to change with these processes. The definitions can be adjusted very easily and new PI's can be added and existing can be dropped, with the agreement of the people involved of course. So the set is flexible.

- complete: the set of indicators has to measure the performance in a complete way. The indicators are based on the core elements of spare parts distribution and thus measure the total process. The set is complete.

The logistic processes are all based on policy statements and market requirements. For example when the customer demands a 24 hours delivery, the logistic network has to be developed in a way that makes such delivery possible. When a customer wants a very fast delivery in case of system down situations and he does not want to have a inventory of his own, there has to be a stock location nearby to enable the repair of that system within agreed time. So these policy statements and market requirements have a deep impact on the values of the PI's.

A few remarks on the indicators is appropriate:

- The cut off time is the latest instant of time to place an order. After that point the order can not be processed the same day. The cut off times for LO PCS and DAF After Sales can be found in Appendix E. For the other companies, which do not use the concept of cut off times, the lead time starts at the moment of order entry.

- The customers who request the parts are in this case the first parties that receive the parts, as shown in figure 5.2.

- If an order line can not be delivered on time or with the requested quantity it is called a backorder. In most cases a new release date for these backorders is set on the basis of supplier lead times.

- A complaint does not necessarily have to be caused by the company but nevertheless, the company is responsible for the order. So every complaint about wrong shipment, wrong quantity, too late delivery or defect parts, has to be taken into account.

Chapter 6 The Benchmark

In this chapter a comparison is made and the results of the logistic performance measurements are looked at for the five companies. An other aspect in most benchmark projects is the financial performance. This is an appropriate topic for companies in the same branch and with the same structure. In this research it is of minor importance but an impression of the financial performance can be interesting. So in the first section a start is made to analyse the different cost places for each company. After that the logistic performances of the companies are compared. At the end an impression of financial comparison is given.

6.1 The Financial Performance

Benchmark projects are most of the time comparisons of financial aspects of companies. In this project this not the case. The main topic is benchmarking the logistic performance. But in order to form an end statement about this kind of performance a few aspects have to be looked at. During the mid term presentation these aspects have been stated by representatives of the five benchmark partners. The aspects are:

1. Policy statements
2. Characteristics of the process
3. Costs
4. Market requirements

These four elements can have a deep impact on the results. So when big differences in logistic performance occur this might be explained by differences in these aspects.

Policy statements are decisions made by management to structure the company and point out the strategy. For example when a company wants to control their own warehouse and transport their parts, they need stock locations all over Europe in order to perform according to market requirements. When they outsource some activities they do not have to control these activities any more and this might effect performance and costs. Another example of policy is giving the end user a "critical parts stock". In this way the end user decides whether or not he orders parts. The extremely urgent orders don't have to be placed, because the critical parts are already there. The responsibility is now passed on to the customer.

The characteristics of the primary processes have been described in chapter 4. It is obvious that these characteristics influence the value of the indicators. The market requirements have a deep impact on the strategy, structure and costs of the company, because in the end the customer defines the requested performance. For example when customers want to have their parts in 24 hours at all costs, you can imagine that your performance will get better and the costs for the customer higher. By means of an extra stock point or a so called on board courier service a part can be delivered very quickly.

So the aspects are all correlated: when there is a change in one aspect the other aspects can change also. This can affect the performances and costs radically. So it makes a good knowledge of each of the aspects necessary in order to form a good end statement.

The third element is the topic of this section and section 6.3. A form of financial performance is knowing the costs of each company and compare them uniformly. To make this element comparable the first thing you have to do is to make a uniform classification. The classification structure that is chosen in this project is can be seen in figure 6.1.

Total costs of activities in guilders	
Total codenumbers Total receipt-lines Total order lines Total emergency orders	
Storage	
Space	
Interest	
Risk	
Handling	
Handling in	
Intern Transport	
Handling out	
Transport	
From warehouse to other stocklocations	
From warehouse to end users	
Ordermanagement	
Procurement, Control and Management of parts	
Overhead	
Not direct related costs	
Total	

Figure 6.1 The classification of costs

The emphasis lies on the main cost places of spare parts management. For example the interest costs are most of the time the interest percentage over the purchase costs. The costs of risk are most of the time scrap costs. The handling costs are the costs of physical handling of order lines. For every company these costs can be retrieved. So it is easy to look at them annually. The difficulty starts when the costs have to be compared and the differences have to be explained. For example differences caused by scale effects have to be taken out. This can be solved by searching for good cost drivers. In this research the only cost driver is the total number of delivered order lines. But when storage costs are looked at you can think of cost drivers as the costs per square meter for space costs, the number of receipt lines for handling-in costs and the number of employees for order management costs. Many aspects can be the cause of the differences. A cost driver can be relevant for one company and not at all for another.

The other three elements stated in the beginning of this section certainly have a deep impact on the values of the costs. This is not a big surprise because this is the main conclusion of financial benchmarks most of the time. It is difficult to make a uniform financial comparison of companies in different markets and branches. The products and margins differ too much and the market requirements lead to differences in structure and strategy.

An indication of the different costs per order line is shown in section 6.3.

6.2 The Results

The performances of the companies on each indicator have been measured. Now the comparison can be made and the results can be interpreted. In this following section the values of the indicators are discussed. The results are presented in a way that performances are related to companies A,B,C,D,E. Only the people involved know which character represents the benchmark partner. This has been done for privacy reasons. One conclusion from these measurements is that for all the indicators measured contaminations occur that influence the value of the indicator in a wrong way. So it is necessary to have insight into these contaminations in order to extrude the influences out of the measurements for the next periods. In this report not all the contaminations are summed up for every company. Instead an often occurring fault is discussed.

Indicator 1 Order Line Throughput Time

This indicator is measured by looking at the average order line throughput time for each country. After that the total average is calculated by looking at the total numbers of order lines per country. In most cases an order cut off time is the starting point of the measurement and the moment the order line leaves the warehouse the time measurement stops. After that an average transport lead time for each country is added. More details can be found in appendix G.

In order to come to a perfect measurement two instants of time have to be registered for each order line, namely the start time, when the customer orders parts, and the end time, when the order line arrives at the customer's site. For a few companies this will be the case in the future. Then an order line can be followed at any moment in time. The results of the measurements for the first indicator are shown in figure 6.2.

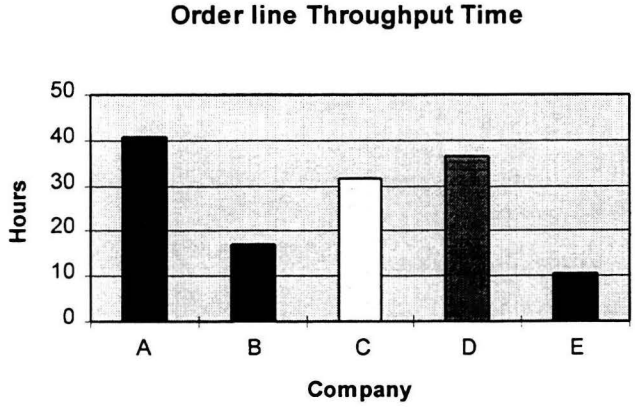

Figure 6.2 The order line throughput time for each company

The results show that throughput times are short and so the performances are high and that is probably a feature of the spare parts business: a part has to be delivered fast in order to make a difference.

Indicator 2 Availability

This indicator is based on the inventory management of the company. In case of a stock out it means that the client, in most cases, has to be disappointed because the part cannot be delivered in the requested time. But for some companies it is possible to acquire the parts in a very short time so that the request can be granted. It is important for every company to reflect the client's wishes in this indicator and measure this wish in a correct way. This means that when the request is made the company has to register if they can or cannot deliver the part within the requested amount of time. Only then a good measurement of availability is possible. This is not the case for a few companies.

In some cases the performances have not been measured for every period, but the results show that availability's are high. So another feature of the spare parts business is that parts have to be on stock in order to perform, because it is very hard to deliver fast and not have a part on stock. The results are shown in figure 6.3. More details can be found in Appendix G.

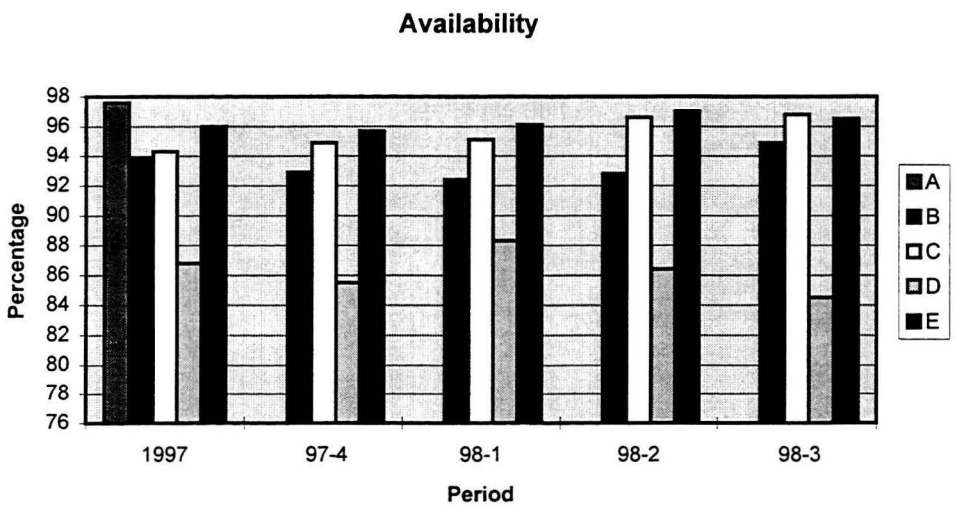

Figure 6.3 The parts availability per year and per quarter

Indicator 3 Reliability of Delivery

This indicator measures the performance of the delivery. The values show the number of requests that have been delivered on time and complete.
When the order lines have to be delivered and they are not on time this can have different causes: the handling out process was too slow, or the transport company has a delay. It is also possible that the order is not complete or damaged. This means that errors have occurred in the warehouse or during transport of the parts.

The value of the indicator is based upon the notion that when the order leaves the warehouse it is complete and on time. If this is not the case this can be seen in the number of backorders and the number and sort of customer complaints in indicator five. The major cause of too late deliveries are the transport companies.
The results can be seen in figure 6.4. Details are shown in appendix G.

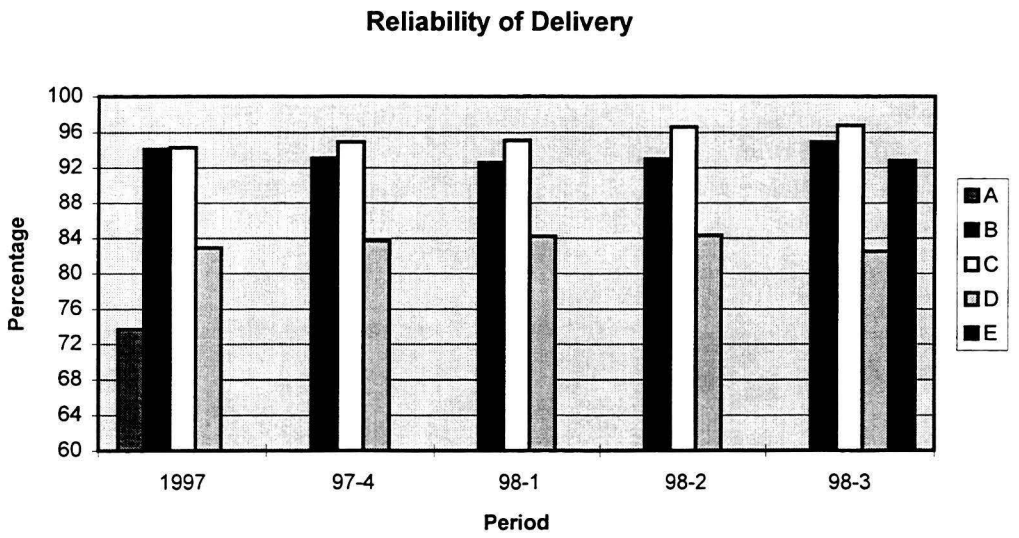

Figure 6.4 The reliability of delivery per year and per quarter

Indicator 4 Reliability of Backorders

This indicator could not be measured by three companies in such a way that comparison is possible. For most of the companies only an estimation can be given rather than an absolute measurement. Only two companies have a good measurement of this indicator. It is important, as for the first three indicators, to have a time label on every order line so that it is possible to follow the order line till the moment of delivery.

All the companies feel that this indicator gives a good reflection of logistic performance and that this indicator is necessary. So now we propose a plan in order to measure the performance of backorders in the future and to come to a good comparison of the results.

The proposition consists of three indicators in order to measure the performance of backorders in a complete way. The three indicators are:

1. Backorder Delivery Date

The number of backorders that receive a delivery date within 24 hours	/	Total number of backorders

2. Reliability of Backorders

The number of backorders delivered within confirmed delivery date	/	Total number of backorders

3. Backorder Lead Time

The average backorder lead time in days

In this way aspects crucial for the performance of backorders are looked at. It is not possible at the moment for the companies to measure these indicators, but in the future it is wise to focus on the possibilities. The same story as for the other indicators is appropriate here. When the start and end time of an order line is registered this also makes backorder measurements possible, because when the initial delivery date is not accomplished this means that the order line gets a new delivery date and thus a back order delivery date is born. The backorder can be followed now.

Indicator 5 Quality

The customer support desks register most of the complaints on order line level. So it is possible to calculate this indicator very easily. Complaints are most of the time about incomplete delivery, damaged delivery or wrong shipment. The results in figure 6.5 show a very high performance for every company. This means that the quality of delivery is high and that the orders are transported in a very good way.

The link with the third indicator is very strong here. When faults occur in the handling out or transport process, this will show in this indicator. The only condition is that the relation with the customer is good and the customer indicates that a mistake has occurred. When they do not report the complaint the company never can take action in order to correct the faults. The number of complaints per month are shown in appendix G. With this number the performance per year is calculated.

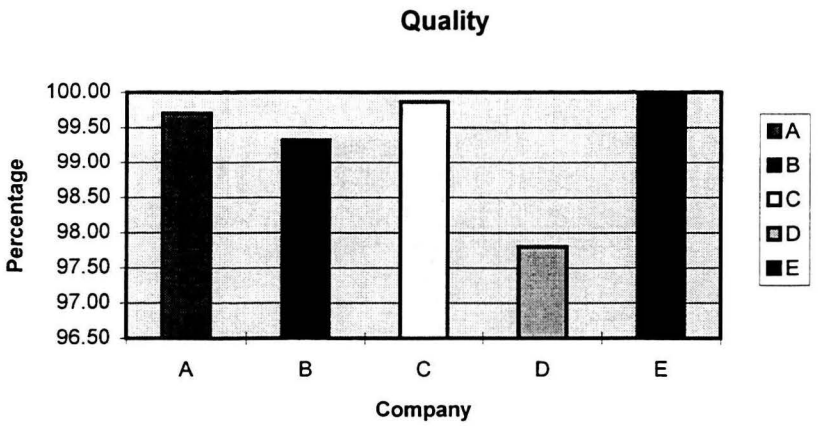

Figure 6.5 The quality of delivery

6.3 The Costs

An indication of the scale of costs can be sufficient for a player to come to the conclusion that a thorough investigation of the costs is needed and that a comparison with other companies is appropriate. This may lead to a new research study. An other option for a company can be a comparison of their costs over time. In this way it can be seen if the company has reduced their costs in comparison with last year.

So to give a simple example of a comparison of costs, the total costs (TC) per order line can indicate the financial performance. Other possibilities are to look at the total costs (C) per order line excluding transport costs. This is because not every company has transport costs. Another is the total costs of storage, handling and order management (S,H and O) per order line, being the more direct related costs. The fourth option is only handling costs and order management costs (H and O) to filter out the very variable storage costs.

Figure 6.6 shows the different costs as described in section 6.1. An expanded form can be seen in appendix H. Different comparisons are made. Now you can see that some companies have no transport costs or that they have high storage costs. The costs are indexed on a scale from 0 to 100.

This means that when the logistic performance is linked to the financial performance a uniform cost indication is necessary in order to make relevant remarks about the correlation between logistic and financial performance. In this research only an overall indication is given and this indication shows that the differences are big. There are a lot of factors responsible for these differences, so the conclusions of the financial comparison can not be that one company is better than the other.

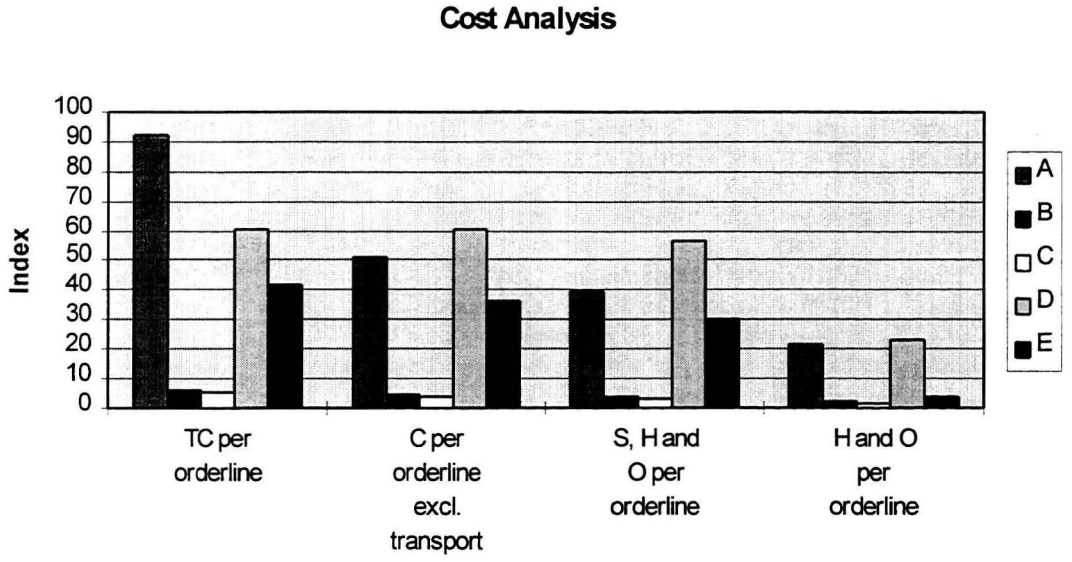

Figure 6.6 Cost Analysis of different costs per order line

The results of this research do not make a uniform comparison of costs possible. The differences and the scale effects cannot be filtered out without a thorough costs research. In order to make the financial comparison possible a lot more research has to be done. To come to a good comparison of costs a lot of differences have to be filtered out. Differences in the total number of requested order lines per year, interest rates, depreciations of parts and transport costs are just some of the many differences. So when a company wants to compare their financial performance with that of other companies it is wise to focus on benchmark partners in the same branch or market and with approximately the same size. In this way a lot of differences are filtered out. Then to come to a clean comparison it is necessary to identify relevant cost drivers and cost places. For example the relevant cost driver for the costs of space can be costs per m^2. Another can be the costs per receipt line for the handling in costs. So when it is desirable to perform a financial benchmark look at companies with the same size and with the same market requirements.

6.4 The Answers

I this section a summary is given of the answers to the questions stated in the beginning of this report. I will give a short answer with a reference to the relevant section of the report.

a. What does it take to compare different companies?
If companies are in complete different markets you have to search for similarities in processes. The processes with the same characteristics can be compared. So the solution is process benchmarking (section 3.1 and 5.2).

b. What is a good benchmarking instrument?
A good benchmarking instrument gives quick insight into the information needed to make a comparison possible. It contains a set of indicators that makes measurement of performance possible in an easy and understandable way. And a good instrument can be used in a frequent way and enables improvement of the processes (chapter 2 and 3).

c. How is logistic performance measured and how can it be compared?
Performance is measured by means of a set of logistic performance indicators that measure the performance of the selected process. A good definition of these indicators makes a comparison possible (section 2.2, 2.3 and 2.4).

The answers to the questions for the sub goals:

d. What are the relevant processes that have to be measured?
The processes that make spare parts distribution possible have to be measured. These are described in the service business chains and the supply chains. A selection of the processes with the same characteristics has to be made. This selection is described in section 5.2.

e. What information is needed to make this measurement possible?
The relevant data to measure the indicators has to be retrieved from the management information systems (section 5.4).

f. What are the costs of the performance?
The costs structure used is storage, handling, transport, order management and overhead. These are the activities involved in spare parts distribution (section 6.1).

g. What are important criteria for comparison?
The criteria are: selection of the right processes, definition of a good set of performance indicators, strong involvement of the companies in the development of the set PI's, proper measurements and a continuous process has to be started (chapter 3).

h. What performance indicators can be benchmarked?
The indicators are: order line throughput time, availability, reliability of delivery, reliability of backorders and quality (section 5.4).

i. What instrument can make benchmarking possible?
An instrument that gives insight into the processes, the set of performance indicators, the way to measure these indicators and how to compare the measures.

j. What are the differences between the companies?
The companies operate in different markets with different requirements. This means that policy, characteristics of the processes and the market requirements are not the same (section 6.1).

h. Which improvements can be initiated to achieve a better performance?
The instrument can be improved by new definitions for the indicator backorders. Every company has to have insight into the pollutions of the values of the indicators. The organisational aspects have to be stated. This means that there has to be an organisation that audits the benchmarking process and manages the data. The frequency of benchmarking has to be agreed upon and there has to be a continuous improvement of the benchmarking process(section 6.2).

The improvements of the processes of the companies can be achieved by comparing the results and the processes that make these results possible.

i. Which IT applications can facilitate the implementation of the instrument possible?
In this instrument Microsoft Excel worksheets are used to save the data and calculate the values of the indicators. With Excel it is also possible to create the relevant figures. When the number of benchmark partners is expanded and the process is performed on a regular basis it is wise to use Microsoft Access. In this way the continuous growing amount of data can be stored and retrieved very easily.

j. What is needed to use these IT applications?
First of all the benchmark institution has to know the possibilities and the shortcomings of the applications. Second they have to know the requirements of this system needed to execute the applications and how to protect the information.

Chapter 7 Conclusions

In this chapter the first part of the end statement is presented. In the following section the main conclusions of this study are summed up.

- Benchmarking is possible. The logistic performance of the spare parts distribution of the companies can be measured and compared.

In the first part of the study the main question was if a comparison could be made. In order to answer this question insight into the spare parts distribution processes of the different companies is needed. After the descriptive phase, in which the activities of every company have been described, the method of the benchmark wheel lead to this insight. The similarity is that in spite of the complete different markets the companies are in, they all have to deliver spare parts. The flow of parts from a central stock location to a user of the parts exists for all companies and the performance of this delivery can be compared.

The combination of this similarity in processes and a good performance measurement of the spare parts distribution of every company makes a comparison possible. So the definition of the set of indicators that measures the performance of the selected processes is crucial. The overall agreement on unequivocal definitions makes it possible to compare the measurements in a structural and repetitive way. Only when all companies agree on the stated definitions and measure their performance in the same way a comparison is possible. When these measurements are compared in an agreed period of time a benchmark instrument is born. With this report as a manual it is possible to apply the benchmark wheel. Then the benchmark wheel can function and continuous improvement is possible. When every company has insight into the performances of other companies and the processes of these companies that lead to these performances, it is possible to improve their own performances.

- When the instrument is used on a regular basis it is necessary to have insight into the possibilities and shortcomings of the instrument, the differences of the companies and new partners have to know how they can join.

The performance indicators order line throughput time, availability, reliability of delivery and quality are measured and make a comparison possible. The performance of backorders cannot be compared. Every company has agreed on the definition of the indicator but for three companies an objective measurement is not possible. Only an estimation has been given and that is not a measurement. In order to compare results the measurements have to come out of a management information system.

Every company is in a different phase of performance measurement. Some companies are still developing a good definition for their performance indicators. Other measure their performance according to stated definitions, but the measurements do not reflect the performance in a good way. This means that not every aspect is looked at and the values are too high or too low. And there are companies that have reached the point that the measurement reflects the performance in a good way but still pollutions in the measurements lead to a deviation of the real performance.

A good insight into these pollutions is necessary to control the processes. When every benchmark partner knows in what phase they are in, they know into what extent it is possible to compare their results with the other companies.

The four indicators have been measured according to the stated definitions and every company has agreed on the way in which a clean measurement has to be performed. The reality is that not for every company it is possible to measure the start and end time of an order line. In most cases the end time for an order line is when it departs the warehouse. From that point on the measurement stops and an indication of the transportation phase is given. There is no complete check of the transportation time and thus the time of arrival of the parts, so it is not possible to measure the guarantee of a complete and on time delivery. Only a sample check of the transport company gives insight into this last step. This is just one of the many pollutions in the measurements. Every company has their own specific pollutions that influence the measurements in a wrong way. This leads to a higher or lower indication of the performance. Insight in the size of these pollutions make a filter possible.

The market requirements have a very deep impact on the processes. This means that a company has developed their processes in such a way that the company can live up to the needs of the market. When a customer wants to have their parts in very short amount of time, say four hours, it is necessary to design the distribution structure in such a way that a stock location is nearby. Only then a fast delivery is possible. It is very hard to deliver fast without high costs, so a stock location has to be nearby. You can imagine that this requirement has a deep impact on the value of the indicator order line throughput time. Every indicator is strongly correlated with these requirements. They set the standard or target for the value of the performance. So every company has to realise what effects this can have for the comparison.

The financial part of this research has lead to insight into the different costs of every company. So for every company it is clear what the cost are of the performance of their spare parts distribution. This makes a comparison of costs in time possible. When a comparison with the other companies has to be made a lot of difficulties appear. Due to differences in size of the companies and the amount of order lines they deliver each year, big differences occur in costs per order line. Then there are differences in interest rates for purchase costs. The depreciation period of every part fluctuates. Transport costs are taken into account by one company and are just costs for the customer for the other. The cost driver number of order lines is not appropriate for every cost place so not all cost places can be compared. It is very hard to compare the financial performance of companies that have a different size, operate in complete different branches and have a complete different cost structure.

When new partners want to join the benchmarking process they have to follow these steps:

1. They have to get insight into the goals of PBF benchmarking (chapter1).
2. Every person involved has to know the theoretical background (chapter2).
3. The steps of the method of approach have to be followed correctly (chapter3).
4. The company has to describe their processes according to the structure in chapter 4. So the service business chain and the supply chain have to be described.
5. A selection of the right processes has to be made and the definitions of the indicators have to be clear. Another important issue is to have insight into the possibility to measure the available indicators (chapter 5).
6. When knowledge of PBF benchmarking is created, performance has to measured and compared with others.
7. Improvement of the processes can be achieved by making the comparison of results and processes with other companies.

In this benchmark instrument the IT application Microsoft Excel is used. This application makes it possible to store the relevant data and to calculate the values of the indicators. The figures that present the results can be generated very easily. When the number of partners is expanded and the amount of data grows in time, it is wise to use a data base application like Microsoft Access. This application makes it possible to store and retrieve the data in a simple way.

Chapter 8 Recommendations

This research is a pilot project. So in order to use the benchmark instrument it is necessary to state recommendations that make improvement of this tool possible. Many aspects have to be agreed on before a periodic benchmark can be performed. In the following part these recommendations are stated.

- The definitions of the indicators and the measurement of these indicators have to be improved constantly. The market requirements have a deep impact on the definitions of the indicators. So it is necessary to check if these requirements have changed. There has to be an absolute agreement on the definitions of the indicators and the way in which they are measured. Only in this way it is possible to compare the results. The values of the indicators have to be registered in an information system so that an objective measurement is possible. An estimation of the value of the indicator is not useful. In order to optimalise the performance measurements it is necessary that every company knows the pollutions of their measurement so that the values can be corrected when conclusions are taken.

- The performance of backorder management has to be looked at in the future. By means of the three new indicators, stated in chapter 6, a complete measurement and comparison is possible. The definitions for backorder confirmation, reliability of backorders and backorder lead time are just an example, but they reflect the major aspects of backorder management. It may not be possible for every company to measure their performances in this way, so an agreement on used definitions is necessary.

- When benchmarking is performed on a regular basis some organisational aspects have to be agreed upon. It is necessary that there is one objective institution that manages the information of the companies and the values of the indicators. Every period this institution receives the data and reports the values of the comparison. It is also necessary that the frequency of benchmarking is stated. I propose a quarterly comparison. Another aspect that has to be taken into account is privacy of data. When new benchmark partners join the benchmark it has to be clear what information they can have insight in. When the relation with the ENAPS consortium is expanded it has to be clear what information can and cannot be interchanged.

- In the near future it is wise to expand the number of benchmark partners. In this way more information can be retrieved and better comparisons can be made. Now there are differences in size and market, but when other companies join it is possible to benchmark with more or less equals. When the number is expanded it is necessary that the new players are initiated in benchmarking and the rules of the game. This has to be done by means of the institution that performs this initiation and this report as a manual.

- If a company wants to compare their financial performance with other companies it is wise to compare with players in the same branch and market and that have more or less the same size. After that I think it is wise not to focus on total costs but on different cost places. For example the handling activities or the order management can be compared. When the costs are retrieved an appropriate cost driver can make comparison possible. For example the handling in costs can be related to the number of receipt lines, the handling out costs can be related to the number of outgoing order lines. The main cost driver for order management can be the number of employees directly involved in order management. So if a financial benchmark is wishful much more research has to be done.

- The actual end time of an order line, that is when the part arrives at the customer is not registered in most cases. The moment the measurement stops is when the transport company picks up the order. After that only a random check gives insight in the last section of order line distribution. It is wise to measure the performance of the transport companies. Because the customer demands a high service from the companies, the companies can also demand a high service level of the transport companies.

- In order to measure performances data has to be retrieved from the information systems. This information is not 100 % accurate: there is a deviation between data in the system and the actual values. In order to get insight into the deviation between system data and actual data, research is necessary to document the differences.

- When the companies have send their values of the indicators at the end of the quarter the benchmark institution has to give feedback on the results. This structural feedback has to give insight into the differences and the reasons that explain these differences. Only in this way improvements can be made. When there is complete insight in the processes that lead to these performances, it is possible for companies to learn from each other.

Definitions and Abbreviations

ASW	Authorised Service Workshop A service unit for Philips products that is officially acknowledged by Philips
CB	Central Buffer The central warehouse of IBM in Amsterdam
CSR	Country Stockroom The national warehouses of IBM in the different countries
DAF After Sales	The service organisation of DAF responsible for sales of spare parts and other activities as technical support in Europe
DOE Handbook	Handbook of the US Department of Energy with techniques and tools to measure performance
EHQ	European Headquarters for IBM in Paris
EMEA	Europe, the Middle East and Africa
ENAPS	European Network of Advanced Performance Studies Project of the European Union to collect and transfer knowledge about best practices within the European industry
ESP	The Eight Step Plan model designed by the ENAPS consortium to perform a benchmark study
IMPL	International Maintenance Parts Logistics Division of IBM that bears responsibility for the maintenance parts process in Europe, the Middle East and Africa
ISLC	Industrial Service Logistics Centre Division of Honeywell that bears responsibility for the delivery of spare parts for the sector industrial cybernetics in Europe, the Middle East and Africa
KOS	Keep On Stock level The maximum stock level for parts
LO PCS	Logistic Operations Philips Consumer Service The service department of Philips responsible for the availability of spare parts

LPI	Logistic Performance Indicator
NEVEM	Nederlandse Vereniging voor Logistiek Management
NSO	National Service Organisation National Organisations of Philips responsible for the support of Philips customers
OPEN SLIM	Order management system used by Philips developed by the company SLIM
ORACLE order management system	Order management system used by Honeywell
PBF	The Parts Business Forum
PCS	Philips Consumer Service Same as LO PCS
PI	Performance Indicator
P1 stock	Inventory for critical spare parts owned by Honeywell at the client's site
P2 stock	Inventory of spare parts at the warehouse of Honeywell in Amsterdam
RA order	Type of order a customer of ISLC can place
REOL	Reorder level Stock level of parts where a replenishment order is placed
TSP	Ten Step Plan model by Kempen and Keizer

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