



***Towards improving contracted and outsourced maintenance activities***

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## ***Preface***

This thesis reflects my graduation research, conducted as part of the study program Master Business Administration International business. This research has been executed in Netherlands at Akzo Nobel Sourcing. The reporting of the research has been done in English. I would like to extend my sincerest gratitude to those who have made this research possible during all phases of the research. First of all I would like to thank my supervisors Peter Schuur and Stephan Maathuis who have helped me to come to this research by giving useful feedback.

Also I would like to thank Akzo Nobel for their cooperation during the execution. In particular I would like to thank sourcing managers and maintenance managers, who have been very supportive by assisting me with collecting information. Last but not least I would like to thank Peter den Besten who has made this research possible by showing interest in my proposal in October 2007 to do an assignment at Akzo Nobel and by facilitating the research, also for giving me an active feedback and shaping my research during the execution phase.

After more than six months of work, I am proud to present my research in this report. I hope Akzo Nobel will consider my research useful to them, and I hope this case can add experience to the business case knowledge that has already been collected in the field of outsourcing.

Enschede, September 2008,

Kristina Sitnikova

## Management summary

Akzo Nobel is one of the world's leading industrial companies. Akzo Nobel is the largest global coatings manufacturer and the number one in decorative paints and performance coatings, as well as a major worldwide supplier of specialty chemicals. Akzo Nobel Sourcing at corporate level gives worldwide sourcing support to business units in the field of raw materials, information technology, technical materials, and general services (both Product Related and Non-Product Related).

There is a general trend of reviewing the company's non-product related (NPR) purchasing activities with the goal of saving costs and optimization within each commodity group. Within the CTMS (Construction Technical Materials and Services) commodity group, in the category Technical Services maintenance activities are being reviewed to optimize these activities and save costs. There is a trend in the market to contract more services and even outsource maintenance activities.

In this research, the possibilities to improve the outsourcing process and what type of maintenance activities can be outsourced/contracted out will be shown. The scope of the research is the category Technical Services in the countries of The Netherlands, Germany, Sweden and USA.

The first steps towards answering this question we made by literature research and analysis of Akzo Nobel case studies.

Literature research was made in two directions. First, according to J. Heizer [10] we have to understand what types of maintenance activities exist and according to Aberdeen Group [9], what KPI's we can use for measuring performance of maintenance activities. Second we need to know how to outsource/contract out maintenance activities (R. Francis [11], S. Burdon [12], M. Levery [2], U. Westergren [4]) and what aspects we have to keep in mind to avoid risks connected with the outsourcing process (J. Heizer [10], R. Francis [11]).

In this analysis two different situations were identified: cases with contracting out maintenance activities and cases with outsourcing maintenance activities. The motivation and the results of the outsourcing process are different. This can be a learning case for Akzo Nobel. Mistakes which have been made can be used as attention points for other locations in the future.

The segmentation of the maintenance activities helps us to understand different approaches in making decisions on outsourcing these activities.

The segmentation can be seen on the following figure:

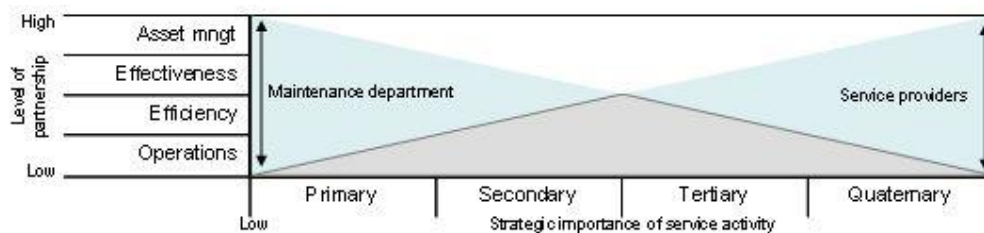


Figure 1. In house and outsourced maintenance activities [Internal Document]

The scope of this research is on primary and quaternary maintenance activities. The secondary and tertiary maintenance activities are difficult to separate. These maintenance activities are the "grey zone" of maintenance.

The differentiation in primary and quaternary maintenance activities requires a different attitude towards the outsourcing process. There are some important aspects which we have to take in account for outsourcing decisions.

To ascertain whether or not outsourcing of maintenance activities is preferred, we developed a block diagram (see Figure 2). In this block diagram the following attention points of making a decision to outsource are presented as follows:

- *Sufficient qualified suppliers*: It has to be sufficient for primary and quaternary maintenance activities. It has always to bring advantages; otherwise the in-house option is preferable.
- *Cost*: Costs of outsourcing have to be less than costs for the same operations in house. It has always to bring advantages; otherwise the in-house option is preferable.
- *Frequency of maintenance activities*: According to the theory of J. Heizer [10], different types of maintenance activities are characterized by different frequencies of these maintenance activities. If there are preventive maintenance activities and frequency is low, then you can outsource these maintenance activities. If there are corrective or proactive maintenance activities, then frequency is high. In this case it is better to keep this kind of maintenance activities in house.
- *Speed of reaction*: This is a critical issue for primary maintenance activities, because it can have influence on the production process. High speed reaction is necessary for primary activities and for quaternary maintenance activities it varies for different cases. That is why this can be a reason for not outsourcing primary maintenance activities.
- *Damage risk*: This is different for primary and quaternary maintenance activities. For primary maintenance activities it is high, because it can have an influence on the production process. Therefore it is better to keep these type activities in-house. For quaternary maintenance activities damage risk is low and that is why this can be outsourced.
- *Knowledge*:
  - *General*: This is important for primary and quaternary maintenance activities.
  - *Environmental*: This is a critical issue for primary maintenance activities, because the plant's knowledge is very important for effective performance of maintenance activities. It takes 3-5 years to acquire this knowledge and that is why this is a competitive advantage if you have it in house. For quaternary maintenance activities this type knowledge is not required.

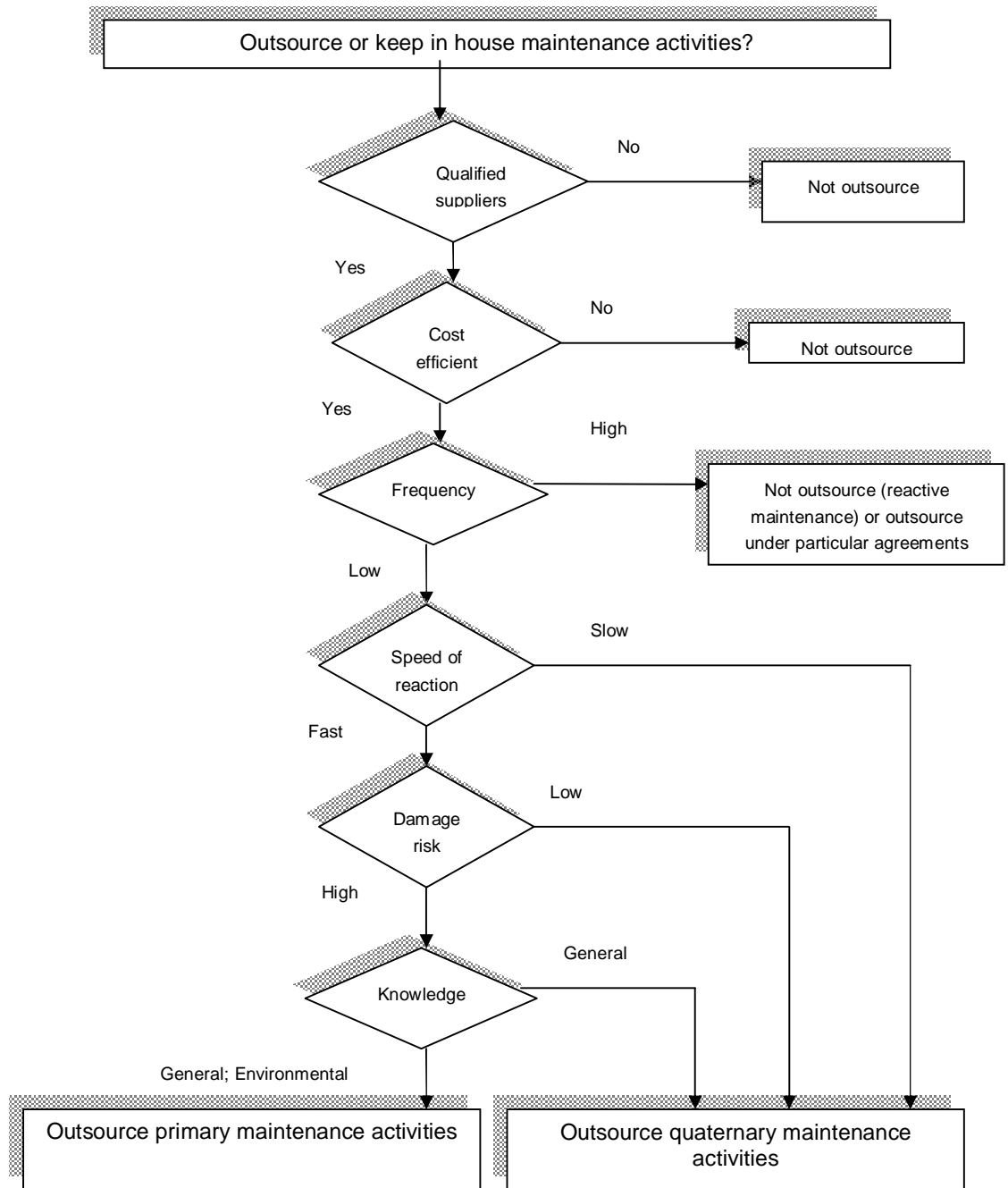


Figure 2. Aspects, which have to be analysed, to make an outsourcing decision

In the outsourcing process it is very important that both parties are really ready to co-operate. The mutual trust is very important and it can be developed through long term relationships. It is also very important to set up the demand organization for maintenance activities. This increases effectiveness and efficiency of maintenance organization and as a consequence it results in saving costs. This brings the maintenance organization from an operations level to an asset management level. Asset management can be done internally or externally. If the choice was made to contract out or outsource maintenance activities then it is important to pay attention to the selected points on the strategic and operational level. These attention points were derived from the literature research and also interviews with purchasing and maintenance managers of Akzo Nobel, ICI, DSM. These attention points will help to improve

the outsourcing process of maintenance activities. The following set of attention points covers these aspects at strategic and operational level:

*Strategic level:*

- *Multiple choice of suppliers:* quality, cost, speed of reaction;
- *Clear task formulation and performance measurements*, which have to be fixed in the contract;
- *Create equivalence between client and supplier* to achieve better results of co-operation. This can be done through economies of scale, giving one supplier more tasks and creating a co-operation process to improve maintenance activities for better efficiency and effectiveness of results;
- *Proposals to improve the maintenance process* and also cooperation in the implementation process;
- *The control function* is established by setting up the demand organization and clear performance indicators, which have to be reviewed once a year. Also the gate keeping function should be established by production, maintenance and purchasing departments. This is very important for control process.
- In the case of outsourcing *clear communication to employees* is required.

*Operational level:*

- *Creating/keeping environmental knowledge* can be done by fixed people who work at the plant on the contract;
- Organize efficient and effective work processes through:
  - § *Efficient work transfer* through effective schedules of activities;
  - § *Clear task formulation* by defining work scope and documentation;
  - § *Checking for spare parts availability*;
  - § *Control and monitor function:* clear results performance measurements and reports about finished work.
  - § Statistical analysis of the reports, including information of finished work, is helpful in the *evaluation of the performance level* of the particular supplier.
  - § *Evaluation and performance feedback for the suppliers* on the base of this analysis.

When attention is paid to these aspects the chance for an optimal outsourcing process will increase. The outsourcing process has to be evaluated from the operations level to asset management level. This can happen when both parties are ready to co-operate. Mutual trust is the most important aspect in the outsourcing process. This can be created through long term relationships. This also comes back in the theory of S. Burdon [12]. An efficient and effective long term relationship can be created when the aspects, which are named in the attention points list, are the basis of the coordination of the outsourcing process.

*Recommendations*

Finally some recommendations are made for Akzo Nobel based on this research. Some can be used as a basis for follow up research.

1. To examine the trend development regarding the outsourcing of both primary and quaternary maintenance activities.
2. To get more insight into the segmentation of secondary and tertiary maintenance activities.
3. To evaluate more extensively which maintenance activities are carried out at the various Akzo Nobel locations and how these are organized with respect to outsourcing/contracting out maintenance activities.
4. To do research about which cultural differences have influence on the outsourcing process of maintenance activities.

## **Table of contents**

Chapter 1. Introduction	8
1.1. Akzo Nobel	8
1.2. Background	10
1.3. Segmentation of the maintenance activities at Akzo Nobel	12
1.4. Problem formulation	13
1.5. Structure of research	14
1.6. Research approach	15
Chapter 2. Theoretical framework	17
2.1. Outsourcing	17
2.2. Maintenance and reliability	19
2.3. Outsourcing maintenance	20
2.4. Maintenance performance measures	25
2.5. Co-operative relationships	26
2.6. Fort framework	27
2.7. How Akzo Nobel sees outsourcing/contracting out maintenance activities	29
2.8. Conclusion	29
2.10. Research model	31
Chapter 3. Analysis and evaluation of current situation	34
3.1. Analysis of outsourcing process by Akzo Nobel case studies	34
3.2. Contracted out maintenance activities	35
3.3. All maintenance activities outsourced	36
3.4. Insight in the maintenance activities cost structure	36
Chapter 4. Benchmark and items of benchmark	38
4.1. Benchmark as a tool	38
4.2. Complete research model	40
4.3. Extra factors	45
Chapter 5. Improving the process of outsourcing maintenance activities	47
5.1. Best practices	47
5.2. Internal benchmarking	47
5.3. External benchmarking (ICI, DSM)	52
5.4. Extra factors	54
Chapter 6. Conclusions and recommendations	56
6.1. Conclusions	56
6.2. Recommendations	61
Literature	62
Abbreviations list	63
Appendix 1. Planning of the research	64
Appendix 2. Technical part of maintenance activities	65
Appendix 3. Analysis and evaluation of current situation	71
Appendix 4. External benchmarking (ICI and DSM)	78
Appendix 5. Insight in the cost structure of maintenance activities by locations Sassenheim and Deventer.	82
Appendix 6. Questionnaire	84

## **Chapter 1. Introduction**

Within the framework of my study, I have to execute a graduation assignment in international management leading to my Master of Science degree in Business Administration. This assignment will be executed in international company Akzo Nobel in the department Sourcing for the commodity group CTMS. This research will help this commodity group in reviewing of the outsourcing process of maintenance activities and has to give proposals for the improving of this process.

In the research we will mention a company information and the background of the problem formulation. Then we are going to do the literature study and on base of literature study the research model is derived. The current situation of the outsourcing maintenance activities will be analysed and the best practices from the internal and external benchmarking will be identified. As a result the KPI's of the outsourcing framework have to be identified and they are making the base for the conclusions of the research.

In this chapter the structure of research is determined. First the company information and background of the research will be given. Then the problem formulation is derived from the background of the research. Subsequently a framework that serves as the backbone of this research will be selected from the existing literature. Then the research questions that need to be answered in order to solve the research formulation will be derived from that framework. At last the research approach is discussed.

### **1.1. Akzo Nobel**

Akzo Nobel is one of the world's leading industrial companies. Akzo Nobel is the largest global coatings manufacturer and the number one in decorative paints and performance coatings, as well as being a major worldwide supplier of specialty chemicals.

The company employs around 60,000 people in more than 80 countries and commits to developing innovative products and cutting-edge sustainable technologies. It endeavours to deliver whatever the customers require, wherever and whenever they need it.

Based in the Netherlands, Akzo Nobel is a Fortune Global 500 company and is listed on the Euronext Amsterdam stock exchange. The company is the Chemicals industry leader on the Dow Jones Sustainability Indexes, as well as being included on the FTSE4Good Index.

#### **Vision**

Akzo Nobel believes the future belongs to those smart enough to challenge it. It believes that real progress belongs to those who not only think with courage, but also have the courage to deliver on the thought. Tomorrow's answers, delivered today.

What drives AN is knowing that what is good for our customers today is not necessarily good enough for them tomorrow. What excites company is asking the unasked question. What inspires it is seeing the opportunity others cannot. What unites AN is the intelligence to deliver where others have not.

This benefits AN customers because company sustains their future competitiveness and meet the consumers' unspoken needs.

This ambition defines Akzo Nobel. This is the way Akzo Nobel works. This is why Akzo Nobel comes to work. This is Akzo Nobel.

Akzo Nobel believes in:

- § Focusing on our customers' future first
- § Embracing entrepreneurial thinking
- § Developing the talents of our people
- § The courage and curiosity to question
- § Integrity and responsibility in our actions



## **Strategy**

The new organization of Akzo Nobel operates in three business areas: Decorative Paints, Performance Coatings, and Specialty Chemicals. Akzo Nobel is now focusing on maintaining our momentum and leadership through faster growth (particularly in emerging markets). AN will take advantage of their global leadership positions and continue to improve their profitability through operational excellence. In particular AN will gain the full commercial benefits of the ICI acquisition.

Company aims to create one of the world's leading industrial companies with a unique brand. AN has a strong portfolio of businesses in attractive growth markets and company remains committed to financial discipline. AN will invest capital to build sustainable leadership positions, aiming for returns significantly above the cost of capital and substantial operational cash flows.

- § Paints and Coatings
- § Specialty Chemicals
- § A well-balanced portfolio

### **• Paints and Coatings**

Akzo Nobel is the world's largest manufacturer of decorative paints and performance coatings. Company supplies products to a broad spectrum of customers – from heavy industrial to consumers.

The industry provides strong, stable and sustainable cash flows with low cyclical movements and modest capital investment requirements.

AN is focused on growing in the emerging markets of Asia, Eastern and Central Europe, and South and Central America, through a combination of organic growth and selected acquisitions strengthening their position in key mature markets, mainly through small and medium-sized acquisitions.

AN ambition is to consolidate our world-leading position in Decorative Paints and Performance Coatings in all AN product markets and key geographic countries and regions. Company intends to be an active consolidator in the industry and continue to use their scale to further develop their leading positions in technology and sustainability.

### **• Decorative paints**

AkzoNobel is the world's leading decorative paint company, home to famous names like Sikkens, Dulux and Hammerite.

Whether AN customers are professional decorators or enthusiastic DIY-ers, they still want paint that gives a great finish. Decorative Paints business has a huge range of quality products for every situation and surface.

As well as paints, lacquers and varnishes, company makes adhesives and floor leveling compounds. AN also offer a range of mixing machines, color concepts and training courses for the building and renovation industry. And company specialty coatings for metal, concrete and other critical building materials lead the market.

AN customers range from trade distributors for professionals to “big box” chains like Home Depot, Bricomarché, B&Q, OBI and Praktiker.

AN Decorative Paints business consists of seven Business Units in three regions: Decorative Paints Europe, Decorative Paints America, Decorative Paints Asia.

### **• Performance coatings**

AN is world leaders when it comes to performance coatings. Over the years company has earned a rock-solid reputation based on their innovative technologies, first-class service and flexible distribution. Their coating brands include famous names like International®, Sikkens® and Interpon®.

Performance coatings have hundreds of uses. AN has divided them into four businesses; together they supply businesses ranging from construction to consumer electronics and shipping to sports equipment:

- § Car Refinishes
- § Marine & Protective Coatings
- § Industrial Activities
- § Packaging Coatings

- **Specialty Chemicals**

AN Specialty Chemicals portfolio focuses on a small number of businesses with leading market positions. Overall, the business is similar to Paints and Coatings in offering relatively stable and sustainable cash flows from a less cyclical base and with average investment demands.

Having realigned the portfolio, Specialty Chemicals activities are now fully concentrated on profitable growth in those markets where they have a competitive advantage – and can achieve above-average financial returns. Akzo Nobel aims to strengthen their leading positions by investing in organic growth, particularly in the emerging markets, and through participating in industry consolidation.

Across the portfolio, they will continue to scrutinize their activities in mature markets for opportunities to improve productivity.

Specialty chemicals are divided in the following six business units:

- § Surface Chemistry
- § Polymer Chemicals
- § Chemicals Pakistan
- § Pulp & Paper Chemicals
- § Functional Chemicals
- § Base Chemicals

- **A well-balanced portfolio**

The basic business models of AN business areas are now very similar, so they can make best use of their scale and size to create value. Company is creating, modifying, and using chemical compounds in all the business areas in which they operate.

This common thread gives AN a technical edge, so they continue to develop joint research and development programs in similar technologies. For example, the cellulose-based thickeners developed by Cellulosic Specialties business are used in decorative wall paints. The surface properties of coatings are also improved by using colloidal silica produced by Pulp & Paper Chemicals business. Both examples highlight the increasing collaboration between company's coatings and chemicals activities.

## **1.2. Background**

At the corporate level Akzo Nobel Sourcing (Figure 3) stimulates synergy and relevant coordination of lead buyers and enhances purchasing professionalism in all aspects. It gives worldwide sourcing support to business units in the field of raw materials, information technology, technical materials, and general services (both Product Related and Non-Product Related).

The organization of Akzo Nobel Sourcing exists from Product related Spend areas and Non – Product related Commodity groups, Controlling and Communication and learning.

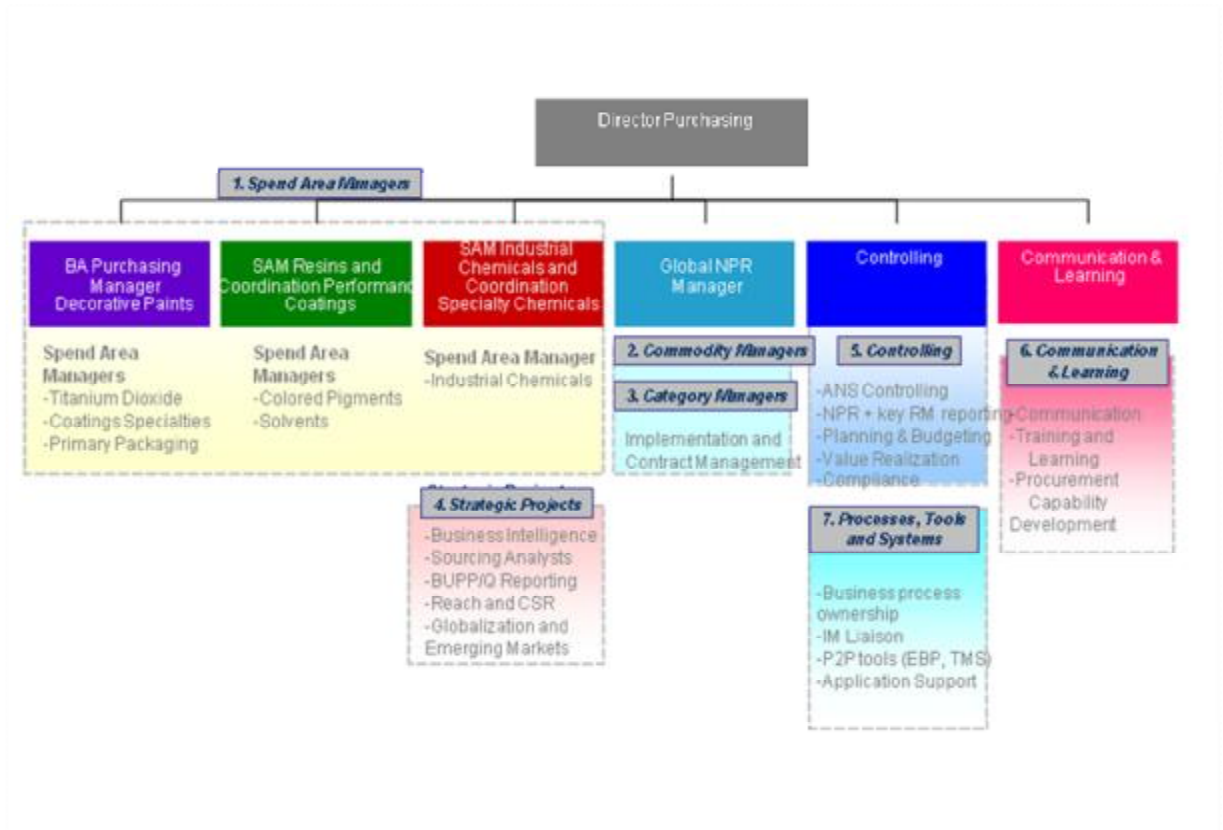


Figure 3. Akzo Nobel Sourcing.

In the scope of the non – product related program, commodity managers have the following goals:

- § Identify synergies leading to cost savings and/or optimization within the commodity
- § Define purchase strategies and action plans to capture this synergies
- § Develop and support cross BU projects and initiatives within the commodity
- § Responsible for development of supplier management approach within the commodity.

There is a general trend of reviewing a company's non-product related (NPR) purchasing activities with the goal of saving cost and optimization within each commodity group. Akzo Nobel Sourcing is following this trend in the following purchasing commodity groups (Figure 4).

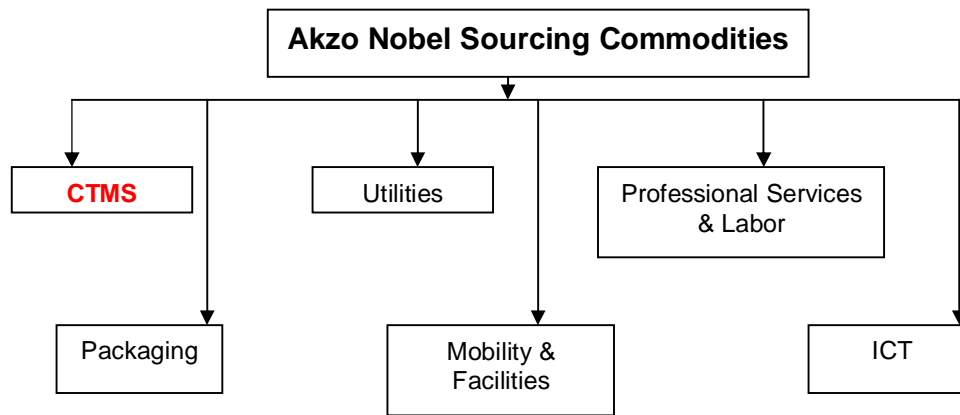


Figure 4. Akzo Nobel Sourcing Commodity groups

CTMS (Construction Technical Materials and Services) commodity group initiates research question of my thesis (see section 1.4). This commodity group consists of the following categories:

- § MRO / Electricals
- § Environmental services
- § Control systems
- § Pumps
- § Forklift trucks
- § Commodity services
- § Inspection services
- § Equipment
- § **Technical services**
- § Filtration
- § Lab suppliers & Equipment

In the category Technical services, maintenance activities are reviewed with the goal to optimize these activities and save costs. There is a trend in the market to contract more and more services and even outsource maintenance activities.

In this research will be shown the possibilities to improve the outsourcing process and what type of maintenance activities can be outsourced.

The scope of the research is the category Technical services in the countries of The Netherlands, Germany, Sweden and USA.

### 1.3. Segmentation of the maintenance activities at Akzo Nobel

On base of internal documentation of Akzo Nobel and with cooperation of Accenture (consultancy agency), the model of in house and outsourced maintenance activities were developed. This model represents the segmentation of the maintenance activities on the strategic importance and also performing sides (in house, outsourced) on the level of partnership.

The following segmentation of maintenance activities is made:

- Primary: services directly related to the production process
- Secondary: combination of services related to the production process and installations and beginning to evolve towards more facility management
- Tertiary: combination of services less related to the production process and more evolving towards facility management
- Quaternary: not related to the production process and mainly related to facility management

Levels of partnership of the performing sides (suppliers and client company) are:

- Operations: In the first level the focus is mainly on costs savings realized by better purchasing prices (hourly rates etc.) and agreements.
- Efficiency: On the second level more insight in the organization is granted to the service provider in which they cooperate to increase the efficiency by for example combining workload etc.
- Effectiveness: This is the third level of services in which a higher level of partnership is agreed upon and services provider assist in increasing the effectiveness of the maintenance organization/activities. Their advice is based on their expertise and market best practices.
- Asset management: This is the highest level of service management in which the supplier or client company becomes responsible for executing and maintaining all assets.

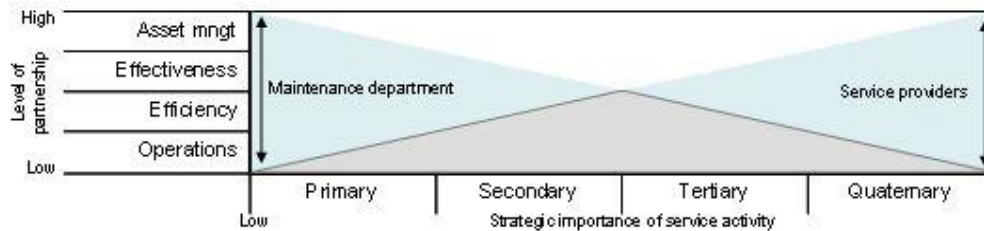


Figure 5. In house and outsourced maintenance activities [Internal Document]

The scope of the research will be primary and quaternary maintenance activities. The reason hereof is that secondary and tertiary maintenance activities are difficult to separate and this is a grey zone of maintenance. There are no clear borders between them. Primary and quaternary maintenance activities are easy to separate and there are clear borders between them. There are also different maintenance philosophies behind these types of maintenance activities. These philosophies will be discussed further.

#### 1.4. Problem formulation

Akzo Nobel Sourcing wants to know what the trend is in outsourced and contracted maintenance services. That is why is useful to identify best practices for outsourced maintenance activities for two segments: Chemicals and Coatings. This gives an understanding of the differences in approaches for outsourcing processes in both segments. Therefore we want to study what activities are already outsourced by different business units (BU's) of Akzo Nobel, how these BU's have done this and why, and what the experiences are. The outcome of the study is to support AN in formulating their policy on outsourcing of maintenance activities by evaluating existing outsourcing activities and compare this with relevant external benchmark. The general question can be formulated as:

*Which best practices with respect to outsourcing maintenance activities by two segments can be concluded based on the evaluation of different outsourcing projects and comparing with a relevant external benchmark.*

Research goal can be summarized as follows:

***How can outsourcing of maintenance activities at Akzo Nobel be improved?***

## 1.5. Structure of the research

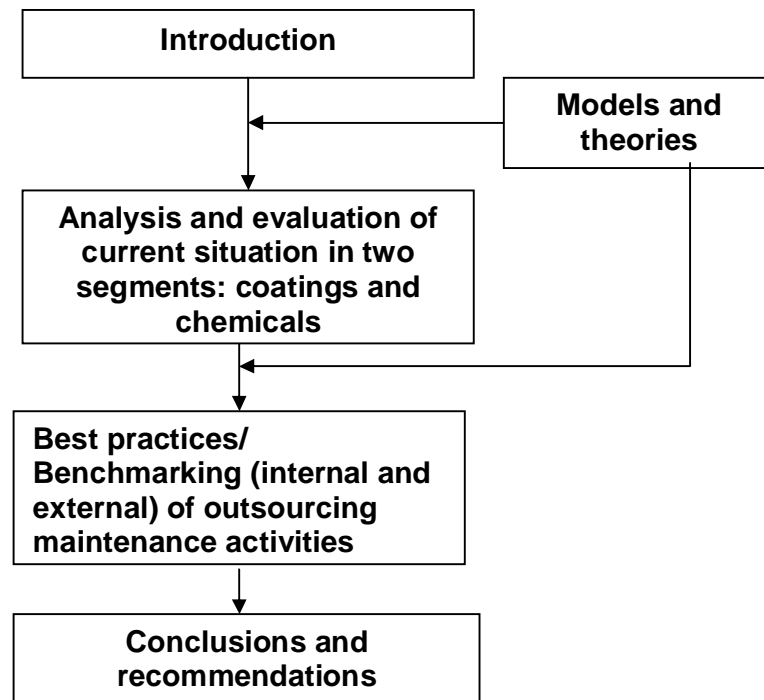


Figure 6. Structure of research

In this structure you can find steps which we need to take to answer main research question: How outsourcing of maintenance activities at Akzo Nobel can be improved.

Each of these steps is connected with research questions and the answers to the research questions form the conclusions and recommendations for Akzo Nobel. In the introduction you will find the background of Akzo Nobel and objectives for the problem question.

The following research questions derived from the research structure:

1. Which theoretical framework does fit this research?
  - 1.1. What is outsourcing / contracting out maintenance activities?
2. What is the current situation of the outsourced / contracted out maintenance activities for two segments Coatings and Chemicals?
  - 2.1. Why, which and how are maintenance activities outsourced/contracted out?
3. What theoretical framework can be used for determining best practices?
  - 3.1. What is a benchmark?
  - 3.2. What items can be included for benchmarking by Akzo Nobel?
4. What are the best practices (internal and external benchmarking)?
  - 4.1. Which best practices can be determined from case studies of Akzo Nobel sites? (Internal benchmarking)
  - 4.2. Which best practices can be determined from case studies ICI, DSM? (External benchmarking)

The deliverables of this research will be the recommendations which types of maintenance activities can be outsourced and how to improve the outsourcing process.

## 1.6. Research approach

This research is qualitative and can be classified as a case study; the problem of improving the outsourcing process of maintenance activities can be solved through analyzing the reasons of the outsourcing and also which maintenance activities are outsourced, analyzing the differences of two segments and as a result sharing the best practices (internal and external benchmarking).

The research is a mix of literature study and fieldwork: the phases of theoretical framework and definition of the benchmark items can be classified as literature studies and Akzo Nobel experience was also involved in it. Case studies and defining of the best practices from internal and external benchmarking can be defined as fieldwork.

Information sources used for this research are primary. Primary data was collected for the purpose of this research. The following information sources have been used during this research:

- Literature
- Employees of Akzo Nobel, ICI
- Employees of DSM
- Employees of Imtech, BAM

The following research methods have been used for the collection of the information:

- Interviews
- Questionnaire

Below the theory, that has been used for answering each research question, has been summarized. These theories are explained in detail in chapters 2 and 4.

### 1. Which theoretical framework does fit this research?

#### 1.1. What is outsourcing / contracting out maintenance activities?

For answering these questions we have to do the literature research in two directions. First, according to J. Heizer [10] we have to understand what types of maintenance activities exist and according to Aberdeen Group [9], what KPI's we can use for measuring performance of maintenance activities.

Second we need to know how to outsource/contract out maintenance activities (R. Francis [11], S. Burdon [12], M. Levery [2], U. Westergren [4]) and what aspects we have to keep in mind to avoid risks connected with the outsourcing process (J. Heizer [10], R. Francis [11]).

How to outsource/contract out maintenance activities? For answering this question we have to look at the selected theories. First of all we have to understand the differences between outsourced and contracted out maintenance services. These differences are analysed in the theory of R. Francis [11]. Other theories complement this theory and give their own insight in the way of outsourcing maintenance activities. According to S. Burdon [12] we have also to pay attention to extra factors which are very important in the outsourcing decision. The problem of aging personnel and future shortage of the skilled maintenance personnel are requires further attention. We should also analyse which risks are connected to the outsourcing maintenance activities. According to J. Heizer et al [10] should keep in mind some of the steps of outsourcing process and possible risks. Also the differences between contracting out and outsourcing (R. Francis [11]) help us to avoid mistakes in the outsourcing/contracting out process (see Table 2). The reasons why the outsourcing goes wrong is analysed from both sides supplier and client company. The combination of these theories will help us in formulating our research model.

### 2. What is the current situation of the outsourced / contracted out activities for the two segments Coatings and Chemicals?

#### 2.1. Why, which and how are maintenance activities outsourced/contracted out?

For answering these questions we have to analyse the current situation at the selected locations of Akzo Nobel in the two segments Coatings and Chemicals. It is important to understand why, which and how maintenance activities are outsourced/contracted out. This information will be gathered through interviews and a questionnaire. The questionnaire you can find in the Appendix 6. The summary information will be extended in the Chapter 3.

*3. What theoretical framework can be used for determining of best practices?*

*3.1. What is a benchmark?*

*3.2. What items can be included for benchmarking by Akzo Nobel?*

For answering these questions we are going to discuss benchmarking theory (E. Jones [1]) and determine attention points (benchmark items). Also we are going to discuss the block diagram of the outsourcing decision making and also pay attention to extra factors, such as aging personnel and position of suppliers in the outsourcing process.

*4. What are the best practices (internal and external benchmarking)?*

*4.1. Which best practices can be determined from case studies of Akzo Nobel sites? (Internal benchmarking)*

*4.2. Which best practices can be determined from case studies ICI, DSM? (External benchmarking)*

Hereby we are going to identify on the base of our research model internal and external best practices. The goal of this analysis is to learn from different locations the best way of organizing maintenance. Second we aim at retrieving effective and efficient ways of outsourcing/contracting out maintenance activities.



## Chapter 2. Theoretical framework

The purpose of this chapter is to discuss theories and tools which can help in answering the main research question. In the sections 2.1 - 2.9 we will discuss selected theories about outsourcing maintenance activities. In section 2.10 we will discuss our research model, which is based on these theories. This research model will be a backbone for the research performed in this thesis.

### 2.1. Outsourcing

#### Ø What is outsourcing?

This is important to give general information about outsourcing and the reasons of expanding all over the world, because this creates an understanding of what outsourcing is and what the reasons of outsourcing are.

Outsourcing means procuring from external supplier's services that are normally a part of an organization. This usually involves the transfer of operational control to the suppliers. If a company moves some of its business processes to a foreign country but retains control, then we can speak hereby about offshoring and not outsourcing. There is also a term nearshoring, which means choosing an outsource provider located in the home country or in a nearby country. A firm that outsources their internal business activity is called a client firm. A company that provides outsourcing is called the outsourced provider.

#### Ø Why is outsourcing expanded all over the world?

The main reasons for expanding outsourcing all over the world are:

- Increasing expertise through sharing best practices;
- reduced costs;
- rapid development and deployment of advancements in telecommunications and computers, which makes communication between different countries easier.

Outsourcing process has not always a positive effect on company's life. That is why the term back-sourcing has been created to describe the return of business activity to the original firm. To predict these situations and prevent back-sourcing practices, it is very important to look at the risks, which can occur by the outsourcing process. Hereunder you can find a table with possible risks in the outsourcing process.

Table 1. The outsourcing process and related risks [10]

Outsourcing process	Examples of possible risks
Identify non-core competencies	Can be incorrectly identified as a non-core competency
Identify non-core activities that should be outsourced	Just because the activity is not a core competency for your firm does not mean an outsource provider is more competent and efficient
Identify impact on existing facilities, capacity and logistics	May fail to understand the change in resources and talents needed internally
Establish goals and draft outsourcing agreement specifications	Goals can be set so high that failure is certain.
Identify and select outsource provider	Can select the wrong outsource provider
Negotiate goals and measures of outsourcing performance	Can misinterpret measures and goals, how they are measured, and what they mean

Monitor and control current outsourcing program	May be unable to control product development, schedules and quality
Evaluate and give feedback to outsource provider	May have a non-responsive provider (i.e. one that ignores feedback)
Evaluate international political and cultural risks	Country may be political unstable, or cultural and language differences may inhibit successful operations
Evaluate coordination needed for shipping and distribution	May not understand the timing necessary to manage flows to different facilities and markets.

There are advantages and disadvantages of outsourcing. The decision of outsourcing has to be made after analyzing advantages and disadvantages of this process.

First it is important to mention *advantages* in order of importance:

- Cost savings;
- Gaining outside expertise;
- Improving operations and services;
- Focusing on core competences;
- Gaining outside technology.

Knowing a number of *disadvantages* is also very important, before firms outsource their activities. This is important to know because you can predict issues, manage them and prevent them to occur. Here are just a few of them:

- Increased transportation costs, e.g. delivery costs can rise substantially if the distance between outsourcing provider and firm client increase.
- Loss of control, managers losing control of operations and costs can increase, because it is hard to control and assess them.
- Creating future competition.
- Negative impact on employees.
- Longer-term impact.

These advantages or disadvantages may or may not occur, but this is the way to think about possibilities in way to manage them effectively. The advantages in outsourcing can be operational and strategic. Operational advantages usually provide for short term trouble avoidance, while strategic advantages offer long term contributions in maximizing opportunities. Effective outsourcing process depends on paying attention to all this advantages and disadvantages.

*Conclusion:*

*For outsourcing maintenance activities we should keep in mind some of the steps of outsourcing process and possible risks. The following steps have to be used in developing our research model:*

- § *Identify non-core activities that should be outsourced;*
- § *Establish goals and draft outsourcing agreement specifications*
- § *Identify and select outsource provider*
- § *Negotiate goals and measures of outsourcing performance*
- § *Monitor and control the current outsourcing program*
- § *Evaluate and give feedback to the outsource provider*

*All risks which are connected with these steps of the outsourcing process have to be analysed and steps to avoid these risks have to be done. This information will be included in the research model.*

## 2.2. Maintenance and reliability

*It is very important to understand what maintenance is and what kind of maintenance types exist.*

The objectives of maintenance and reliability are to maintain the capability of the production system. Systems must be design and maintained to reach expected performance and quality standards. Maintenance includes all activities involved in keeping a system's equipment in working order. Reliability is the probability that a machine part or product will function properly for a specified time under stated conditions. (J. Heizer [10])

There are four tactics determined for reliability and maintenance.

The reliability tactics are:

- improving components quality;
- providing redundancy.

The maintenance tactics are:

- Implementing or improving preventive maintenance;
- increasing repair capabilities or speed.

Maintenance activities can be classified in the following three types:

- Preventive maintenance.  
Preventive maintenance involves performing routine inspections and servicing and keeping facilities in good state.
- Proactive (predictive).  
Proactive (predictive) maintenance has to find potential failures and make changes or repairs that will prevent failure.
- Corrective (reactive) maintenance.  
Corrective or breakdown maintenance occurs when equipment fails and must be repaired on an emergency or priority basis.

The difference with preventive maintenance is that this finding for potential failures has to be done regularly, based on many different factors, and not just on the official date, when the parts have to be changed. The emphasis of preventive and proactive maintenance is on understanding the process and keeping it working without interruption.

Preventive and predictive maintenance implies that we can determine when a system needs service or will need repair. Therefore, to perform both maintenances, we must know when a system requires service or when it is likely to fail. Failures occur at different stages of the life cycle of a product. A high initial failure rate, known as infant mortality, may exist for many products.

Many firms have moved to bring total quality management concepts to the practice of preventive and predictive maintenance with an approach known as total productive maintenance (TPM). It involves concept of reducing variability through employee involvement and excellent maintenance records. In addition, total productive maintenance includes:

- Designing machines that are reliable, easy to operate, and easy to maintain.
- Emphasizing total cost of ownership when purchasing machines, so that service and maintenance are included in the cost.
- Developing preventive maintenance plans that utilize the best practices of operators, maintenance departments, and depot service.
- Training workers to operate and maintain their own machines.

High utilization of facilities, tight scheduling, low inventory, and high reliability of installations are characteristics of TPM. Total productive maintenance is the key to reducing variability and improving reliability, because this philosophy provides efficiency and effectiveness of maintenance activities.

*Conclusion:*

*In this section we mention the segmentation of different types of maintenance activities. The logic behind these types of maintenance activities will help us in analyzing what type of maintenance activities can be outsourced/contracted or kept in house. This information is very important in the decision making process of outsourcing. Different types of maintenance require different approaches in the outsourcing process.*

### **2.3. Outsourcing maintenance**

*In this section we are going to describe some theories of outsourcing maintenance activities. We will discuss such questions as what is outsourcing and contracting out, maintenance strategy/policy, why business outsource maintenance activities, where it goes wrong and what is the five phases of successful outsourcing. Discussing these questions will help us to understand study cases of Akzo Nobel, ICI and DSM.*

#### **Ø Outsource or In-house maintenance?**

Most organisations when maintaining their productive assets use a combination of in-house and contract maintenance. Contractors are used either for specialist maintenance where the expertise is not held in-house, or where routine, repetitive maintenance work is carried out. In-house is where the process knowledge is maintained, such that problems are readily resolved because the inter-relationship between the processes in production plant is understood. At first it appears that outsourcing the maintenance function is relatively straightforward as all that is being lost is process knowledge, but the implications reach much further.

#### **Ø Outsourcing and contracted out maintenance activities**

Outsourcing can be defined as the complete contracting of the maintenance function including the management, supervisions, trade labour functions, human and industrial relations, planning and scheduling, budgets and cost control, stores and purchasing, technical support, long term asset management, predictive, preventive, breakdown, shift and shutdown maintenance under controlled conditions.

Contracted out services can be defined as followed. Specified functions within Maintenance can also be outsourced separately but the same principles apply - give the contractor responsibility in return for specialist service. The control function has to stay in house. The difference between outsourced and contracted out services is that by outsourced maintenance activities all maintenance organization belongs to third party and only control function is kept by client company. By contracted out maintenance activities, different types of maintenance activities can be performed by supplier on the competition base. By utilising a contractor to perform maintenance to best practice standards the company can concentrate on its core business.

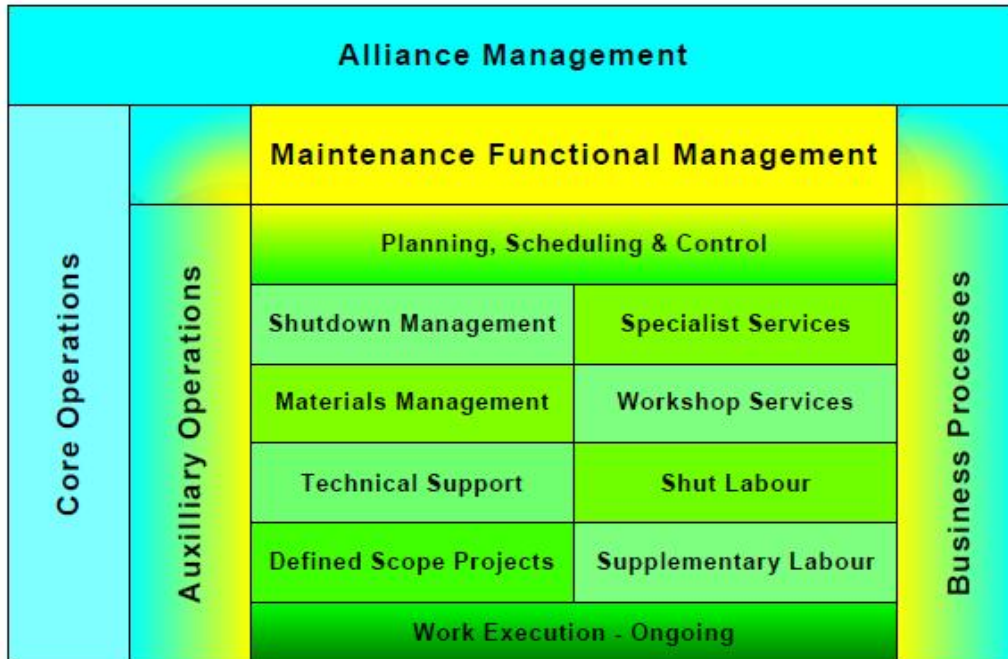


Figure 7. Contracting and outsourcing [11]

There are many types of contracts and organisations use a number of them for different purposes.

At the lower end of contractor responsibility is the “Work as Directed” used for field service and Condition Monitoring. At this level no decisions are made by the contractor and the work is at an agreed cost and delivered to a schedule. “Agreed Scope” work such as maintenance projects, major shuts, breakdown, workshops and peak labour supplements give the contractor greater decision making responsibility and control.

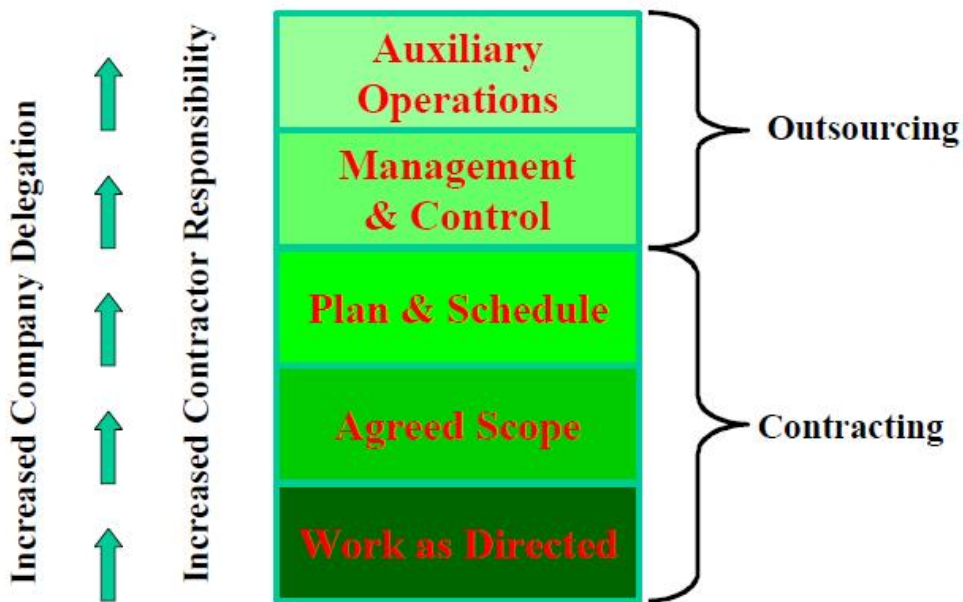


Figure 8. Levels of contracting/outsourcing [11]

“Plan & Schedule” contracting may include maintenance support and planned maintenance activities where the delivery is to a schedule and is planned by the contractor with the

customer company having high-level control. The next level, "Management and Control" may include all services, life cycle care for operations and maintenance reliability and availability. Here the contractor takes near complete responsibility for Safety, QA, IR, Budget Control and work is performed to KPI's. The higher levels of contracting (Outsourcing) give greater scope for innovation & freedom to perform at improved levels. Increased company delegation is accompanied by increased contractor responsibility and work is performed under agreed conditions.

When a complete function is contracted out at the higher end of the responsibility scale it is often done as a Partnering style contract on an incentive and profit share basis. The differences between traditional contracting and partnering are presented in the Table 2.

*Table 2. Differences between traditional contracting and outsourced partnering [11]*

<b>Traditional Contracting</b>	<b>Outsourced Partnering</b>
Responsibilities defined	Relationships Defined
Responsibilities remain In-house	Contractor decides How
Contractor follows instructions	Jointly decide What & When
Work Scopes defined	End results are defined
Work Methods defined	Shared Objectives
Payments for Inputs	Incentives agreed
Penalties defined	Payment for results
Claims & Variations	Integration of Efforts
Inwardly focussed	Long term Focus
Self Protection	Mutual Trust
Short Term Focus Trust & Simplicity	Trust & Simplicity
Adversarial	Incentive not Control

### Ø Strategic Alliance

At the upper end of these arrangements is the Strategic Alliance that is a form of business cooperation forged between organisations at local or international level, and is consistent with the overall strategic direction of the partners. The maturity of the organisation is reflected in the following fundamental capabilities:

- Compatibility - Concerns reciprocal rights & obligations or the "give and take" approach at business, organisational and interpersonal level.
- Reliability - The partners continued ability to deliver what they promise.
- Cooperation - The partners are willing and able at business and interpersonal level to go the extra mile to cooperate with each other.
- Durability - Partners must be capable of providing continued input for the duration of the alliance.

If the organisation is cost cutting or fixing an immediate problem in a non-core area a more traditional contractor relationship may be the most appropriate. Maintenance would generally be considered non-core in the broader business and commercial sense. Traditional relationships do not ensure that you get the best out of outsourcing from all perspectives. Moving too quickly to traditional arrangements may result in opportunities being missed and underestimating the potential of more sophisticated relationships. A key aim of a strategic alliance is to exploit opportunities that are difficult to address on your own.

#### *Conclusion:*

*In this section we analysed the characteristics of the process of outsourcing and contracting out maintenance activities. It is important to know what levels of contracting out/outsourcing maintenance activities exist. Contracting out maintenance activities have the following levels in increasing order of responsibility: Work as Directed, Agreed Scope and Plan & Schedule. There are two levels in outsourcing maintenance activities, namely: Management & Control and Auxiliary Operations. These levels help us to understand what responsibilities are for the supplier and for the client company. Also this helps to identify what the characteristics are of*

traditional contracting and outsourced partnering. The level differences help us to avoid mistakes in the outsourcing/contracting out process. So together with theory from 2.1 it helps us to understand how to organise the outsourcing/contracting out process and what attention points we have to keep in mind to avoid mistakes in this process.

### Ø Maintenance strategy/policy

There is also another point of view about outsourcing maintenance activities available. According to M. Levery in their work "Outsourcing maintenance a question of strategy", there are four different ways of carrying out maintenance:

- The first quadrant "interdependent plant and processes" means that all processes are internally supplied and internally managed. So there is no outsourcing process.
- The second quadrant "low level maintenance" means that there is the task-tariff system. The task has been externally supplied and internally managed.
- The third quadrant "totally managed maintenance" can be both internally or externally supplied and managed. That means that maintenance management goes direction asset management. This can be provided both internally and externally. Maintenance management gets another philosophy and all processes will be reviewed. That is why optimization of maintenance processes and reliability will be rising.
- In the fourth quadrant "specialist equipment maintenance" means that the maintenance of special installations is externally supplied (sometimes under guarantee) and internally managed.

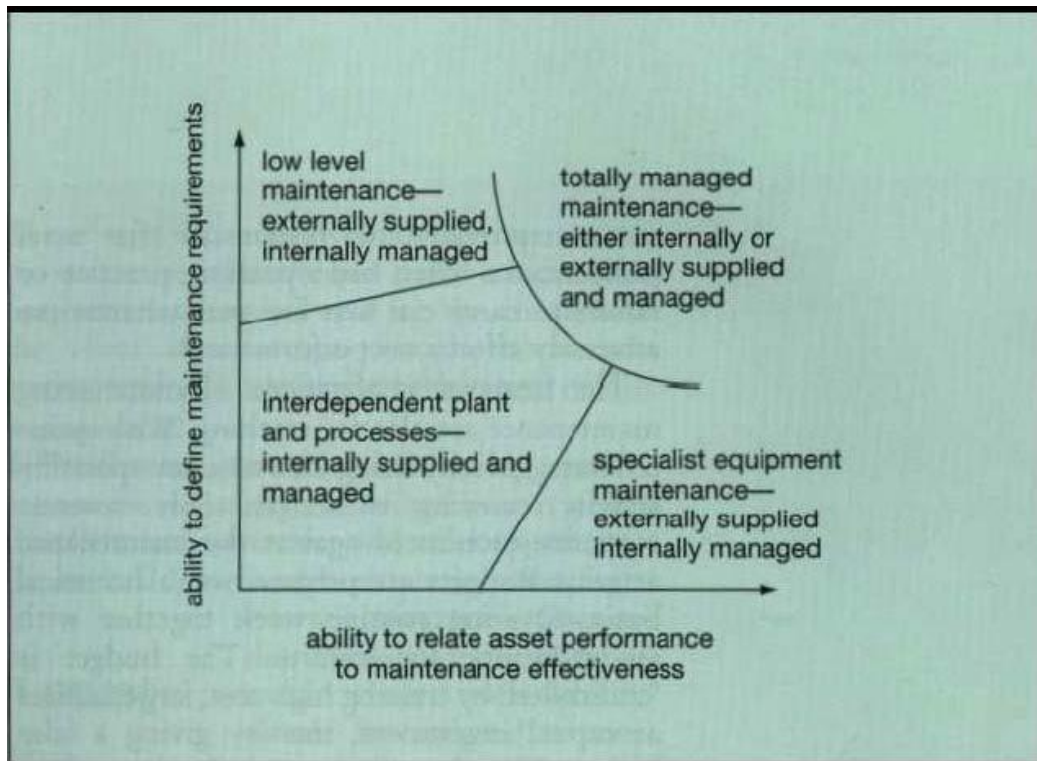


Figure 9. Maintenance strategy/policy [2]

For three of these areas the client is in control of the activity, namely in-house, low level and specialist. When outsourcing maintenance is considered, then it is important to determine where responsibility lies for the performance of the assets. The client must not only be able to define the maintenance requirements for the productive assets, but also be able to relate maintenance effectiveness to asset performance if control of the activity remains with the client.

Should control of maintenance be passed to the contractor, then responsibility for asset performance should also be passed on together with appropriate financial responsibilities. It is at this point that parallels can be drawn with maintenance of buildings as part of office facilities management, where the contractor has full control over spending to ensure performance standards are met, with the client merely being a user of the services provided. However, when one considers production plant, then the client has a major impact on performance of the plant as invariably they carry out first line maintenance, and operator care has a major impact on plant serviceability. How can the maintenance provider be responsible for asset performance when bad operating practice or failure to carry out first line maintenance can adversely affect asset performance?

The financial implications of outsourcing maintenance are also far reaching. With maintenance generally being viewed as an operating activity carrying a budget, only revenue costs are monitored against the maintenance activity.

In the case of maintenance of building services, all financial control can lay with the contractor, but in the case of production plant, how much say can a contractor have in capital investment on the plant. It is vital that the full financial picture, revenue and capital, together with the financial roles and responsibilities, understood before consideration is given to outsourcing. Failure to invest is one of the major reasons for poor performance and high maintenance costs!

#### *Conclusion:*

*This theory gives us another way to look at the maintenance strategy/policy. It goes from the possibility for managing and supplying internally possibility for externally supplied and internally managed (task-tariff system), special equipment maintenance, and tot totally managed maintenance (asset management) which can be done internally or externally. This gives us insight in the ability to define maintenance requirements and ability to relate asset performance to maintenance effectiveness. This knowledge is important for analysing maintenance activities at sites. It gives us for understanding how maintenance activities are organized.*

#### **Ø Why does business outsource maintenance**

The reasons for going to an outsourced arrangement are normally based on a strategy to make a rapid step change in a major area of operation such as technology advancement, cultural change / paradigm shift or a step change in cost structure. Apart from these tactical reasons there are some strategic influences as well including improving company focus, concentrating on core competencies and gaining access to world-class capabilities.

General H Norman Schwarzkopf said; "The truth of the matter is that we all know the right thing to do. The hard part is doing it". Sometimes, however, we do not know what to do. Internal change programs are usually slow due to internal resistance, and are forever changing programs, tools and techniques due to management's frustration at not achieving the desired results. Many organisations try RCM (Reliability centered Maintenance), installing new CMMS (Computerized Maintenance Management System) etc and the current in-vogue system, often justified on the basis that they are cost effective and will lead to huge savings. Regrettably these programs/ systems are frequently not implemented well and the results are not achieved. (R. Francis [11])

#### **Ø Where outsourcing of maintenance goes wrong**

According to the information contained in a paper presented at the 2001 IMMC by Mark Zammit, which is based on a survey conducted for approximately 800 outsourcing cases (R. Francis [11]), top 10 Client barriers were given as:

1. Shortage of skilled trades people
2. Inadequate contractor planning of work to be done
3. Contractor not experienced in specific plant
4. Too many jobs underway at the same time
5. Poor relationships - Client & contractor employees



6. Low contractor commitment to safety
7. Inadequate Client planning of work to be done
8. Inadequate contractor supervision
9. Client work scope and documentation not clear
10. Inadequate Client supervision

It is interesting that four of the top ten barriers are client induced by their own admission. Other items such as the shortage of skills and supervision are interesting given that many contracts are let for increased scope with a significantly reduced cost compared to the former in-house situation. In addition many contracts have tight conditions and unrealistic Key Performance Measures in relation to the freedom to act. You may conclude that most of the significant barriers to outsourcing, as perceived by the client, are client induced. They want to tighten the belt, but in doing so strangle the Contractor.

Similarly the top 10 Contractor perceived Barriers are:

1. Inadequate Client planning of work to be done
2. Client work scope & documentation not clear
3. Clients stores and spares not available when needed
4. Too many jobs underway at the same time
5. Shortage of skilled trades people
6. Contract duration too short for work scope
7. Poor relationships - Client & contractor employees
8. Client not releasing or cleaning equipment as agreed
9. Inadequate Client supervision
10. Contractor not experienced in specific plant

From the contractors perspective client barriers rate six out of ten. Once again some of the other items give rise to questions about the clients contract and requirements.

*Conclusion:*

*This section is very important because it gives insight in the reasons why business does outsource maintenance activities. Also it provides reasons why outsourcing of maintenance activities goes wrong from the position of supplier and client. These reasons are very important for us because it gives us attention points which we have to keep in mind. The most of these attention points will be included in our research model. These attention points we will compare with attention points which we will get from the field research.*

#### **2.4. Maintenance Performance Measures**

Maintenance performance has to be analysed. According to Aberdeen Group [9], following measures could be used for analyzing maintenance performance:

- quality,
- quantity
- cost.

Quality measures for maintenance usually relate to the response time to execute work requests together with time taken to return plant to service. Coupled with the timeliness for carrying out planned and preventative maintenance, quality measures reflect how well maintenance responds to the production function's needs.

Quantity, or volume measures, indicates how hard the maintenance provider is working in delivering the maintenance service.

Cost measures must examine both revenue and capital costs to ensure the benefits of capital expenditure are being reflected in reduced maintenance revenue costs. However, efficient maintenance is about making cost effective decisions every time work is carried out, and an overall effectiveness measure is needed.

The maintenance effectiveness can be defined as “the appropriate combination of preventative and repair work to deliver the lowest units costs in terms of operating cost/hour divided by plant availability”.

Too little preventative maintenance delivers a breakdown philosophy, with high unit costs. As more preventative maintenance is carried out, the optimum point is reached before the effect of overmaintaining with its associated labour costs and reduced availability once again causes unit costs to rise.

The optimum balance of preventative and repair work changes throughout the life of an asset, and to achieve this, a balanced approach in the application of maintenance techniques should be adopted.

In the case of critical process plant with no standby, RCM (reliability centred maintenance) and condition monitoring would be appropriate, right through to a breakdown philosophy for low cost, low risk items where it is cheaper to replace than refurbish. There should be a review of the maintenance strategy when major changes of operational philosophy due to, for example, capital investment or plant refurbishment taking place to ensure that the minimum unit cost is continuously being sought. Identifying the appropriate effectiveness measure will ensure lowest unit costs are met.

Before considering maintenance for outsourcing, the current maintenance performance in terms of quality, quantity, cost and effectiveness must be understood and quantified to form a benchmark against which the future service can be measured.

There is a clear trend of the preventive and proactive maintenance philosophy at Akzo Nobel and minimizing corrective maintenance. Through this change in the philosophy the costs and quantity of work are minimizing and quality is rising. There is less unnecessary work made. The efficiency and effectiveness of maintenance activities will be improved.

*Conclusion:*

*This section gives us criteria for setting up the KPI's. First is quality, this has to be at acceptable level. Each location has to identify this level itself. Quantity, this is the indicator how often the supplier delivers maintenance services. Mostly the client company has to have statistic reports to identify which of the delivered services were really necessary. This is necessary for avoiding extra costs. In this case the defined strategy of the supplier has to be changed. This is a very sensitive question in the phase of the hour – payment relationship with the supplier. Cost is also an important factor, which requires overall effectiveness of delivered maintenance services. These three criteria are very important in identifying KPI's and moving from an hour – payment relationship with a supplier to the outsourcing of some services and measuring performance with identified KPI's. This is the base for asset management, which can be delivered internally and externally, because it helps to reach higher level of effectiveness and efficiency of performing maintenance activities.*

## **2.5. Co-operative Relationships**

The continuing low profile of maintenance as a profession has also led to the trend of skill shortage, and organisations with operational problems have been unable to attract high level maintenance experts to resolve their issues. Also the problem of aging personnel with a lot of experience can be the reason in the future of shortage of the skilled maintenance personnel. (S. Burdon [12])

Facilities management companies are seen as centres of excellence providing an attractive alternative to the traditional in-house approach. For this approach of maintenance activities you have to understand the subject, be concerned about loss of control, be aware that needs and requirements will change, and be worried about the financial implications. Then you will reach providing maintenance activities on the excellence level.

Most organisations would turn to an independent maintenance expert to write a specification for their maintenance requirement for contractors to tender against. They will be specific in terms of the immediate maintenance requirements and what is expected of the contractor with regard to quality, quantity and cost measures, but specifications cannot cover the changing needs of the plant, financial responsibilities and maintenance effectiveness.

If outsourcing is the only option open to the client, and the contractor is to take full responsibility for the maintenance activity, then the client/contractor relationship has to be built on mutual trust and understanding. Specifications and tendering are not the order of the day in this working relationship. The client must have the confidence that the contractor is working in his best interests; not an easy concept to grasp in a business environment of driving down costs and overheads.

Partnering contracts have been used over recent years between client and contractor to enable non-core activities to be outsourced, but in the case of maintenance, where there are significant interdependencies, a much fuller and deeper relationship requires developing. You cannot write a specification for this type of relationship, as the requirements of both the client and contractor continuously change. There must be incentives for the contractor to maximise effectiveness and achieve the optimum lowest unit cost for the client, and the client must accept that the contractor knows best and not dictate the terms of the arrangement.

To achieve this working relationship, specifications are replaced by a defined way in which the client and contractor will work together to the mutual benefit of both parties creating a win-win situation. Ownership is taken jointly of those areas where responsibility cannot be assigned to one party or the other.

Typically this would cover financial issues, performance measures and investment decisions, and in the true spirit of co-operation, any criticism of one party by the other is taken constructively to further develop the understanding. Most important of all, the relationship must be on a long term basis which will create the proper environment for developing cooperation and trust.

This is very difficult to reach the mutual understanding between supplier and client. Most of the Akzo Nobel locations have difficulties with creating relationship, which are based on trust, because of the past bad experience.

Another difficulty is to let supplier to come up with improving proposals, which will increase effectiveness / efficiency by client. The reason hereof is that increasing efficiency / effectiveness by client means less work can be done by supplier. Motivation by supplier to come up with improving proposals can be work volume which can be done by client. So the client firms tries to contract more and through the economies of scale creating importance of these outsourced/contracted out maintenance activities for the supplier. The most important thing in the cooperative relationship is that supplier and client have to be really ready for these kind relationships. This can be creating only by long term relationship, which has to be fixed in contract.

*Conclusion:*

*Literature in this section gives us extra attention points which are very important in the outsourcing decision. The problem of aging personnel and future shortage of the skilled maintenance personnel requires further attention. We have to analyse how Akzo Nobel, and the suppliers and companies, which we use in the external benchmarking, solve these problems. The understanding of cooperative relationships with suppliers is also very important. Mutual trust, understanding and freedom in the performing of maintenance activities are very important. This level of cooperation is very difficult to reach; it needs long term experience with suppliers.*

**2.6. FORT framework**

The FORT framework developed by Kishore et al. [4] consist of four different types of outsourcing relationships, which varying degrees of involvement/ownership substitution and strategic impact.

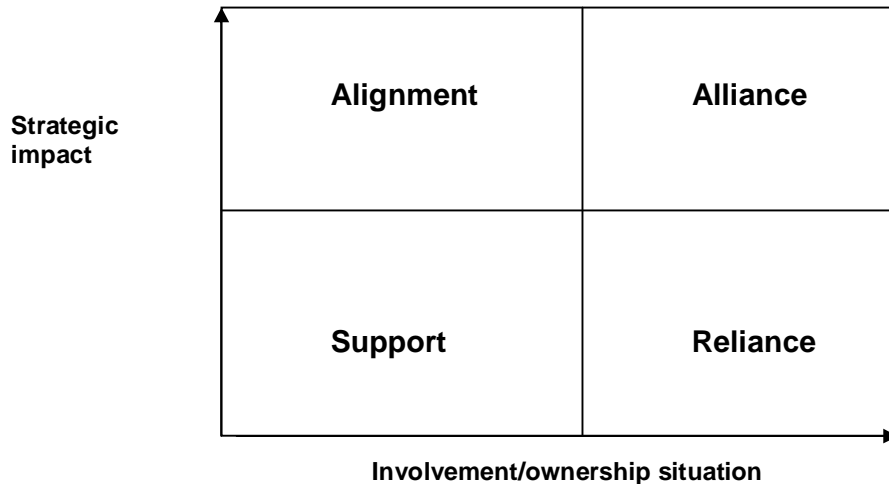


Figure 10. FORT framework [4]

The first two types of relationships, support and alignment, have a low extent of involvement. Such outsourcing relationships tend to be short termed and project specific: "Clients generally control the specification, design, and implementation aspects of outsourced projects and services and these relationship, therefore, do not entail transfer of skills to the client firm or training of the client firm's personnel".

The other two types of outsourcing relationships, reliance and alliance, on the other hand, entail a high extent of ownership substitution.

The client organization invests heavily in service provider specific assets, such as technology, infrastructure and skills.

In an alliance type relationship, the strategic impact of the service provider on the client organization is high, which calls for a high degree of mutual inter-organizational trust in order for the relationship to hold. "Moreover, the impact of the alliance relationship on the organization and the degree of lock-in with the particular service provider is so large that it is usually difficult to reverse this relationship". In such a relationship it is therefore crucial to achieve goal symmetry between the two parties so that they engage in mutually beneficial behaviour, and to manage the notion of distance as described by Chudoba et al. [4] in order to maintain trust.

The strategic alliance form of the relationship was mention before in this chapter.

The FORT framework is useful in providing an understanding for the mechanisms of different outsourcing relationships. However, it merely touches upon the issue of competence. When two organizations become intertwined in an alliance type outsourcing relationship, there is an apparent risk of competence-loss from the client organization as skills are moved from residing within the organization to the external supplier. While engaging in such a partnership, it is therefore important to identify and secure strategies for minimizing the knowledge-drainage on the client organization.

At Akzo Nobel we can see developing relationships with suppliers from the support function to the alliance. This is not completely possible with maintenance activities, because control function has to stay within the client company (Akzo Nobel). This trend just gives us an idea that supplier can be involved also on the strategic level of organizing philosophy of maintenance activities. It helps to improve maintenance activities, because mostly supplier has more knowledge and experience in this field. The one thing that is important to remember is that to get special plant knowledge gets 3 - 5 years and that is why it is important to have the same people, who work at plants. The creation of internal knowledge together with external can help to improve maintenance activities and create mutual understanding and trust for both parties.

*Conclusion:*

*The FORT framework gives us again insight in the involvement in the situation and strategic impact of the outsourcing maintenance activities. Presence of different forms of the outsourcing relationships by Akzo Nobel gives us understanding on which level of readiness different sites of Akzo Nobel are. This framework linked some other theories which we looked*

*at before in this chapter, such as theory of R. Francis (Figure 8) [11] and some aspects of the theory of M. Levery (Figure 9) [2]. The different forms of outsourcing relationships, which are extracted from these three theories, will be used further in our research.*

## **2.7. How Akzo Nobel sees outsourcing/contracting out maintenance activities**

Starting point of this analysis at Akzo Nobel is “should we outsource maintenance activities or not?”. The next question is how far we should outsource/contract out maintenance activities. There is important to reach the balance between quality of the supplied maintenance activities (internally, externally) and savings of the maintenance costs.

At Figure 9 ( M. Levery[2]) you can find four different outsourcing/contracting out approaches. Three of them can be found at Akzo Nobel: low level maintenance, totally managed maintenance, specialist equipment maintenance. Akzo Nobel uses mostly the combination of these approaches.

Low level maintenance: Begin of each outsourcing/contracting out process is contracting out particular activities. This process is always internally managed. The reasons for this outsourcing can be different: lack of the internal knowledge or the cost of supplier, which is lower than internally.

Specialist equipment maintenance: The outsourcing of maintenance for special equipment is mostly outsourced and internally managed. The reason hereof can be lack of internal knowledge and also this kind of maintenance is mostly done under guarantee on the special equipment.

Totally managed maintenance: The other reasons stay behind asset management. This is another approach for maintenance. This philosophy Akzo Nobel will implement in future on all their locations. That can be done internally or externally.

The control function of outsourced maintenance activities is important to keep in house. This gives overview over maintenance activities and the reasons why these activities have to be done. Finally, this approach has to help in creating demand organization at the locations. Maintenance organization has to be efficient and it has to avoid overstaffing problem.

At Akzo Nobel we use the same definition of outsourcing maintenance activities according to the theory of R. Francis [11]. At the most sites of Akzo Nobel maintenance services are contracted out and the situation with outsourcing maintenance activities is rare. If we look also at the segmentation of maintenance activities, then we can see that quaternary maintenance activities more often outsourced, because environmental knowledge is not required. Control function of Akzo Nobel by outsourcing maintenance is organized on base of fixed performance indicators. So suppliers are free to fulfill the performing process by themselves within the fixed performing indicators and this means that process will be optimized.

The negotiation process is a very important part of the outsourcing process. First of all, after the selection process of the suppliers, all expectations and performance measures have to be properly documented in the contract. Then the control function has to check the performance and also the need of the particular maintenance activities. Demand organization has to be developed. Suppliers have to cooperate for improving projects. This is very important to give supplier the freedom to change things and optimize processes and at the same time use tight controls on their performance. This way of cooperation can create a successful long term relationships and as result mutual trust and understanding between partners.

## **2.8. Conclusion**

In this chapter we discussed different theories about maintenance activities and outsourcing maintenance activities. These theories will help us in answering our research questions and our main problem question. It is important to distinguish two theory directions which we have analysed in this chapter.

First, according to J. Heizer [10] we have to understand what types of maintenance activities exist and according to Aberdeen Group [9], what KPI's we can use for measuring performance of maintenance activities.

There are three types of maintenance activities: preventive, proactive and corrective. The logic behind these types of maintenance activities will help us in analyzing what type of maintenance activities can be outsourced/contracted or kept in house. This information is very important in the decision making process of outsourcing. Different types of maintenance require different approaches in the outsourcing process, e.g. preventive maintenance activities are mostly outsourced/ contracted out and corrective maintenance activities are mostly kept in house. This knowledge we have to use in our research, because it helps to identify these different approaches in the outsourcing process.

Basic criteria for setting up the KPI's are quality, quantity and costs. These three criteria are very important in identifying KPI's and moving from an hour – payment relationship with a supplier to the outsourcing of some services and measuring performance with identified KPI's. This is the base for asset management, which can be delivered internally and externally, because it helps to reach a higher level of effectiveness and efficiency of the performing of maintenance activities. These criteria will be used in our research model.

Second we need to know how to outsource/contract out maintenance activities (R. Francis [11], S. Burdon [12], M. Levery [2], U. Westergren [4]) and what aspects we have to keep in mind to avoid risks connected with the outsourcing process (J. Heizer [10], R. Francis [11]).

How to outsource/contract out maintenance activities? For answering this question we have to look at the selected theories. First of all we have to understand the differences between outsourced and contracted out maintenance services (R. Francis [11]). It is very important to know what levels of contracting out/outsourcing maintenance activities exist. These levels help us to understand what the responsibilities are of the supplier and of the client company. The theory of M. Levery [2] gives us another way to specify maintenance strategy/policy. It gives us insight in the ability to define maintenance requirements and ability to relate asset performance to maintenance effectiveness. This knowledge is important to use for analysing maintenance activities at sites for understanding how maintenance activities are organized. Both of these theories complement each other. The FORT framework (U. Westergren [4]) gives us again insight in the involvement in the situation and strategic impact of the outsourcing maintenance activities. Presence of different forms of the outsourcing relationships by Akzo Nobel gives us understandings on which level of readiness different sites of Akzo Nobel are. These theories complement each other and will be used further in our research. According to S. Burdon [12] we have also to pay attention to extra factors which are very important in the outsourcing decision. The problem of aging personnel and future shortage of skilled maintenance personnel requires further attention. The understanding of cooperative relationships with suppliers is also very important. Mutual trust, understanding and freedom in performing maintenance activities are very important. These points we are going to analyse further in our research. We should also analyse which risks are connected to the outsourcing maintenance activities. According to J. Heizer et al [10] we should keep in mind some of the steps of the outsourcing process and possible risks (Table 1), such as: identify non-core activities that should be outsourced; establish goals and draft outsourcing agreement specifications; identify and select outsource provider; negotiate goals and measures of outsourcing performance; monitor and control the current outsourcing program; evaluate and give feedback to outsource provider. All risks which are connected with these steps of the outsourcing process have to be analysed and steps to avoid these risks have to be done. This information will be included in the research model. Also the differences between contracting out and outsourcing (R. Francis [11]) help us to avoid mistakes in the outsourcing/contracting out process (see Table 2). The reasons why the outsourcing goes wrong are analysed from both sides supplier and client company.

Both of these theories give us insight in the attention points for outsourcing maintenance activities. The combination of these theories will help us in formulating our research model.

## 2.10. Research model

The research model will be combined from two models. The first model is based on the results of the cooperation Akzo Nobel and Accenture (consultancy agency). Second model is based on literature research and interviews with the maintenance managers of Akzo Nobel.

The first model is illustrated by Figure 11. It gives understanding of the importance of the different maintenance activities and the level of the possibility of outsourcing/contracting out or keeping it in-house. This model present the segmentation of the maintenance activities: the strategic importance and the performing sides (in house, outsourced) on the level of partnership.

The following segmentation of maintenance activities is made:

- *Primary*: services directly related to the production process
- *Secondary*: combination of services related to the production process and installations and beginning to evolve towards more facility management
- *Tertiary*: combination of services less related to the production process and more evolving towards facility management
- *Quaternary*: not related to the production process and mainly related to facility management

Levels of partnership of the performing sides (suppliers and client company) are:

- *Operations*: In the first level the focus is mainly on costs savings realized by better purchasing prices (hourly rates etc.) and agreements.
- *Efficiency*: On the second level more insight in the organization is granted to the service provider in which they cooperate to increase the efficiency by for example combining workload etc.
- *Effectiveness*: This is the third level of services in which a higher level of partnership is agreed upon and services provider assist in increasing the effectiveness of the maintenance organization/activities. Their advice is based on their expertise and market best practices.
- *Asset management*: This is the highest level of service management in which the supplier or client company becomes responsible for executing and maintaining all assets.

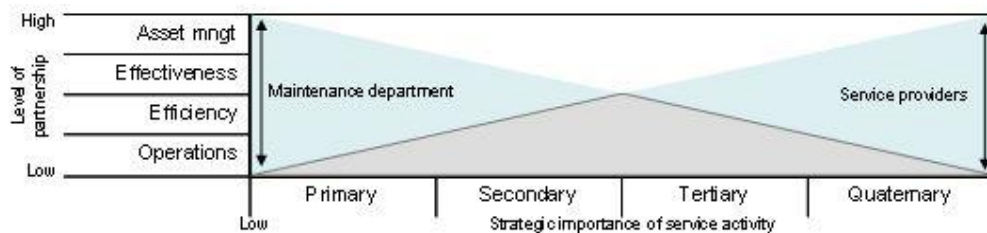


Figure 11. In house and outsourced maintenance activities [Internal Document]

Looking at the segmentation of the maintenance activities we can see that primary and quaternary maintenance activities are quite easy to identify in this segmentation. The secondary and tertiary activities are very difficult to separate. This is a “grey zone” of the maintenance activities and the segmentation of these activities varies from the processes on the plant. For example, changing pump in the chemical production (e.g. Salt production) is the primary activities and for coatings it can be tertiary activity. That is why in our research we will not make this segmentation and we will take a look at primary and quaternary maintenance activities. So the scope of our research will be on primary and quaternary activities.

In the second model we look at maintenance activities from another point of view, as you can see in Figure 12. Hereby, maintenance activities are presented in the two categories process and performance.

Under “Process” we understand the technical part of the maintenance process. The technical part of this model is very important for understanding what types of maintenance activities exist (J. Heizer [10]) and how quality, quantity and costs are brought in balance. Hereby the theory (Aberdeen Group [9]), which is mentioned in section 2.4. gives insight in how to get balance in these three aspects. These aspects are the base of performing measures of maintenance activities. Under different types of maintenance activities we will understand preventive, proactive and corrective maintenance. These types of maintenance activities are explained in the section 2.2. The technical part of this model will be outside of the scope of this research, because it is difficult to gather data for this analysis. This theory is also the base for understanding which KPI’s can be used as performance measures of maintenance activities carried out in house or outsourced/contracted out. This will be used in the second part of this model – “Performance”.

“Performance” is the way how maintenance is organized: in house or outsourcing/contracting out. The theories of R. Francis [11], J. Hayzer [10] and Aberdeen Group [9] will help us to understand the reasons of the decision to outsource or keep these activities in house and also the way how to organize this process in the efficient and effective way.

In the theory of J. Hayzer [10] the following points are important:

- § We have to identify which types of maintenance activities are core business. If it is core business then the decision is not to outsource, but it is possible to contract out maintenance activities. In view of Figure 11 we have to analyse which type of maintenance activities can be outsourced/ contracted out. However also the other segmentation of maintenance activities has to be mentioned, namely preventive, proactive and corrective maintenance activities. Different approaches have to be identified for this segmentation.
- § Establishing goals and draft outsourcing agreements are also very important, because if you know exactly what you want from suppliers then it is very important for efficiency and effectiveness of outsourcing process. This happens on the strategic level.
- § Identify and select outsource provider. This is an important stage of the outsourcing process, the best in class suppliers have to be selected on the base of the selected criteria.
- § Negotiate goals and measures of outsourcing process. Hereby it is very important to determine - together with suppliers - goals and KPI’s for measuring performance of deliverable work. This is important on the operational level.
- § Monitor and control the current outsourcing program. This is one of the most important steps in the outsourcing process on both strategic and operational levels.
- § Evaluate and give feedback to the outsource provider. This is important for building long term relationships. If this cooperation is successful then it stimulates the option to grow relationships from operations (hour – payment) level of relationship to the following levels of efficiency, effectiveness and asset management.

These aspects we will use together with other aspects which we will get from interviews with maintenance and purchasing managers to make our research model more complete.

In the theory of R. Francis [11] lists are available with the reasons why outsourcing can go wrong from the positions of supplier and client company. These lists we will also use in our research model. Also extra factors (S. Burdon [12]), such as aging personnel and position of suppliers will be analysed in chapter 5. The complete research model will be presented in the chapter 4. The backbone of this research is presented hereunder in the Figure 12.



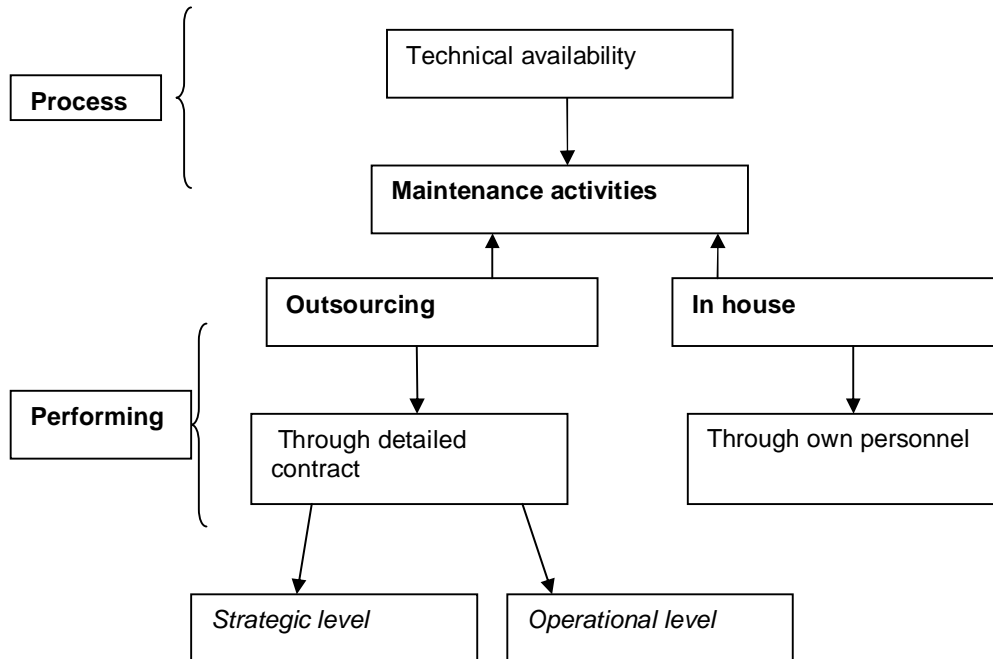


Figure 12. Maintenance activities. Process and performing

The objective of this research model is to reach a balance between good quality of the maintenance activities and optimizing performance of delivering these services.

The outsourcing of the maintenance activities should be analysed on the strategic and operational level. This has to be done for understanding different needs and different expectations on these levels.

Our research will be focused on the key performance indicators. These indicators will be discussed in chapter 4. The key indicators for the performance maintenance will have a qualitative character.

The objective of this research model is to identify best practices by Akzo Nobel locations and also at the locations of ICI and DSM.

### Chapter 3. Analysis and evaluation of current situation

In this chapter we are going to analyse the current situation with outsourcing maintenance activities. In the section 3.1 we present the table of analysis of outsourcing/contracting out process by Akzo Nobel case studies; in the section 3.2 you will find analysis of case studies where maintenance activities are contracted out and in the section 3.3 you will find analysis of case studies where all maintenance activities are outsourced. Insight in the maintenance costs will be discussed in the section 3.4.

#### 3.1. Analysis of outsourcing process by Akzo Nobel case studies

The analysis of outsourcing process is made on base of interviews with purchasing and maintenance managers on plants of AN. This is the analysis of current situation of the process of outsourcing maintenance activities.

In this analysis we are going to give answers on the questions why, which and how the maintenance activities are outsourced/contracted out and what the differences of two segments are. The extensive information of this analysis you can find in Appendix 3.

The scope of our analysis is locations Deventer (NL), Sassenheim (NL), Delfzijl (NL), Bohus (Sweden), Duren (Germany).

Hereunder in Table 3, we present the summary of analyses of outsourcing process for these five locations:

Table 3. Analysis of current situation of outsourcing process.

Location	Outsourced/Contracted out	Why maintenance activities outsourced / contracted out?	Which maintenance activities outsourced / contracted out?	How maintenance activities outsourced / contracted out?
Deventer (NL) (Chemicals)	Contracted out	Special knowledge; Cost savings	Special equipment, non-primary activities, preventive maintenance activities; Control function is not outsourced	Guarantee contracts for special equipment; performance contracts for preventive maintenance activities and for big part of quaternary maintenance activities
Sassenheim (NL) (Coatings)	Contracted out	Special knowledge; Cost savings	Special equipment, non-primary activities, preventive maintenance activities; Control function is not outsourced	Guarantee contracts for special equipment; performance contracts for preventive maintenance activities and for big part of quaternary maintenance activities
Delfzijl (NL) (Chemicals)	Outsourced	Cost savings	All maintenance activities are outsourced.	Maintenance organization sold to the third party. Personnel also "moved" to third party.
Bohus (Sweden) (Chemicals)	Outsourced	Cost savings, because of closing a big chlor plant, the maintenance organization was too big for the left plants	All maintenance activities are outsourced. Control function is not outsourced	Maintenance organization sold to the third party. Personnel also "moved" to third party.

Duren (Germany) (Chemicals)	Outsourced	Cost savings (different tariffs for chemical and technical people); Special knowledge	All maintenance activities are outsourced. Control function is not outsourced	Maintenance organization sold to the third party. Personnel also “moved” to third party.
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As it follows from the table, there are two locations (Deventer and Sassenheim) which contracted out maintenance activities, such as non-primary maintenance activities, preventive activities and maintenance of special equipment. The information about contracted out maintenance activities at these locations will be discussed in the section 3.2. The other three locations (Delfzijl, Bohus, Duren) outsource all maintenance activities. There is not the same result reached at these locations. The information about outsourcing maintenance activities at these locations will be discussed in the section 3.3.

### 3.2. Contracted out maintenance activities

First we will look to the locations where maintenance activities contracted out (Deventer and Sassenheim).

The reasons of outsourcing/contracting out at these locations where the same: get extra knowledge and save the costs.

As it follows from the interviews with maintenance managers of these sites, there are the same policy about what types of maintenance activities they outsource/contracted out and what types of maintenance activities they absolutely do not want to outsource. They are also completely agreed about reasons which stay behind decision making of outsourcing/contracting out process. Decision to outsource/contract out maintenance activities has to be made only when it can bring positive influence on them.

The next step is which kind of maintenance activities you can outsource/contract out in the most efficient and effective way. Then you have to think about non-primary activities. This kind of activities is easy to manage and control. So you can easily outsource/contract out this kind of activities.

The primary maintenance activities are difficult to outsource/contract out, because they are difficult to manage and control and they require the special plant knowledge.

Outsourcing/contracting out of these type activities requires high level of maintenance organization, such as demand organization. If the organization can manage and control processes effectively and efficiently by themselves with their own people, then organization can do it also with third party.

This level of maintenance organization is not achieved by all locations of Akzo Nobel. That is why outsourcing/contracting out of primary activities is not yet a real option for most locations of Akzo Nobel. Outsourcing/contracting out has to be an option for location if it can bring a positive influence on the maintenance processes and as consequence on the production process.

The difficulties in the control function can be explained by dynamic environment and technology, so it is difficult to define the critical performance indicators. That is why it is difficult to measure and control something without fixed performance indicators.

The plant knowledge is also very important for effective and efficient outsourcing/contracting out process. There is approximately 3 - 5 years need for creating this knowledge. That is why the option to keep this kind of maintenance activities in house is most appropriated.

According to the Figure 9 [2] these plants (Location Deventer and location Sassenheim) can be placed in two quadrants: totally managed maintenance and specialist equipment maintenance. Both of this quadrants show high ability to relate asset performance to maintenance effectiveness. That is very important to know, because it means that maintenance is effective and outsourcing process is optimal organized. That is a good balance between outsourced/contracted out and in house activities at this location.

Analyzing different sites we can notice that by Chemicals more activities are outsourced/contracted out than by Coatings sites. The reasons hereby are differences in the segmentation of what types of maintenance activities can be identified as primary and what

types of them as not primary. These differences are based on the differences in the production processes.

As example can we mentioned maintenance of the buildings is by chemicals not identified as a core business and the reason hereof is that production mostly consists of the outside installations and buildings are mostly used for the offices. Maintenance of buildings by coatings defined as core business and the reason hereof is that production of paints takes place in the buildings, so they have to be in the good condition. The same situation occurs with ventilation systems. Coatings sites have an explosive production environment, so ventilation is then a core business.

So as we see the differences in the percentages of outsourcing/contracting out and in house maintenance activities can be explained also by the kind of the production process. This process also requires a different percentage of technical availability by coatings and by chemicals. By chemicals technical availability has to be around 97-98%. That is a line process and attention has to be paid to all links of the process, otherwise the production will be collapsed. By coatings attention has to be paid to the bottlenecks of the process, because they are responsible for technical availability.

### **3.3. All maintenance activities outsourced**

If we look at the locations where all maintenance activities are outsourced, then we can see the differences of the results which are reached.

The reasons of outsourcing at these locations are different. The most important reason is cost savings. The common idea in these reasons is the maintenance organization was too big and too expensive for these locations.

Process of outsourcing was the same in all cases. The maintenance organizations were sold to the third party and this third party also delivers maintenance services for Akzo Nobel.

The experiences of the outsourcing processes are very different. The reasons hereof are the condition of readiness by company and supplier for cooperation. How good the sites of Akzo Nobel were prepared for outsourcing and how good they fixed everything in the contracts.

For the optimizing delivering of the maintenance services, control function has to stay within company.

That is why the demand organization was settled and the control function was active through fixed performance indicators which are reviewed once a year, as it was done by Bohus.

By Delfzijl control function was also outsourced and that delivered a lot of problems, because you are not anymore responsible for technical availability of installations for you production.

This is very dangerous and if performance indicators are not fixed in the contracts then that is a real problem. This is what happens in Delfzijl. At this moment the control function is insourced. They are trying to set up a demand organization and developing new performance indicators for controlling performance of the third party.

The international differences can also play here their role; the different mentality towards company and work process can play also their role.

So some aspects have to be kept in mind, when decision of outsourcing of maintenance activities is made. These aspects help management to organize outsourcing process in the efficient and effective way. Examples, which were mentioned, show us that outsourcing of all maintenance organization is possible only when company and supplier are both ready for it. Also the process of outsourcing has to be good prepared and good communicated on all levels.

In the Netherlands neither Akzo Nobel sites nor suppliers are ready for complete outsourcing of maintenance organization. The possibilities for outsourcing lies by facility management and tertiary maintenance activities (when this segmentation will be reached by most of locations).

### **3.4. Insight in the maintenance activities cost structure**

It is important to mention the segmentation in costs between primary and non-primary maintenance activities and in –house or outsourced gives us insight in how budget is spend and what possibilities are for the defining strategy in the decision to outsource or keep in house different types of maintenance activities.

We made analysis of this cost structure for two locations Sassenheim and Deventer (see Appendix 5). There are a lot of differences in the segmentation of costs by these two locations, which represent Coatings and Chemicals.

The budget for primary maintenance activities is bigger by Chemicals (69%) then by Coatings (43%). By Chemicals is more primary activities contracted out then by Coatings. There are also differences occurs at the segmentation of costs by non primary maintenance activities, e.g. by Coatings (46%) is more contracted out then by Chemicals (31%). So the biggest part of extern costs by Coatings goes to non primary activities and by Chemicals is vice-versa. This can show us the differences in the locations or may be in segments Coatings and Chemicals. For this conclusion two locations are not enough, but they let us thinking about this segmentation. The reason is that after interviews with maintenance and purchasing managers and also suppliers we made a conclusion that non primary activities will be more contracted out and primary maintenance activities will be kept in house.

These examples show us that may be this conclusion can be corrected with relation to different segments Coatings and Chemicals. This correction can be made after further research in the trend developing in which type of maintenance activities are going to be contracted out and which type of maintenance activities will be kept in house.

### **Conclusion:**

In this chapter we made analysis of the current situation of outsourcing / contracting out maintenance activities. The case studies with contracting out maintenance activities were analysed in the locations Deventer (NL) and Sassenheim (NL) and the case studies with outsourcing maintenance activities were analysed in the locations Delfzijl (NL), Bohus (Sweden) and Duren (Germany). There are different experiences with outsourcing maintenance activities at these locations. The case studies with contracting out of non-primary maintenance activities have a positive experience with outsourcing process and case studies with outsourcing of maintenance activities have different experiences. At the location Delfzijl, outsourcing process was not identified as a good experience and by other two locations there are positive experiences with outsourcing process. This can be explained with reasons for outsourcing, the way how the outsourcing process was organized and the preparations phase of outsourcing process. Approach for identifying best practices will be given in the chapter 4 and identifying best practices for internal and external benchmarking can be found in the chapter 5.

Also we get insight in the cost structure of maintenance activities. It gives us a feeling of trend development in what types of maintenance activities are going to be outsourced and what type of maintenance activities will be kept in house. This can gives also the differences in outsourcing maintenance activities in the two segments: Coatings and Chemicals. That is why the further research in this direction is required. It will help ANS in identifying strategy in the outsourcing maintenance activities.

## Chapter 4. Benchmark and items of benchmark

In this chapter we are going to discuss the theories of benchmarking process- the way how we identify best practices (see section 4.1). These theories have to give us an understanding of what benchmarking process is and also identify benchmarks items for our research model (see section 4.2.). In the section 4.3. we will pay attention to the extra factors, which have influence on the outsourcing decision of maintenance activities. This will be the base for analyzing the best practices for internal and external benchmarking.

### 4.1. Benchmark as a tool

Benchmarking is a systematic, continuous process for measuring, evaluating, and comparing business practices against recognized leaders to determine the extent to which you can improve your organization's performance.

The goal of benchmarking is to help with strategic decisions on strategic level and also implementing the results of the benchmark on tactical and operational level. This is also can be illustrated with following picture:

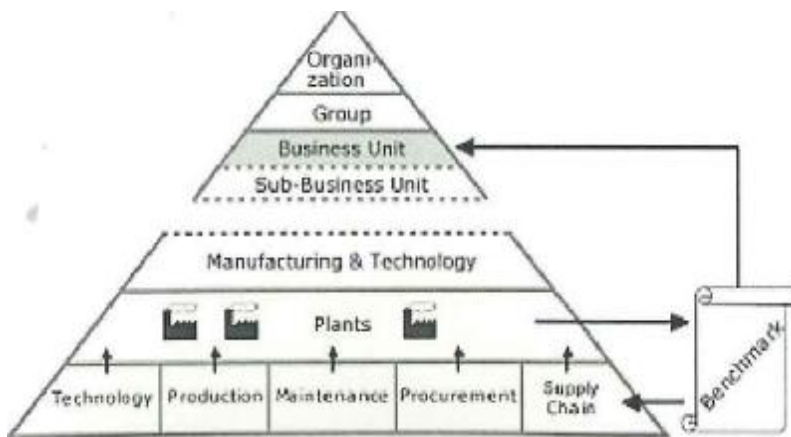


Figure 13. Strategic view on the benchmark [6]

There are different types of benchmarking [1]:

*Internal benchmarking* is comparing processes within a company.

*External benchmarking:*

- Competitive benchmarking – comparing processes with a competitive company.
- Function benchmarking – comparing a function (e.g. maintenance) in one plant or company with the same function elsewhere.
- Generic benchmarking – comparing processes with an “unrelated” organization recognized for innovation or specific expertise.

“Benchmarks are like the warning lights on the dashboard of your car,” says William L. Hagan, Jr., vice president, A.T. Kearney, Inc. “When a light goes on, you need to look under the hood to see what the problem is. Benchmarks might identify an area that needs attention, but they will not tell you what needs to be done or how to do it. You need to know the reasons and drivers behind the numbers. It is easy to get caught in the trap of just comparing numbers, when in fact the lows or highs that represent best practices for some other plant might not be appropriate for your facility. Everything has to be looked at in context.”

For example, according to Edwin K. Jones [1], a plant engineering and maintenance consultant, there is a trend for world-class operations in outsourcing around 30% of their maintenance work (on a cost basis), but this is should not be a target. Some companies have

adopted strategy of maximizing outsourcing in every possible area and others prefer to protect their “corporate knowledge” by minimal outsourcing. In these cases a benchmark can make an interesting comparison, but is not necessarily an indicator of best practice. For example, maintenance cost as a percentage of estimated plant replacement value is usually higher in discrete manufacturing plants than in continuous processing operations. The realizing and understanding of all these aspects will give a possibility to use a benchmark in more efficient and effective manner.

According to Edwin K. Jones [1], plant engineering and maintenance consulting, there are 10 key indicators of maintenance performance:

1. *Mechanical availability (asset utilization)*  
The “business contribution” of maintaining personnel is to provide highly reliable equipment at the lowest possible cost. World-class plants are typically driving reliability rather than cost reduction. (Industry sensitive)
2. *Ratio of direct maintenance personnel to support maintenance personnel*  
World-class plants tend to fall in the range of 2:1 to 3:1 workers per support person. Support personnel are those who provide the supervision, parts management, planning, reliability improvement, equipment condition monitoring, and other supporting tasks for the “hands on” workers.
3. *Ratio of direct maintenance personnel to maintenance planning personnel*
4. *Ratio of direct maintenance personnel to engineering and technical maintenance personnel*  
This is usually a correlation between this metric and a plant’s equipment reliability and costs.
5. *Maintenance cost as a percentage of plant estimated replacement value*  
This value is a classic measure of maintenance cost. Unfortunately, by itself, it drives cost reduction behavior without necessarily reinforcing the need for improved maintenance practices.
6. *Ratio of plant estimated replacement value (in millions) to direct maintenance workers*  
This value is a measure of direct maintenance productivity (“How much plant and equipment, in dollars, can each worker maintain?”). Many world-class plants fall into the range of \$6 - \$9 million/worker. (Somewhat industry sensitive)
7. *Maintenance contracting cost as a percentage of total maintenance cost*  
This value is a measure for comparison, but without a “target” value. World-class plants don’t shoot for a specific level; rather they are disciplined in defining the role of contractors in maintenance, based on business related criteria. On average top plants around the world contract over 30% of their maintenance work – a little less in the United States. But, top plants are driven by a defined strategy, not a target percentage.
8. *Stores parts and investment as a percentage of plant estimated replacement value*  
For years, the target for this measure was about 1%, but top plants around the world now routinely achieve ratios in the range of 0.25% - 0.5%.
9. *Stores turnover (ratio of annual disbursements to inventory value)*  
This ratio reflects stocking strategy and may run above or below 1 depending on the plant’s strategy (for example, balancing risk against insurance stocks). Performance is measured against the plant’s own target.
10. *Ratio of stores disbursements to stores personnel (dollar investment/stores person)*  
This value is a measure of “productivity” of the stores operation and associated personnel.

Some of them can be used as items of for the technical part of maintenance activities in the benchmarking process, the rest is good for precisely analysis of a particular plants. This technical part is outside of the scope of this research, but it is very important to mention these indicators for understanding background of maintenance activities.

The testing of all indicators takes place on the plant level. On the basis of questionnaire the information which is needed for calculating key indicators can be collected and the key

indicators can be compared and reported on the higher level of hierarchy for the making decisions about improvements. This is can be seen on the following picture:

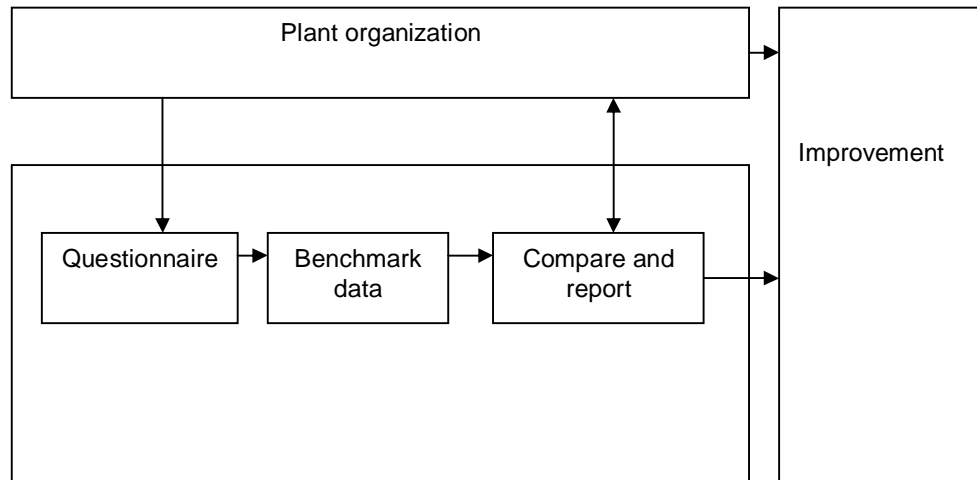


Figure 14. Benchmark process

According to this picture, first step that should be done is making selection of the key indicators and the questionnaire for the collecting this information.

Making choice of which key indicators should be in the benchmark is difficult process. For this decision understanding of the maintenance and outsourcing processes is required.

#### 4.2. Complete research model

For the selection attention points (items for the benchmark) it is necessary to understand the logic of the process behind maintenance activities and outsourcing process and how both of them can be optimized.

As we mentioned in chapter 2.10, the technical part of maintenance activities, “Process” is outside the scope of this research. The reason is that the information is very difficult to gather from the plants and this information is very different for all plants and can not be compared. It is impossible to choose the best practice from this information, but it is important to know at the locations about this sort of information for the control function of the maintenance activities. It helps to manage the maintenance organization and improve maintenance activities. More information about “Process” part of this research model you can see in the Appendix 2.

That is why we analyse in this section just one side of maintenance activities – “Performing” (see Figure 15). The complete picture of the attention points of outsourcing maintenance activities you can see at Figure 16. The questions like why it should be outsourced and what should be outsourced are the key questions in this analysis. Also we will mention the decision making of outsourcing process in the block diagram (Figure 17).

For identifying items for the “performing” part we should use our knowledge of the outsourcing process, outsourcing maintenance activities, reasons for outsourcing, reasons why it can go wrong and also how outsourcing of maintenance activities can be improved. Also knowledge about optimizing the maintenance process (outsourcing, in house) is very important. Hereby we will use literature R. Francis [11], J. Heizer [10], Aberdeen Group [9].



Ø **Optimizing of outsourcing process:**

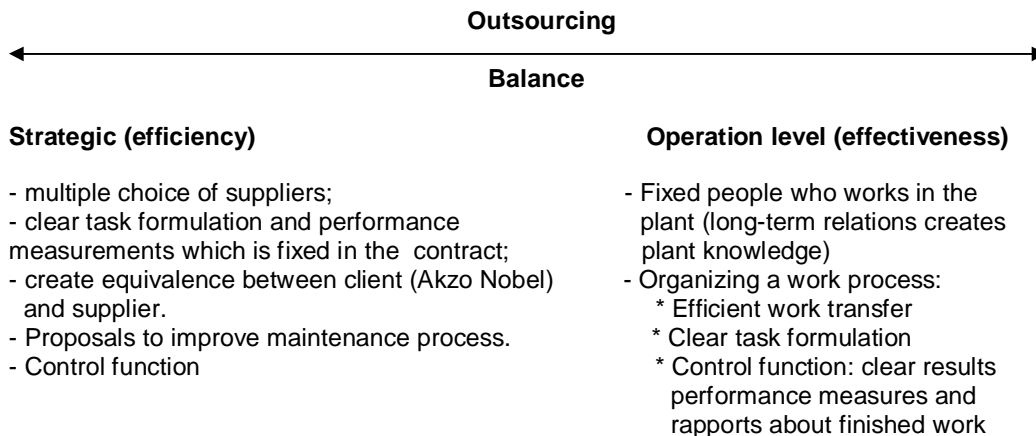


Figure 15. Optimization outsourcing process

Based on the literature research (R. Francis [11], J. Heizer [10], Aberdeen Group [9]) and interviews with purchasing and maintenance managers, we obtain the diagram of Figure 15 which displays critical success factors/attention points of outsourcing, both from a strategic and operation level. The literature gives us an understanding of the outsourcing of maintenance activities, what types of maintenance activities can be outsourced, how to organize outsourcing process in an effective way and what are the important performance indicators, which we can use for performance measurements. We look at the performance of outsourcing process of maintenance activities from two sides: effectiveness and efficiency. The two sides have to be in balance for sufficient performing of the outsourcing process of maintenance activities. On the effectiveness side we are looking at the operational level and on the efficiency side at strategic level. For both sides performance indicators are developed.

Let us explain Figure 15 in more detail. For optimizing outsourcing process the following key indicators/attention points are developed on base of literature research and interviews of purchasing and operations managers at Akzo Nobel:

1. Identify and select provider (*multiple choice of suppliers*) (J. Heizer [10]). This is important stage of the outsourcing process, the best in class suppliers have to be selected on the base of the selected criteria's.  
The follow criteria are important for the supplier's selection:
  - a. Cost;
  - b. Quality;
  - c. Quantity (frequency);
  - d. Speed of the reaction (e.g. distance from the client, availability of personnel).

First three comes from the theory of Aberdeen Group [9]. There are important for setting up the performance measurements. The last one comes from the experience of maintenance managers at the sites.

2. Establishing goals and draft outsourcing agreements (*clear task formulation and performance measurements which is fixed in the contract*) are also very important, because if you know exactly what you want from suppliers then it is very important for efficiency and effectiveness of outsourcing process. This happens on the strategic level.
3. *Create equivalence between client company and supplier.* This point is based on the theory of S. Burdon [12] and experiences from the sites of Akzo Nobel. The

importance of creating mutual trust and understanding for creating cooperative relationship between supplier and client company is extensive explained in the section 2.5.

4. *Evaluate and give feedback to the outsource provider.* This is important for building long term relationships. If cooperation is successful then it stimulates the option to grow relationships from operations (hour – payment) level of relationship to the following levels of efficiency, effectiveness and asset management. This comes both from the theory of J. Hayzer [10] and interviews with maintenance managers.
5. *Monitor and control current outsourcing program.* This is one of the most important steps in the outsourcing process on both strategic and operational levels. This comes both from the theory of J. Hayzer [10] and interviews with maintenance managers.
6. *By organizing the work process on the operational level* following aspects have to be analysed. These aspects come from the theory of Hayzer [10], R. Francis [11] (Lists with the reasons why outsourcing goes wrong) and interviews with maintenance managers:
  - § Extensive preparation of the outsourced maintenance activities for avoiding time wasting.
  - § Determining together with supplier goals and KPI's for measuring performance of deliverable work. This is important on the operational level.
  - § Clear task formulation for meeting expectation for supplier and client company.
  - § Evaluate and give feedback to the outsource provider. This is important for building long term relationships. If cooperation is successful then it stimulates the option to grow relationships from operations (hour – payment) level of relationship to the following levels of efficiency, effectiveness and asset management.
7. *Environmental knowledge* (plant specified knowledge) is required for primary maintenance activities. The absence of this knowledge is one of the reasons why outsourcing goes wrong (R. Francis[11]) which is named by both suppliers and client companies. This aspect was identified by maintenance managers with a high importance degree.

All these attention points can be seen in the Figure 16. Attention points for the technical part can be found in the Appendix 2. This part is outside the scope of our research.

Complete picture of the analysis of outsourcing process (benchmark tool) can be found at the Figure 16. This is very important to understand how the outsourcing process has to be organized and what are the attention points. This can help to minimise mistakes in the outsourcing process. Also looking at the strategic and operational level helps to meet different needs on the both levels. This can prevent misunderstanding between these two levels in the company and also with suppliers.

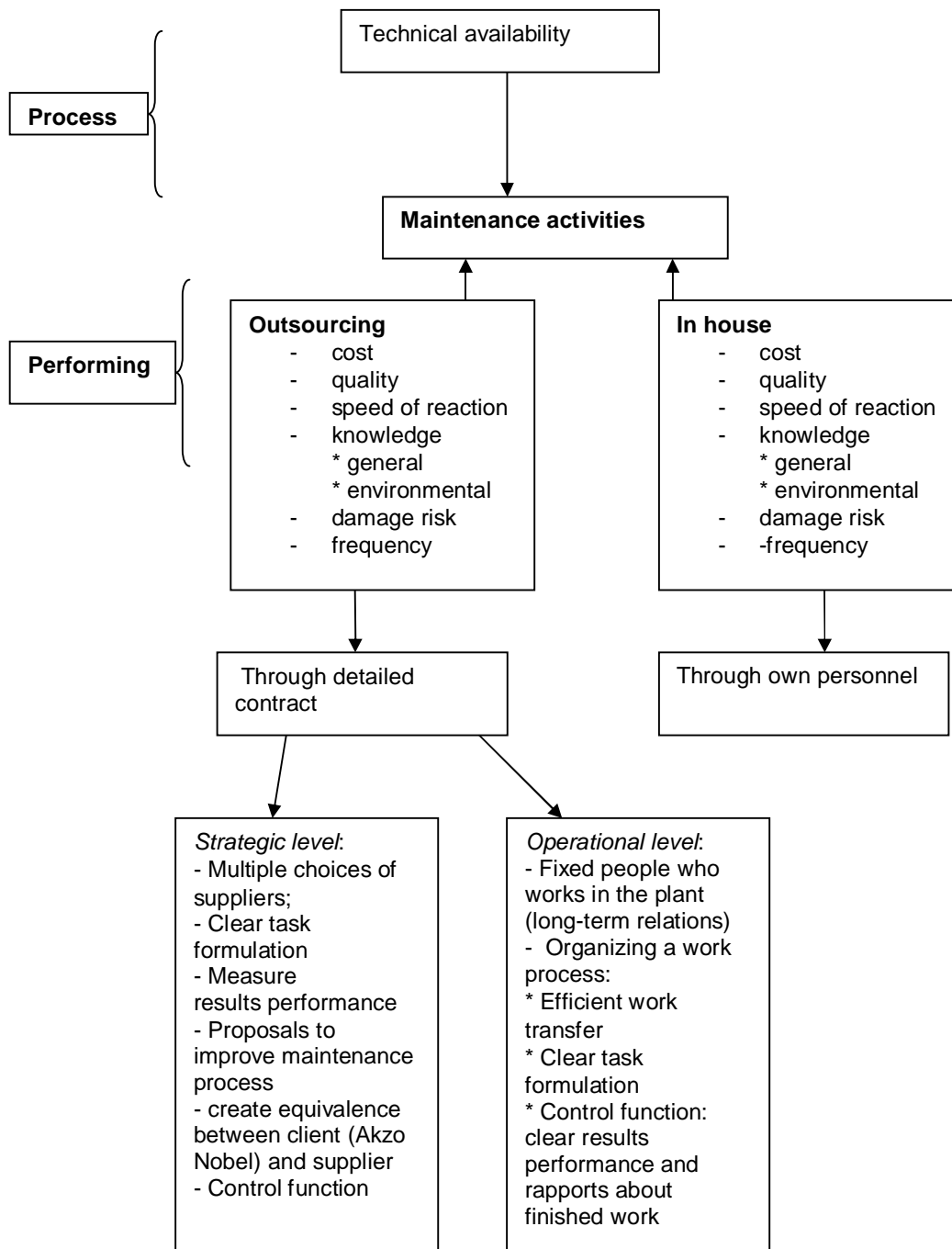


Figure 16. Maintenance activities

In the above we have obtained an overview of the critical success factors/attention points related to the performance of the outsourcing process of maintenance activities. So far we did not discuss whether it would make sense to outsource at all. Let us now focus on that. It is important to mention that the outsourcing process is the strategic choice that we have to make. It is very important to understand the differences between outsourcing decision for different types of maintenance activities.

The scope of this research is primary and quaternary maintenance activities. The reason hereof is that secondary and tertiary maintenance activities are “grey zone” of maintenance. They are difficult to separate and they are changing per production process.

To make a decision to outsource these types of maintenance activities it is important to mention the following aspects. These aspects based on the literature of Aberdeen Group [9], R. Francis [11] and interviews with maintenance managers at the different sites. Important aspects for outsourcing decision making:

- *Cost*: It has to be sufficient for primary and quaternary maintenance activities
- *Availability of qualified suppliers*: It has to be sufficient for primary and quaternary maintenance activities
- *Speed of reaction*: This is a critical issue for primary maintenance activities, because it can have influence on the production process. The speed of reaction has to be high for primary activities and for quaternary maintenance activities it can be varied for different cases. That is why this is can be a point for not to outsource primary maintenance activities.
- *Damage risk*: This is a critical issue for primary maintenance activities, because it can have influence on the production process. So this is also the point for not outsourcing decision of primary maintenance activities. For quaternary maintenance activities it has less/no influence on the production process and that is why it can be outsourced.
- *Frequency of maintenance activities*: If there are preventive maintenance activities and frequency is low, then you can outsource these maintenance activities. If there are corrective or proactive maintenance activities, then frequency is high and it is better to keep this kind of maintenance activities in house.
- *Knowledge*:
  - a. General: This is important for primary and quaternary maintenance activities.
  - b. Environmental: This is a critical issue for primary maintenance activities, because the plant’s knowledge is very important for effective performance of maintenance activities. To get this knowledge takes 3-5 years and that is why this is a competitive advantage if you have it in house. For quaternary maintenance activities this type knowledge is not required.

These aspects will help us to understand which and why maintenance activities can be outsourced. To ascertain whether or not outsourcing of maintenance activities is preferable, we developed the following block diagram (see Figure 17). This diagram enables us to make an outsourcing decision for primary and quaternary maintenance activities. The attention points for making the outsourcing decision were discussed above.

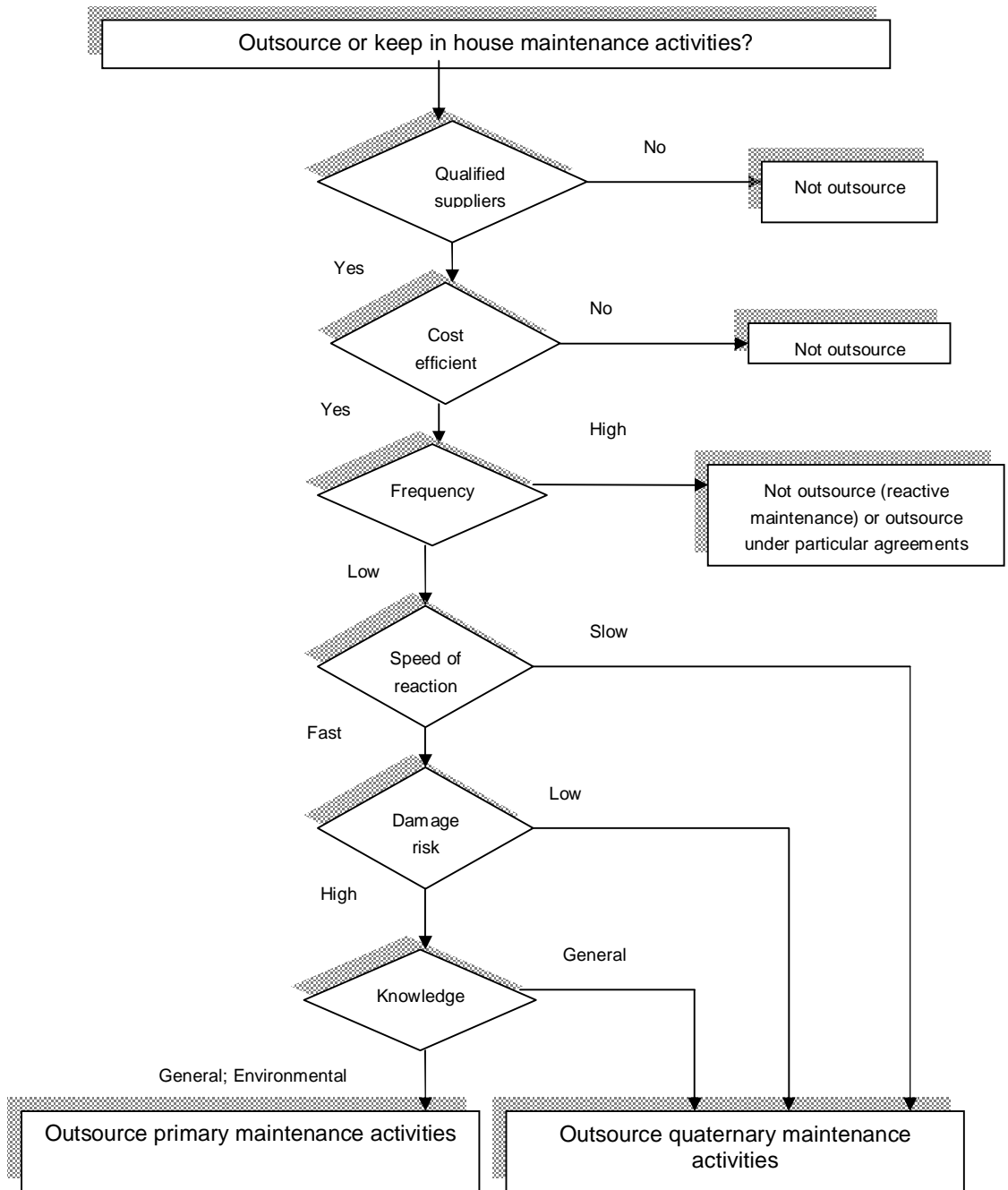


Figure 17. Outsourcing decision making

#### 4.3. Extra factors

Although Figure 17 displays a fairly complete picture of the outsourcing decision making process. There certainly are additional factors to be taken into account. According to theory of S. Burdon [12] it is important to pay attention to the following extra factors: aging personnel and suppliers position. These factors can have influence on the decision to outsource maintenance activities or keep them in house and also on the outsourcing process. That is why it is important to know, what the situation with aging personnel is and how different companies solve this problem. Also it is important to know what the opinion of suppliers about outsourcing is and what the trend in the outsourcing maintenance activities is.

At the section 5.4, we are going to look at how different parties going to solve problem of the personnel aging and also what is de position of suppliers and how they see outsourcing of maintenance activities and which possibilities and trend is there.

**Conclusion:**

In this chapter we discussed the theory about benchmarking and we made our research model complete with attention points important for outsourcing process. Also we made a block diagram for the outsourcing decision making process for primary and quaternary maintenance activities. This is very important to know, because for the same factors different attention is paid by primary and quaternary maintenance activities. We mention that extra factors, such as aging personnel and position of suppliers in the outsourcing process are very important. This gives us extra information in making strategic decision what maintenance activities can be outsourced in the future. In chapter 5 we will identify best practices in the internal and external benchmarking on the base of our research model.

## **Chapter 5. Improving process of outsourcing maintenance activities**

*In this chapter we are going to discuss the way how we identify best practices (see section 5.1.). Then we are going to discuss the best practices: internal (see section 5.2.), external (see section 5.3.) benchmarking. Best practices within Akzo Nobel will be based on the locations which were discussed in the chapter 3. Best practices outside Akzo Nobel will be based on the information from sourcing managers by ICI and DSM. In section 5.4. we are going to discuss extra factors, which can have influence on the outsourcing decision.*

### **5.1. Best practices**

For choosing best practices we should understand what actually we want and which criteria we are going to use for the selection of the best practice. In general the process of benchmarking is “you get what you measure”. We have to set priorities on what we find important and why.

At this point we should look at how we can optimize maintenance process. This can be done through both possibilities outsourcing and keeping it in house. So it means that outsourcing can be option only when it can be done better and cheaper then by own personnel.

Also the segmentation of maintenance activities is important, because it gives us an understanding of the different approaches by different segments, e.g. approach for primary activities is different than approach for quaternary activities (facility management).

Also it is important to keep in mind the differences between two segments: coatings and chemicals.

There are different best practices possible; we will mention the best practice of completely outsourced maintenance activities and also the best practice of outsourcing of non-primary maintenance activities. The reason hereof is that in different countries is different mentality about outsourcing and the level of readiness of outsourcing by client and supplier differs per country.

### **5.2. Internal benchmarking**

In this research we analysed case studies with outsourcing of maintenance activities (Delfzijl, Bohus, Duren) and also case studies with contracted out maintenance activities (Deventer, Sassenheim). For the complete picture we will discuss best practice from cases with both possibilities.

As it was mentioned in our research diagram we will analyse these cases on strategic and operational level (Figure 16).

At strategic level the choice of suppliers are made after analysis of all proposals which they present. This happens on the competition base. The important aspects are quality, cost and motivation to improve maintenance processes. Supplier who has the best combination of these aspects gets the contract. From the AN location is required clear task formulation and fixed performance measurements.

At operational level important to remember that environmental knowledge is very important and it is required to fix in the contract that the same people have to works at the location. This long term relations create plant knowledge and also informal connection for client company. The work process has to be organized in efficient and effective way. This means such aspects as:

- § Efficient work transfer: preparation phase has to be done by client employee before supplier employee begins with work; this saves a lot of time and as a consequence costs (especially by contracts payment-hour);
- § Clear task formulation helps in the clear formulation of the expectations, this helps in avoiding frustrations by both sides;
- § Control function is very important by checking performance measurements and also by requiring rappsorts about finished work. This rappsorts show the statistic of what type of work is done and how often it is done. On the base of these rappsorts it is possible to follow performance of the supplier and for identifying maintenance philosophy.

All these aspects are summarized in table 4. These aspects are treated in different ways at the sites. That is why we are going to identify best practices in the cases with contracted out maintenance activities (Deventer, Sassenheim) in the section 5.2.1. and in the section 5.2.2. we are going to identify best practices in the cases with outsourced maintenance activities (Delfzijl, Bohus, Duren).

*Table 4. Attention points for identifying best practices.*

Attention points	Deventer	Sassenheim	Delfzijl	Bohus	Duren
<b>Strategic level</b>					
Multiple choice of suppliers	Yes	Yes	Not enough in the preparation phase	Yes	Yes
Clear task formulation	Yes	Yes	Yes	Yes	Yes
Measure results performance	KPI's fixed in the contract; using frame contracts if necessary	KPI's fixed in the contract; using frame contracts if necessary	KPI's fixed in the contract not good enough; using frame contracts if necessary	KPI's fixed in the contract; umbrella (frame) contracts and additional local details	KPI's fixed in the contract; umbrella (frame) contracts and additional local details
Proposals to improve maintenance process	Yes, fixed in the contract	Yes, fixed in the contract	Yes, fixed in the contract	Yes, fixed in the contract	Yes, fixed in the contract
Create equivalence between client and supplier	No	No	No	Yes	Yes
Control function	Through KPI's	Through KPI's	Through KPI's	Through KPI's; revising contracts each year; Steering committee	Through KPI's
<b>Operational level</b>					
Fixed people who works at the plant (environmental knowledge through long term relations)	Yes	Yes	Try to keep this knowledge was unsuccessful	Yes	Yes
Organizing a work process:					
Efficient work transfer	Yes	Yes	Not always	Yes	Yes



Clear task formulation	Yes	Yes	Not sufficient	Yes	Yes
Control function: clear results performance measures and reports about finished work	Yes	Yes	Not sufficient	Yes	Yes

### 5.2.1. Best practice in the case study contracted out maintenance activities.

For identifying best practice, we will analyse two case studies, locations Deventer and Sassenheim. This analysis will be based on interviews with maintenance and purchasing managers of Akzo Nobel and literature research. The backbone for this analysis you can find at Figure 16.

*At the location Sassenheim at the strategic level* choice of the supplier is made on the competition base (multiple choices of suppliers).

There is mix of the different contracts available. Some of them are based on the performance measurements and some of them are based on the principle hour – payment. For the quaternary maintenance activities (facility management) performance measurements contracts used. There is the trend to reach more efficiency and effectiveness through pushing forward performance measurement contracts also for other types of maintenance activities. As a consequence task formulation is formulated in the clear way and performance indicators are defined. (Performance measures and also clear task formulation)

In the contracts suggestions for improving maintenance activities per particular periods of time are required. The active reaction on the feedback from Akzo Nobel is expected.

(Proposals to improve maintenance process)

The most contracts with suppliers have a long term base. If the experience with the particular supplier is on the expected level then the work volume can be increased by this supplier and other way around. (Creating equivalence between client (Akzo Nobel) and supplier)

The most important is to organise the control function in the efficient and effective way. Clear task formulation and performance indicators are the base for the control function. This helps also in the organizing demand organization at the location. This is very important, because it helps in the optimizing of maintenance organization. (Control function)

*On the operational level* it is required the same people have to work at location and this helps in creating environmental knowledge, which is very important for performing some maintenance activities. (Fixed people for creating environmental knowledge)

Other aspects, such as work transfer, clear task formulation and control function, are organized in the efficient and effective way. The planning of all maintenance activities and work transfer organized on the optimal way. It helps to save time and also costs, if it goes on hour – payment contracts. (Clear task formulation and work transfer)

Control function which is based on clear task formulation and performance measures organized in the efficient and effective way. The reports of the finished work are analysed and that is the base for determining of delivered quality. This statistical information helps by future choices of suppliers. (Control function)

There is also clear tendency by this location towards new developments in the organizing maintenance organization. The open culture at the location creates a lot of possibilities for cooperation with AN Sourcing. This brings as a consequence also possibilities for cost savings by particular maintenance activities.

*At the location Deventer* the situation is approximately the same.

*At the strategic level* choice of suppliers is made on the competition base. (Choice of suppliers)

There are also both types available: contracts based on the performance measurements and contracts based on the principle hour – payment. For the quaternary maintenance activities (facility management) performance measurements contracts used. There is a tendency towards performance measurement contracts also for other type's maintenance activities. As a consequence task formulation is formulated in the clear way and performance indicators are defined. (Performance measures and also clear task formulation)

In the contracts suggestions for improving maintenance activities per particular periods of time are required. The active reaction on the feedback from Akzo Nobel is expected. (Proposals to improve maintenance process)

The most contracts with suppliers have a long term base. If the experience with the particular supplier is on the expected level then the work volume can be increased by this supplier and other way around. (Creating equivalence between client (Akzo Nobel) and supplier)

The most important is to organise the control function in the efficient and effective way. Clear task formulation and performance indicators are the base for the control function. (Control function)

*On the operational level* it is required the same people have to work at location and this helps in creating environmental knowledge, which is very important for performing some maintenance activities. (Fixed people for creating environmental knowledge)

Other aspects, such as work transfer, clear task formulation and control function, are organized mostly in the efficient and effective way.

The planning of all maintenance activities and work transfer organized on the optimal way. It helps to save time and also costs, if it goes on hour – payment contracts. (Clear task formulation and work transfer)

Control function which is based on clear task formulation and performance measures organized in the efficient and effective way. (Control function)

The culture at the location is more or less open for changes.

### **Conclusion:**

This is very difficult to define best practice from these two locations. The reason hereof is that the both locations try to organize outsourcing process in efficient and effective way. The results, which they have been reached, are above the expectations. These two locations presented two different segments: coatings and chemicals. The mentalities at locations are different towards outsourcing and cooperation with ANS and suppliers. The openness and readiness for cooperation by Sassenheim reaches higher level then by Deventer. There is a try to set up the demand organization by Sassenheim. This is one of the important aspects for identifying best practices.

The both locations can be identified as best practices, but location Sassenheim has advantages in the openness towards suppliers and ANS and also in the steps towards setting up demand organization at their location.

### **5.2.2. Best practice in the case study of outsourcing maintenance activities.**

For identifying best practice, we will analyse three case studies, locations Delfzijl, Bohus and Duren. This analysis will be based on interviews with maintenance and purchasing managers of Akzo Nobel and literature research. The backbone for this analysis you can find at Figure 16.

*At the location Delfzijl* the outsourcing of maintenance organization was not successful.

*At the strategic level* choice of supplier was made on the base of the criteria that supplier can buy maintenance organization. The people who made this choice have not the sourcing experience. (Choice of suppliers)

The maintenance organization was sold and the contracts for delivering services were not optimal prepared and details and performance measures in some cases were missing. As a consequence task formulation is formulated not always in the clear way and performance indicators are not for all maintenance activities optimal defined. (Performance measures and also clear task formulation)

In the contracts suggestions for improving maintenance activities per particular periods of time were fixed, but these suggestions are not always on the expected level. (Proposals to improve maintenance process)

The control function was in begin also outsourced and now is insourced, because it is very important to control supplier performance and also to define the tasks which has to be done. There is a try to improve the situation with outsourced maintenance organization at this location. (Control function)

*On the operational level*, the same people were required to keep working at this location, but a lot of people left maintenance organization and as consequence a lot of environmental knowledge were lost. (Fixed people for creating environmental knowledge)

Other aspects, such as work transfer, clear task formulation and control function, were organized not in the efficient and effective way. The speed of reaction was longer that it was fixed in contracts and that creates a lot of problems, which people in the production solve through personal contacts with local companies.

The planning of all maintenance activities and work transfer organized not always in the optimal way, because a lot people have problems with fact that they are not working anymore by Akzo Nobel (personal and emotional factor). (Clear task formulation and work transfer)

Control function which was outsourced was not function in the optimal way. Nowadays control function is insourced and there is a try to set up the demand organization at this location. (Control function)

So after this analysis we can see that the result of the outsourcing maintenance organization was not positive at the location Delfzijl. That is why we will not identify this location as a best practice.

The other two locations have successful experience with outsourcing of maintenance activities. We are going to look per location how the outsourcing process was organized.

*At the location Bohus* outsourcing process were organized in an effective and efficient way. This conclusion is based on the interviews with maintenance and purchasing managers at these locations. This conclusion is approved by time and the results which they achieved reports in the annual savings. That is why it is important to share this knowledge with other locations.

The key factors of the successful outsourcing process *on the strategic and operational level* are:

- § The maintenance organization was sold to the supplier, which was chosen on the competitive base. (Choice of suppliers)
- § There is a demand organization developed and the segmentation of maintenance activities is made. (Performance measures and also clear task formulation on the strategic and operational level)
- § Control function is organized through “gate keeping system”. “Gate keepers” were placed at production, facility and maintenance. They have to make segmentation in maintenance activities and also are responsible for clear task formulation. (Control function)
- § The segmentation in maintenance activities made in primary and facility maintenance activities. (Understanding of different attention points in the outsourcing process by these two types of maintenance activities)
- § “Umbrella contracts” are used and for each production unit there is a possibility for subcontracts. Steering committee revised these contracts once a year and a special group analysed it 3-4 times a year. This shows us another level of outsourcing process. (Proposals to improve maintenance process);(Performance measures and also clear task formulation)

- § Environmental knowledge is insured by fixing in contracts use of the same people.  
(Fixed people for creating environmental knowledge)

This all factors show us a high level of organizing of outsourcing process; suppliers are free in the process of delivering high level of the performance. They have to show an improvements plans and implementation of them. (Proposals to improve maintenance process)

The control function is good defined on all levels and that is why it can insure expected performance. In the fast changing environment of production contracts are revised and this gives a control feeling at the location. Contracts revising means also revising performance indicators/measurements and this means insuring the expected quality will be delivered by this location. The close cooperation between supplier and Akzo Nobel means also reaching higher level of asset management and as a consequence effective and efficient maintenance organization (Control function); (Performance measures and also clear task formulation)

*At the location Duren* it is also a good experience of outsourcing process. The interests on the *strategic and operational level* were taken into account.

The maintenance organization was sold to the supplier, which was chosen on the competitive base. (Choice of suppliers)

The control function is executed through production, facility and purchasing managers. This gives possibility to analyse work orders and the necessity of them. Close cooperation between this departments give possibility to increase efficiency and effectiveness of maintenance activities. (Control function)

Clear task formulation and key performance indicators create a good base for the effective and efficient performing of the control function. (Performance measures and also clear task formulation).

Close cooperation between different departments and supplier create a lot of possibilities for improving proposals. (Proposals to improve maintenance process)

The guarantee of keeping environmental knowledge is included in contracts (the same people have to work at location, long term relations).

### **Conclusion:**

Actually these two locations organized outsourcing process and management of it in the effective and efficient way. Both locations have a lot in common in the organizing of the outsourcing maintenance activities. At the location Bohus they are much further in it. The organization of managing outsourcing activities are on a high level and attention is paid to all details. The strength is that they use "umbrella contracts", which is fulfilled by each production unit with all details. The effects of economies of scale and freedom to give a new completion for the contracts come back in quality of performing maintenance activities and savings of approximately 1,6 million euro.

On the base of this information we can concluded that location Bohus can be identified as best practice of outsourcing maintenance activities. They reached also the level of asset management. This is very important to let other locations know about this practice, because it shows that this level of outsourcing maintenance activities can be successful.

These examples show us that if outsourcing process is good prepared, attention is paid to all details and suppliers are ready for this level of cooperation than the outsourcing of maintenance activities can be successful.

### **5.3. External benchmarking**

The scope of the external benchmarking is represented by companies ICI, which are now a part of Akzo Nobel, and DSM which operates in the same field as Akzo Nobel.

For understanding of the outsourcing process by this companies we will made the same analysis as we made by the different locations of Akzo Nobel.

This analysis is made on base of interviews with purchasing managers on these companies.

In this analysis we are going to give answers on the questions why, which and how the maintenance activities are outsourced/contracted out. We are going to give the answer per company. The extensive information about the external benchmarking you can find in Appendix 4. Hereunder in Table 5, we present the summary of analyses of outsourcing process for these two companies:

*Table 5. External benchmarking. Analysis of outsourcing process*

Company	Outsourced/ Contracted out	Why maintenance activities outsourced / contracted out?	Which maintenance activities outsourced / contracted out?	How maintenance activities outsourced / contracted out?
ICI	In house	Approximately nothing is outsourced. Maintenance activities are the core business.	A small part of facility management, may be 10%, contracted out.	Contracted out on operations level (hour-payment)
DSM	Contracted out	Special knowledge; Cost savings	Primary activities are core business and will not be outsourced. Non primary activities are contracted out.	Mostly contracted out on operations levels (hour-payment). Maintenance of the R&D laboratories outsourced on performance contracts on long-term base.

There are big differences at these companies in how they see maintenance activities and how they define them. Also a mentality plays a big role at these different approaches.

At ICI maintenance organization is a core business. According to sourcing and operations managers, maintenance organization is organized in non effective and non efficient way. This point of view is based on the following information. The maintenance organization is huge, because for all kinds of maintenance activities there is a particular specialist in the organization, who is responsible for the particular activity. The people is low educated and unmotivated. There are no suppliers with required quality in the region and the philosophy of maintenance is absolutely different than in the Europe. There is no demand for third party. If it will be possibility to outsource maintenance activities, then only non –primary maintenance activities will be outsourced. The primary maintenance activities will be always defined as core business with the consequence to keep them in house.

At DSM the position is different. The primary maintenance activities defined as core business, which will not be outsourced. The non-primary activities are already outsourced. On the sites, which recently went through acquisition, these activities will be reviewed and if advantages can be reached they will be also outsourced. There is also different maintenance organization is settled. There is an organization which is collect work orders of the plants and which contract them further out to the third party. On this way they want to reach effectiveness and efficiency of the processes. This organization is also a profit centre.

As we can see there are different approaches for maintenance activities possible. There are a lot of difficulties to optimize the maintenance organization and the process of outsourcing maintenance activities. There are also some aspects, such as different country’s mentality and also company mentality, which makes the process of optimization more difficult.

Analyzing these two companies we can identify DSM as a best practice by external benchmarking.

First of all DSM optimises maintenance organization and tries to achieve performance and cost optimization of these activities. They give the maintenance organization status of profit centre, and this organization has to serve the most plants of DSM in Netherlands. This

organization has to play role of the demand organization and organize further the role of suppliers. The role of suppliers is limited by performing non-primary activities. So the control function stays within DSM and actually services are contracted out on base hour-payment. So they really busy with reviewing maintenance organization and try to optimize it.

As we mention before maintenance organization by ICI is big and ineffective and also very expensive, because of overstaffing and absence of real maintenance philosophy. It has to be changed a lot in the way of organising maintenance activities and the philosophy behind them. They have to collect more knowledge and motivated people who will be capable to change the current organization. This is not a fast process, but this is the changes which have to be made. First of all maintenance organization has to be optimized in house and there is no option for outsourcing yet. The reasons hereof are the procedures and processes have to be documented, performance measures have to be developed and people should be capable to perform broader spectrum of maintenance activities.

#### **5.4. Extra factors**

According to theory of S. Burdon [12] it is important to pay attention to the following extra factors: aging personnel and suppliers position. These factors can have influence on the decision to outsource maintenance activities or keep them in house and also on the outsourcing process. That is why it is important to know, what the situation with aging personnel is and how different companies solve this problem. Also it is important to know what the opinion of suppliers about outsourcing is and what the trend in the outsourcing maintenance activities is.

##### **Ø Aging personnel**

*There is a trend in lack of technical specialists. This profession is not popular among young people and the older generation is in 10 years will go on pension. So this shortage is critical for performing maintenance activities, especially for primary maintenance activities. Hereunder we are going to discuss what different parties going to do for solving this problem.*

##### *Akzo Nobel policy*

At Akzo Nobel paid for education for young motivated people and also tries to get good people from schools. Also the experience from colleagues is shared with young people. This helps in short time to get environmental (plant) and general knowledge. This is very important to keep this position for people which involved in the primary maintenance activities.

##### *ICI policy*

At ICI there is not conscious policy about aging personnel. They've got young people from school and educated them at plant themselves through sharing experience and environmental knowledge. Each person is busy with a particular activity and that is why the general knowledge is not required.

##### *DSM policy*

There is segmentation between policy people for primary maintenance activities and non-primary maintenance activities. For primary maintenance activities young people are taken from the school and get further knowledge at the plants. For non-primary activities old people are "outsourced" and there is a hope that supplier will educate own young people with the environmental knowledge which is important for DSM. The activities, where no special knowledge is required, are outsourced or going to be outsourced.

##### *BAM, Imtech policy*

This is the point of view from the other side. Imtech and BAM try to get best people from the school. Then the policy is to give them extra knowledge in the company through special organized cuscuses and sharing of the experience of other colleagues. At BAM is also own education available in the form of school/university, which can give extra knowledge on all levels from repairman to engineer.

##### *Conclusion:*

As we can see that all parties have the same policies to solve aging problem. Also in the society there are a lot of measures taken to raise the prestige of technical professions. This

helps to get more motivated people at the school and further in the company life. Also the educational institutes in company themselves helps to provide required knowledge for motivated people.

#### **Ø Suppliers position about outsourcing**

*In this section we are going to discuss the position of suppliers about outsourcing maintenance activities. Position of the suppliers will be based on the information from Imtech and BAM.*

These companies have different profiles and different ambitions in providing maintenance services. They can provide a combined package of different maintenance services. This combination gives a possibility to increase efficiency and effectiveness of maintenance activities. They make segmentation in primary and non-primary maintenance activities. For both of these type's activities they have different ambitions and policies.

Primary maintenance activities are outside their ambition at that moment. There are following reasons to keep these sort activities outside of scope:

- Not enough power for acquisition of AN maintenance organization;
- Difficulties to set in the contract all performance indicators for the control function;
- Constant changing situation on the production floor and as consequence difficulties to set everything in the contract;
- Lack on environmental knowledge.

Non-primary activities (direction facility management) and preventive maintenance are the ambition fields for these companies. The combination which this two companies offer can be resulted in "all inclusive" contracts. This means that they can offer maintenance from buildings tot HVAC (Heating, Ventilation, Arco Conditioning). This can result in positive cooperation if all performance indicators will be measured by control function. That is why is very important to set everything in the contract and use a "frame" contract on global level and each locations has to have possibility to fill it with own needs.

*Conclusion:*

Suppliers are ready for the cooperation. They will develop the proposals for the improving maintenance organization by different locations of Akzo Nobel. They want to rich a new level of the relationship and move from operations level (hour – payment) towards effectiveness and efficiency for non-primary maintenance activities. They can use the knowledge what they get from the cooperation with others companies. This is also the goal of the Akzo Nobel to move towards this level of the maintenance organization. This cooperation can help to optimize the maintenance organization and give the learning effects of the best practices.

#### **Conclusion:**

*In this chapter we made an analysis of the internal and external benchmarking. By internal benchmarking, cases were separated in cases with contracted out maintenance activities and outsourced maintenance activities. The best practices were identified by both internal and external benchmarking. These analyses were made on the base of our research model. In the internal benchmarking, location Sassenheim was identified as best practice in the cases with contracted out maintenance activities and location Bohus was identified as best practice in the cases with outsourced maintenance activities. In the external benchmarking DSM was identified as best practice. Also attention was paid to the extra factors such as aging personnel and position of suppliers. Aging personnel has influence on the outsourcing process for non-primary maintenance activities. For primary maintenance activities the aging of personnel has not so much influence, because primary maintenance activities identified as a core business. The position of suppliers gives us an understanding of strategies on short/long terms and how it can influence proactive position of Akzo Nobel. After this analysis we can conclude that outsourcing of maintenance activities can be successful when this process is extensively prepared, all details are taken into account and suppliers are ready for this level of cooperation.*

## Chapter 6. Conclusions and recommendations

*In this chapter we are going to conclude: did we meet our objectives? How we can interpret results? What recommendations can be given to Akzo Nobel?*

### 6.1. Conclusions

The objectives of the research was what is the trend in the outsourced and contracted maintenance activities and which best practices can be identified with respect to outsourcing maintenance activities by Akzo Nobel and comparing these practices with external benchmarking.

This resulted in the following problem formulation:

“How can the outsourcing process of maintenance activities be improved?”

This question was answered through theory research and analyzing the current experience of outsourcing maintenance activities by Akzo Nobel, ICI, DSM and position of suppliers.

Literature research was made in two directions. First, according to J. Heizer [10] we have to understand what types of maintenance activities exist and according to Aberdeen Group [9], what KPI's we can use for measuring performance of maintenance activities. Second we need to know how to outsource/contract out maintenance activities (R. Francis [11], S. Burdon [12], M. Levery [2], U. Westergren [4]) and what aspects we have to keep in mind to avoid risks connected with the outsourcing process (J. Heizer [10], R. Francis [11]).

On the base of this theory research we analysed the current experience in the two types of cases which were presented: case studies with contracting out maintenance activities and case studies with outsourcing maintenance activities. The motivation and the results of the outsourcing process are different.

The position on outsourcing is differentiated by the type of maintenance activities. In this research attention was paid to primary and quaternary maintenance activities. There are different maintenance philosophies behind this segmentation.

Different case studies in different countries were analysed. They show how outsourcing/contracting out process of maintenance activities can be organized. Some of them show a positive experience and some show learning moments of the mistakes which were made. Also external benchmarking cases show the different ways of organizing maintenance organization.

After analyzing different study cases on the base of theory and interviews with purchasing, operations and maintenance managers, we can conclude that outsourcing maintenance activities can be done only when the client and supplier company are really ready to co-operate. This is also approved by the theory of S. Burdon [12], that mutual trust and understanding is the highest level of cooperative relationship between supplier and client company and can be achieved only through long term successful relationship. In the three case studies with complete outsourcing of maintenance organization two were successful. In both these cases the outsourcing process had a proper preparation phase. The own maintenance organization was reviewed and the demand organization was set up. This demand organization performs a managing and controlling function of supplier performance. It is very important to realize that this form of maintenance organization helps in organizing maintenance activities in an effective and efficient way. For this type of outsourcing process mutual trust between client company and supplier is required.

At most Akzo Nobel locations primary maintenance activities are not outsourced, except preventive maintenance activities. The quaternary maintenance activities mostly outsourced.

When client and supplier company are not ready for this kind of co-operation, then outsourcing can create problems in the performance of maintenance activities and also problems in the production department. The segmentation in primary and quaternary



maintenance activities helps us to understand different approaches in the making decision on outsourcing these activities and how to outsource them.

Once again, the diagram of the segmentation of maintenance activities is given below:

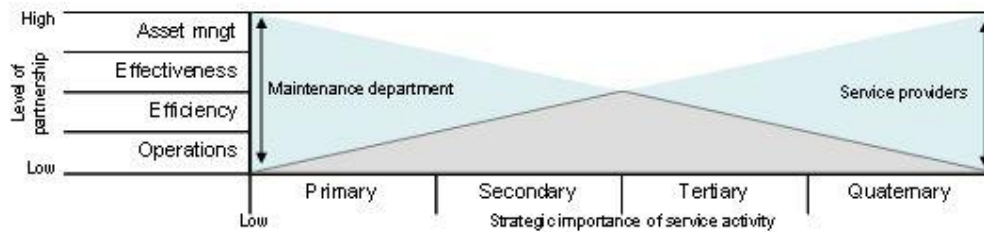


Figure 18. In house and outsourced maintenance activities [Internal Document]

The following segmentation of maintenance activities is made:

- Primary: services directly related to the production process
- Secondary: combination of services related to the production process and installations and beginning to evolve towards more facility management
- Tertiary: combination of services less related to the production process and more evolving towards facility management
- Quaternary: not related to the production process and mainly related to facility management

Levels of partnership of the performing sides (suppliers and client company) are:

- Operations: In the first level the focus is mainly on costs savings realized by better purchasing prices (hourly rates etc.) and agreements.
- Efficiency: On the second level more insight in the organization is granted to the service provider in which they cooperate to increase the efficiency by for example combining workload etc.
- Effectiveness: This is the third level of services in which a higher level of partnership is agreed upon and services providers assist in increasing the effectiveness of the maintenance organization/activities. Their advice is based on their expertise and market best practices.
- Asset management: This is the highest level of service management in which the supplier or client company becomes responsible for executing and maintaining all assets.

Primary maintenance activities are difficult to outsource, because they require environmental knowledge (knowledge of the plant and production process). They are also much more difficult to control, because the production process is dynamic and it is difficult to keep changing performance indicators. Mostly primary maintenance activities are identified as a core business and that is also the reason that this type of maintenance activities is not outsourced.

Quaternary maintenance activities are more easily to outsource. They are not core activities for the maintenance organization and do not endanger the production process. Environmental knowledge is not require and that is why is easier to outsource.

Identifying which type of maintenance activities can be primary or quaternary differs by the type of production. For Chemicals and Coatings the same activities can be identified in the different segments.

On the basis of the literature research and interviews with purchasing, operations and maintenance managers, the following block diagram is derived (Figure 19). In this block diagram we can see when an outsourcing decision has to be made and what type of maintenance activities can be outsourced. This can be analysed on the following aspects:

- Quality of suppliers and cost. They always have to bring advantages; otherwise the in-house option is preferable.
- Speed of reaction. This is different for primary and quaternary maintenance activities.

- Damage risk. This is different for primary and quaternary maintenance activities. For primary maintenance activities it is high, because it can have an influence on the production process, so it is better to keep these type activities in-house. For quaternary maintenance activities damage risk is low and that is why this can be outsourced.
- Frequency; Low frequency means preventive maintenance activities and these activities can be outsourced; High frequency means reactive and predictive maintenance activities and then it is better to keep these activities in-house.
- Knowledge; General knowledge is important for both types maintenance activities; Environmental knowledge is very important for primary maintenance activities. It takes 3-5 years to gather this knowledge and this makes the outsourcing of primary maintenance activities difficult.

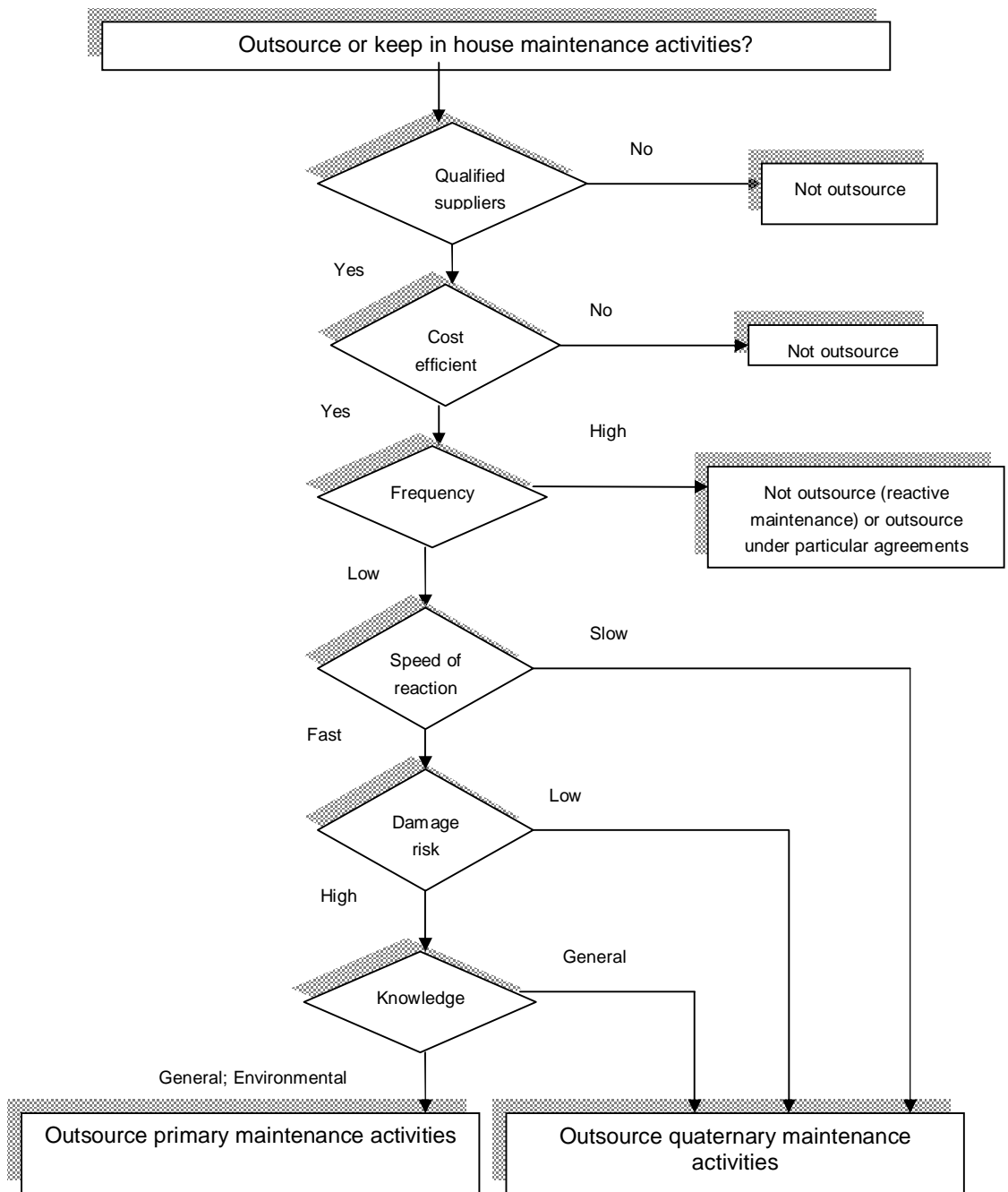


Figure 19. Aspects, which have to be analysed, to make outsourcing decision

In this research we also analysed the outsourcing process at the strategic and operational level. This analysis is based on the literature research and also interviews with purchasing and maintenance managers of Akzo Nobel, ICI, DSM. At this both levels we have to pay attention to different aspects to reach optimal level of outsourcing process. In the following set of attention points the most important selection of these aspects are named:

*Strategic level:*

- Multiple choice of suppliers: quality, cost; speed of reaction;
- Clear task formulation and performance measurements, which have to be fixed in the contract;

- Create equivalence between client and supplier to achieve better results of co-operation. This can be done through economies of scale, giving one supplier more tasks and creating a co-operation process to improve maintenance activities for better efficiency and effectiveness of results;
- Proposals to improve the maintenance process and also cooperation in the implementation process;
- The control function is established by setting up the demand organization and clear performance indicators, which have to be reviewed once a year. Also the gate keeping function should be established by production, maintenance and purchasing departments. This is very important for control process.
- In the case of complete outsourcing clear communication to employees is required.

*Operational level:*

- Creating/keeping environmental knowledge can be done by fixing people who work at the plant on the contract;
- Organize efficient and effective work process through:
  - § Efficient work transfer through effective schedules of activities;
  - § Clear task formulation by defining work scope and documentation;
  - § Checking for spare parts availability;
  - § Control and monitor function: clear results performance measurements and reports about finished work.
  - § Statistical analysis of these reports helpful in the evaluation of the performance level of the particular supplier.
  - § Evaluation and performance feedback for the suppliers on the base of this analysis.

When attention is paid to these aspects the chance for an optimal outsourcing process will increased. The outsourcing process has to be evaluated from the operations level to asset management level. This can happen when both parties are ready to co-operate. Mutual trust is the most important aspect in the outsourcing process. This can be created through long term relationships. An efficient and effective long term relationship can be created when the aspects, which are named in the checklist, are the basis of the coordination of the outsourcing process.

*On the basis of the analysis of all case studies and literature research, we answered the question of our research how the outsourcing process can be improved.*

## 6.2. Recommendations

Some recommendations are derived from this research for Akzo Nobel. Some of them can be used as a basis for following research.

1. We should mention that part of outsourcing quaternary maintenance activities will be increased, but the part of outsourcing primary maintenance activities will stay relatively on the same level. This can be the theme of the following research. It can give insight into the costs of primary and quaternary maintenance activities. This information has already been gathered for two locations Sassenheim and Deventer (Appendix 5), but it is not enough to make a reasonable conclusion. This gives the feeling of the development trend of outsourcing these types of maintenance activities.
2. Another recommendation is to get more insight into the segmentation of secondary and tertiary maintenance activities. It can also help in the clear definition of the work descriptions and as consequence save costs. This is also the part of developing demand organization by locations.
3. Reviewing maintenance activities can also be recommended by different locations. This can help in creating a demand organization by locations and reaching the asset management level of maintenance activities. This will increase effectiveness and efficiency of the maintenance organization and as consequence increase saving costs.
4. There are differences concluded about experiences of outsourcing process in different countries. It can be useful to research whether these differences can be also explained by different countries mentalities, cultures and practices towards organizing maintenance activities.

## Limitations

There were some limitations during my research:

- § In the beginning of my thesis research question was different and it concerned benchmarking maintenance activities. This was not possible to realize, because there was not enough data available;
- § The locations choice was limited and it is good for showing different study cases of outsourcing process, but it is not enough to set the development trend in the outsourcing maintenance activities.
- § The analysis of segmentation maintenance activities came at later stage of the research.
- § The combination of limited number of locations and late analysis of segmentation maintenance activities resulted only in the insight in the cost structure of maintenance activities for two locations. This is not enough for trend defining.

These limitations and first two recommendations can be the basis for the following research.

This research can be formulated as:

Identify trend development in the primary and quaternary maintenance activities for determination sourcing strategy within CTMS commodity group.

For this research it is important to get insight in the maintenance activities cost structure for primary and quaternary maintenance activities for last five years for 10-20 locations in both segments (Coatings and Chemicals). That can be enough for trend identification. This trend and insight into costs are important for identifying sourcing strategy in the CTMS commodity group and as consequence cost savings.

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## Abbreviations list

AN	Akzo Nobel
ANS	Akzo Nobel Sourcing
CTMS	Construction Technical Materials and Services
KPI	Key Performance Indicator
NPR	Non Product Related
PR	Product related
FTSE4Good Index	The FTSE4Good Index Series has been designed to measure the performance of companies that meet globally recognized corporate responsibility standards, and to facilitate investment in those companies. Transparent management and criteria alongside the FTSE brand make FTSE4Good the index of choice for the creation of Responsible Investment products.
MRO	Maintenance, Repair and Overhaul
BU	Business Unit
TPM	Total Productive Maintenance
RCM	Reliability Centred Maintenance
CMMS	Computerized Maintenance Management System

## Appendix 1. Planning of the research

The planning of the research you can see below:

<b>Week:</b>	<b>Activities:</b>	<b>Completion of:</b>	<b>Reporting:</b>
9,10,11	<b>Research proposal:</b> Research in the Netherlands	Interim report	
10,11	<b>Getting started:</b> Orientation week	Refine interim report	
12, 13	<b>Research design:</b> Data collection		Report in week 13
14	<b>Data gathering:</b> Collection and analyzing data		
15 – 26	<b>Data analysis and interpretation:</b> Analyse and interpreted the collected data		Report in week 26
26,27	<b>Research reporting</b> Submit draft to principal Present results Improve draft Submit improved draft to principal	Draft report  Improved draft report	Report in week 27
26,27	<b>Research reporting:</b> Debriefing meeting with supervisors		
15-27	<b>Writing of the draft thesis</b>	Draft thesis	Report in week27
27, 32	<b>Research reporting:</b> Discussing draft with graduation committee		
27-40	<b>Improving draft</b>		
40	<b>Research reporting:</b> Preparing and executing colloquium	Final thesis	Report in week 38



## Appendix 2. Technical part of maintenance activities

In this appendix we are going to describe the technical part of our research model, named "Process".

Ø *Optimization of maintenance activities can be representing in the following picture:*

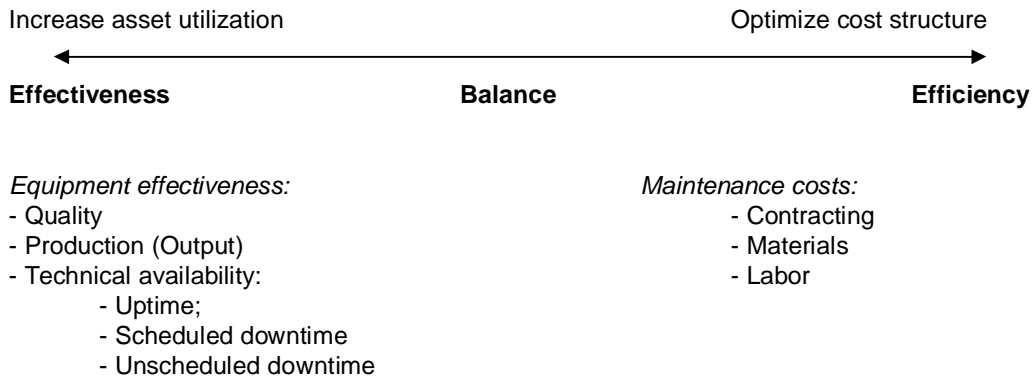


Figure 20. Maintenance optimization

This diagram is based on the literature research and interviews with purchasing and maintenance managers. The literature gives us an understanding of which types of maintenance exist and what are the important performance indicators, which we can use for performance measurements. We look at process of maintenance activities from two sides: effectiveness and efficiency. These two sides have to be in balance for optimal performing of maintenance activities. On the effectiveness side we are looking at the equipment effectiveness and on the efficiency side at the maintenance costs. For both sides are performance indicators available.

Akzo Nobel Technical and Engineering department have developed a benchmark tool "Amon" for all processes in the organization. It covers all processes in the company such as: technology, production, maintenance, procurement and supply chain. On base of all performance indicators this tool gives a graphic analysis of the processes.

This tool is not used in all BU's. It is just started the implementation processes by Functional Chemicals and may be it'll be spread for other BU's as well.

"Amon" tool used 50 key performance indicators by the maintenance part. These indicators are developed for analyzing and controlling performance of maintenance activities in all details. The selection of these key indicators you can find hereunder.

Maintenance indicators:

### 1. Technical availability (%)

OEE (overall equipment effectiveness) availability, actual uptime divided by theoretical production time-overcapacity-scheduled downtime.

For calculation of this indicator following questions should be used:

- Theoretical production time:  
What was the total number of hours that was available for production for the specified period?  
This is the number of hours that a manufacturing process could be running in the specified period when no downtime (scheduled or unscheduled) would occur.
- Total downtime:  
What was the total downtime (in hours) of the plant during the specified period?
- Downtime due to overcapacity:

What was the downtime due to overcapacity (scheduled or unscheduled, resulting from marketing conditions) for the specified period?

- Downtime due to scheduled maintenance:  
What was the downtime due to scheduled maintenance (in hours) for the specified period?
- Downtime to scheduled changeovers:  
What was the downtime due to scheduled changeovers/product changes (in hours) for the specified period?
- Other scheduled downtime:  
What other scheduled downtime time (in hours) occurred which was not due to scheduled maintenance, scheduled changeovers or overcapacity?

## 2. *Maintenance effectiveness (%)*

Effectiveness of maintenance, (actual availability / Target availability) / (Actual maintenance cost / Maintenance budget).

For calculation of this indicator following questions should be used:

- Theoretical production time:  
What was the total numbers of hours that was available for production for the specified period?  
This is the number of hours that a manufacturing process could be running in the specified period when no downtime (scheduled or unscheduled) would occur.
- Downtime due to overcapacity:  
What was the downtime due to overcapacity (scheduled or unscheduled, resulting from marketing conditions) for the specified period?
- Downtime due to scheduled maintenance:  
What was the downtime due to scheduled maintenance (in hours) for the specified period?
- Downtime to scheduled changeovers:  
What was the downtime due to scheduled changeovers/product changes (in hours) for the specified period?
- Other scheduled downtime:  
What other scheduled downtime time (in hours) occurred which was not due to scheduled maintenance, scheduled changeovers or overcapacity?
- Downtime due to breakdowns:  
What was the total downtime due to breakdowns (in hours) for the specified period?
- Other unscheduled downtime:  
What other unscheduled downtime (in hours) was due to other causes than unscheduled changeovers or breakdowns?
- Target technical availability:  
What was the target that was set for the technical availability?  
The availability is one of the three aspects of the Overall Equipment Effectiveness (OEE) approach.  
The availability is defined as the actual uptime divided by the scheduled uptime (=actual uptime + unscheduled downtime)
- Total maintenance cost  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.
- Total maintenance budget:  
What was the yearly budget for the total maintenance cost?

## 3. *Maintenance cost / Plant replacement value (%)*

Maintenance cost as a percentage of plant replacement value.

For calculation of this indicator following questions should be used:

- Plant replacement value  
What was the total replacement value (in Euros) of the plant?  
The number equals the insurance value of the plant

- Total maintenance cost  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.

4. *Maintenance cost / Revenue (%)*

Maintenance cost as a percentage of revenue.

For calculation of this indicator following questions should be used:

- Revenue  
What was the total revenue from sales of finished product (in Euro's) of this plant over the specified period?
- Total maintenance cost  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.

5. *Maintenance labor cost / Total maintenance cost (%)*

Maintenance labor cost as a percentage of total maintenance cost.

For calculation of this indicator following questions should be used:

- Total maintenance cost:  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.
- Maintenance cost labor:  
What was the actual cost of labor for maintenance for the specified period?  
This does not include cost of hired personnel.

6. *Maintenance materials cost / Total maintenance cost (%)*

Materials cost as a percentage of total maintenance cost.

For calculation of this indicator following questions should be used:

- Total maintenance cost:  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.
- Maintenance cost materials:  
What was the actual cost of materials related to maintenance for the specified period?

7. *Maintenance contracting cost / Total maintenance cost (%)*

Cost of external contractors (material and labor) as a percentage of total maintenance cost.

For calculation of this indicator following questions should be used:

- Total maintenance cost:  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.
- Maintenance contracting cost:  
What was the actual cost of all maintenance activities outsourced to external contractors (material + labor) for the specified period?

8. *Hired maintenance labor cost / Internal maintenance cost (%)*

The cost of hired maintenance labor as a percentage of the internal maintenance cost (= total maintenance cost – maintenance contracting cost)

For calculation of this indicator following questions should be used:

- Maintenance cost labor:  
What was the actual cost of labor for maintenance for the specified period?  
This does not include cost of hired personnel.
- Hired maintenance labor cost

What was the total cost for hired maintenance personnel during the specified period?

- Maintenance cost materials:  
What was the actual cost of materials related to maintenance for the specified period?

9. *Internal maintenance / (Internal + External maintenance) (%)*

The ratio of internal maintenance cost (labor + materials) and the sum internal and external maintenance cost (contracting)

For calculation of this indicator following questions should be used:

- Maintenance cost labor:  
What was the actual cost of labor for maintenance for the specified period?  
This does not include cost of hired personnel.
- Maintenance cost materials:  
What was the actual cost of materials related to maintenance for the specified period?
- Maintenance contracting cost:  
What was the actual cost of all maintenance activities outsourced to external contractors (materials + labor) for the specified period?

10. *Maintenance employees / Total employees (%)*

Maintenance employees (own) as a percentage of total plant employees

For calculation of this indicator following questions should be used:

- Number of employees on plant:  
What was the total number of own and hired employees (in FTE's) that can be attributed to the plant?  
An FTE is a full-time equivalent. This is equal to the workload of one full-time employee or typically about 1500 manhours/year.  
This number is excluding all contractors' employees that were working at this plant.
- Maintenance employees:  
What was the total number of FTE's from own and hired employees that are dedicated to maintenance?  
An FTE is a full time equivalent. This is equal to the workload of one full-time employee or typically about 1500 manhours/year.

11. *Maintenance overtime / Total maintenance (%)*

% of maintenance that is booked as overtime

For calculation of this indicator following questions should be used:

- Total maintenance hours:  
What was the total number of manhours spent on maintenance during the specified period?
- Maintenance overtime:  
What was the total number of manhours of maintenance employees that are booked as overtime in the specified overtime?

12. *Corrective maintenance hours / Total maintenance hours (%)*

Number of hours spent on corrective maintenance as a percentage of total number of hours spent on maintenance.

For calculation of this indicator following questions should be used:

- Total maintenance hours:  
What was the total number of manhours spent on maintenance during the specified period?
- Corrective maintenance:  
What was the total number of manhours spent on corrective maintenance in the specified period?  
Corrective maintenance is carried out after fault recognition and intended to put an item into a state in which it can perform a required function.

13. *Preventive maintenance hours / Total maintenance hours (%)*

Hours spent on preventive maintenance as a percentage of total hours spent on maintenance.

For calculation of this indicator following questions should be used:

- Total maintenance hours:  
What was the total number of manhours spent on maintenance during the specified period?
- Preventive maintenance:  
What was the total number of manhours spent on preventive maintenance in the specified period?  
Preventive maintenance is carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item.

14. Predictive maintenance hours / Total maintenance hours (%)

Hours spent on predictive maintenance as a percentage of total number of hours spent on maintenance.

For calculation of this indicator following questions should be used:

- Total maintenance hours:  
What was the total number of manhours spent on maintenance during the specified period?
- Predictive maintenance:  
What was the total number of manhours spent on predictive maintenance in the specified period?  
Predictive maintenance is condition based maintenance carried out following a forecast derived from the analysis and evaluation of the significant parameters of the degradation of the item.

15. Unscheduled maintenance hours / Total maintenance hours (%)

The percentage of manhours spent on maintenance that is unscheduled.

For calculation of this indicator following questions should be used:

- Total maintenance hours:  
What was the total number of manhours spent on maintenance during the specified period?
- Scheduled maintenance hours:  
What was the number of manhours spent on maintenance that was scheduled during the specified period?

16. Cost of unscheduled maintenance / Total maintenance cost (%)

The total cost of unscheduled maintenance as a percentage of the total maintenance cost.

For calculation of this indicator following questions should be used:

- Total maintenance cost:  
What was the total cost of maintenance for the specified period?  
This includes labor, materials, external contractors and all maintenance management and overhead costs associated with maintaining the plant including the grounds.
- Cost of unscheduled maintenance:  
What was the total cost of unscheduled maintenance?  
This includes the cost of actual maintenance performed and the cost of production losses.

17. Hours emergency maintenance / Total maintenance (%)

Number of hours spent on maintenance that count as emergency maintenance resulting from breakdowns.

For calculation of this indicator following questions should be used:

- Total maintenance hours:  
What was the total number of manhours spent on maintenance during the specified period?
- Emergency maintenance:  
What was the total number of manhours spent on maintenance that resulted from breakdowns of the manufacturing process in the specified period?

18. Value of inventory / Plant replacement value (%)

Total value of all inventory as a percentage of plant replacement value.

For calculation of this indicator following questions should be used:

- Plant replacement value:

What was the total replacement value (in Euros) of the plant?

The number equals the insurance value of the plant.

- Value of all inventory:

What was the average value (in Euros) of all spare parts and other materials currently in inventory?

19. Value of risk spare parts / Value of all spareparts (%)

The value of insurance items/risk parts as a percentage of the total value of spare parts in inventory.

For calculation of this indicator following questions should be used:

- Value of all inventory:

What was the average value (in Euros) of all spare parts and other materials currently in inventory?

- Value of spare parts inventory insurance items/risk parts:

What was the average value of spare parts (in Euros) currently in inventory that are insurance items/risk parts?

20. Inventory turnover (number)

The total value of all materials purchased divided by the average value of the inventory.

For calculation of this indicator following questions should be used:

- Value of all inventory:

What was the average value (in Euros) of all spare parts and other materials currently in inventory?

- Purchase volume technical materials:

What is the total value of all purchase orders for technical materials?

The analysis of the technical part of maintenance activities is not the objective of this research, but it is very important to keep these performance indicators in mind. It gives us understanding of maintenance activities and performance measurements of maintenance activities.

The reason, that the technical part of maintenance activities is outside of the scope of this research, is that the information is very difficult to gather from the plants and this information is very different for all plants and can not be compared. It is impossible to choose the best practice from this information, but it is important to know at the locations this sort of information for the control function of the maintenance activities. It helps manage maintenance organization and improve maintenance activities.

## **Appendix 3. Analysis and evaluation of current situation**

### **3.1. Deventer (NL, Chemicals, Polymer Chemicals)**

#### **3.1.1. Background information**

Akzo Nobel Polymer Chemicals holds worldwide leading positions in the production, handling and supply of organic peroxides, metal alkyls, organometallic specialties, as well as anti-fouling and suspending agents. These products are used primarily in the production of thermoplastic and thermoset plastic materials but also have various other applications. Polymer Chemicals also supplies customers throughout the world with polymer additives and high purity metalorganics.

Production location Deventer represents Polymer Chemicals BU in our research.

#### **3.1.2. Why, which and how the maintenance activities are outsourced/contracted out?**

*Why maintenance activities are outsourced / contracted out?*

The main reason to contracting out maintenance activities was the need to get more special knowledge, which own people don't have. The cost savings was also important factor in this decision.

*Which maintenance activities are outsourced / contracted out?*

Primary activities are not outsourced.

Primary maintenance activities which are outsourced:

Special equipment/installations, which have a guarantee from supplier, require a special knowledge for maintaining activities.

The same reason is for outsourcing non-primary activities, such as energy installations, ventilation etc. This can be secondary, tertiary and quaternary activities.

All preventive maintenance also has been outsourced, because you can plan it before and there is no need to develop a special knowledge in house for this kind of activities.

The proactive and corrective maintenance activities are not outsourced. The own maintenance personnel is responsible to achieve the optimal level of performance. Therefore the program for developing demand organization is started up. This program means that maintenance organization has to avoid unnecessary maintenance activities and try to get new view on planning maintenance activities. This new view on planning maintenance activities has to be organized in efficient way and not just follow the routine way of doing things, because they always have been done in this way.

Also important to mention, that control function is not going to be outsourced. The reason therefore is that this is the part of internal knowledge which has to be stay within the organization. This concerns not only the control function, but also planning function and analytical function. This creates an internal demand organization for total productive maintenance (TPM). As a consequence hereby is a shift from corrective maintenance to the preventive and proactive.

The following quaternary maintenance activities are outsourced: catering, cleaning, sewer, carpenter and gardening.

*How maintenance activities are outsourced / contracted out?*

There are a guarantee contracts for the special equipment / installations.

For the preventive maintenance and maintenance for the special equipment / installations, which has not a guarantee terms, are contracts settled for the delivered performance. In this

contracts have been used fixed prices for unit trades. So suppliers have to deliver a quality on the expected level. In other words supplier has to develop their own optimal strategy, to deliver expected performance for fixed settled price.

The suppliers for the preventive maintenance have been chosen on the competitive base. There are mostly long-term contracts and it is necessary to build long term relationship based on the mutual trust. The delivered performance has to be checked and controlled through the performance indicators. If it is not possible to control performance of maintenance activity, then it can be the reason not to outsource it.

According to the Figure 9 this plant can be placed in two quadrants: totally managed maintenance and specialist equipment maintenance. Both of this quadrants show high ability to relate asset performance to maintenance effectiveness. That is very important to know, because it means that maintenance is effective and outsourcing process is optimal organized. That is a good balance between outsourced/contracted out and in house activities at this location.

This analysis explained us which 47% of maintenance activities are outsourced/contracted out and which 53% are in house. This insight gives us understanding why and which activities contracted out and what can be improved. With this knowledge we can better compare different locations and the way how maintenance is organized and performed (internal/external).



## **3.2. Sassenheim (NL, Coatings, Performance Coatings, Decorative paints)**

### **3.2.1. Background information**

#### **Performance Coatings. Car Refinishes**

Car Refinishes business is a leading supplier of paints and services to car repair, commercial vehicle and automotive plastics markets around the world.

The brands include Lesonal®, Dynacoat® and Sikkens®, an innovative, top-of-the-range brand for commercial vehicles. Distributors, bodyshops, fleet owners and producers all choose Akzo Nobel because we treat our customers as partners.

With operations in more than 60 countries, you can count on Akzo Nobel for outstanding customer service and reliable deliveries. It offers also top-notch training, full technical and logistical support, and detailed local knowledge practically anywhere in the world.

#### **Decorative Paints**

Akzo Nobel is the world's leading decorative paint company, home to famous names like Sikkens, Dulux and Hammerite.

Akzo Nobel provides a full range of coatings for interior and exterior decoration of houses in most continents throughout the world for both the professional and the DIY market. In addition, we offer a whole range of services from mixing machines to color consultation and training courses for the applicators as well as color concepts and color tools as the color fans for the consumers.

### **3.2.2. Why, which and how the maintenance activities are outsourced/contracted out?**

*Why maintenance activities are outsourced / contracted out?*

The main reason to contracting out maintenance activities was the need to get more special knowledge, which own people don't have. The cost savings was also important factor in this decision.

*Which maintenance activities are outsourced / contracted out?*

Primary maintenance activities are not outsourced.

Primary activities which are outsourced:

Special equipment/installations, which have a guarantee from supplier, require a special knowledge for maintaining activities.

All preventive maintenance has been outsourced, because you can plan it before and there is no need to develop a special knowledge in house for this kind of activities.

The proactive and corrective maintenance activities are not outsourced.

Corrective maintenance in general is to be carried out on short notice, requires proper communication with problem environment and requires adequate knowledge and experience with the technical content, process environment. So outsourcing of corrective maintenance will not be effective and that is why is not outsourced.

The own maintenance personnel is responsible to achieve the optimal level of performance. Therefore the program for developing demand organization is started up. This program means that maintenance organization has to avoid unnecessary maintenance activities and try to get new view on planning maintenance activities. This new view on planning maintenance activities has to be organized in efficient way and not just follow the routine way of doing things, because they always have been done in this way.

Non primary activities are mostly outsourced, but some of them still performed in house. Hereby we mean maintenance activities, such as secondary and tertiary (internal transport, ventilation). Also some of the quaternary activities have been done internally, such as maintenance of buildings. This has the reason that coatings processes performed in buildings and it can be defined as core business.

The big part of the facility management is outsourced. This kind of maintenance activities is easier to control.

The policy of the site is to outsource only when it can be better and cheaper done by external party. Otherwise it has to be done in house. Also not all suppliers can deliver required quality.

Also important to mention, that control function is not going to be outsourced. The reason therefore is that this is the part of internal knowledge which has to be stay within the organization. This concerns not only the control function, but also planning function en analytical function. This creates an internal demand organization for total productive maintenance (TPM). As a consequence hereby is a shift from corrective maintenance to the preventive and proactive.

#### *How maintenance activities are outsourced / contracted out?*

There are a guarantee contracts for the special equipment / installations.

For the preventive maintenance and maintenance for the special equipment / installations, which has not a guarantee terms, are contracts settled for the delivered performance. In this contracts have been used fixed prices for unit trades. So suppliers have to deliver a quality on the expected level. In other words supplier has to develop their own optimal strategy, to deliver expected performance for fixed settled price.

The suppliers for the preventive maintenance have been chosen on the competitive base. There are mostly long-term contracts and it is necessary to build long term relationship based on the mutual trust. The delivered performance has to be checked and controlled through the performance indicators. If it is not possible to control performance of maintenance activity, then it can be the reason not to outsource it.

The most often excuses, which is used by suppliers, are technology and operations. They using them as a points why they can not deliver required performance, because of dynamic environment you can't fix the performance indicators and that is why is difficult to measure it.

According to the Figure 9 this plant can be placed in two quadrants: totally managed maintenance and specialist equipment maintenance. Both of this quadrants show high ability to relate asset performance to maintenance effectiveness. That is very important to know, because it means that maintenance is effective and outsourcing process is optimal organized. That is a good balance between outsourced/contracted out and in house activities at this location.

This analysis explained us which 39% of maintenance activities are outsourced/contracted out and which 61% are in house. This insight gives us understanding why and which activities contracted out and what can be improved. With this knowledge we can better compare different locations and the way how maintenance is organized and performed (internal/external).

### **3.3. Delfzijl (NL, Chemicals, Base Chemicals)**

#### **3.3.1. Background information**

Delfzijl site locates several plants of Salt, Energy and Base Chemicals. Akzo Nobel produces salt, energy, chlorine and chlorine derivatives for numerous industrial applications.

The production facilities are part of the Delfzijl Chemical Park, a sustainable, dynamic and self-supporting cluster with, besides Akzo Nobel, companies such as Brunner Mond, BioMethanol Chemie Nederland, Noveon, Stork and Teijin Twaron.

The common ground for the whole Delfzijl Chemical Park lies in the extraction of durably available raw materials such as salt and natural gas. This common basis is transformed into, for example, chlorine, hydrogen, caustic soda, sodium hypochlorite and (bio)methanol. These products form the basis for numerous high grade solutions and applications for industrial customers in foodstuffs, pharmacy, plastics, cosmetics, detergents, paper and textiles.

#### **3.3.2. Why, which and how the maintenance activities are outsourced/contracted out?**

*Why maintenance activities are outsourced / contracted out?*

The own maintenance organization was too big and expensive. It was sold to the third side "Stork".

*Which maintenance activities are outsourced / contracted out?*

All activities were outsourced.

*How maintenance activities are outsourced / contracted out?*

The maintenance organization was sold to the third party. Less experience in this sort of outsourcing delivered a lot of problems on the operational level and as a consequence losing trust on operational and strategic level. The appointments which have been made were not followed.

The changing situation on the site delivered a lot of problems with measuring of the performance indicators. As a consequence the insourcing process takes place.

The control function is now insourced. Personnel try to settle the demand organization and in this way try to optimize work of the third party.

Also for the corrective maintenance new people are now educated. As practice was showed people for the corrective maintenance has to be kept in house.

Suppliers were not ready to give a good performance and that is also very difficult to set everything in the contract. This is new plant and all changing processes take place, so it is not possible to set all performance measurement in contract and as a consequence to control them.

*Which mistakes were made in the outsourcing process?*

Both sides were not ready for this sort of cooperation. On paper sometimes it looks better than in reality.

- The performance measurements were not properly developed and settled in the contract.
- The people, who were taken from Akzo Nobel, went away to other companies and as a consequence Akzo Nobel loose people with environmental knowledge (knowledge of plants). The people with knowledge and experience were setting to work for other companies and for Akzo Nobel work not enough competent people.
- It was less cooperation between different sides. Also the process of coworking for improving maintenance process was not efficient.
- To educate new people with this specific environmental knowledge takes 3-4 years.
- Supplier was chosen not because it was the best in this class, but because it was big enough to buy Akzo Nobel maintenance organization

### **3.4. Bohus, Sweden (Sweden, Pulp and Paper Chemicals, EKA)**

#### **3.4.1. Background information**

Eka Chemicals is a business unit within Akzo Nobel and a leading supplier of bleaching chemicals, paper chemicals and systems to the pulp and paper industry throughout the world, and supplies certain special chemicals to the pharmaceuticals industry, water treatment, the electronics industry etc.

Eka has a presence in everyday life that most people are unaware of. The range of goods made with paper is enormous, and the range of products made with the help of chemicals from Eka is equally extensive. Papers, juice boxes, tea bags, money, matches are some examples.

#### **3.4.2. Why, which and how the maintenance activities are outsourced/contracted out?**

*Why maintenance activities are outsourced / contracted out?*

The maintenance organization was sold to the third party. The reason hereof was the fact of closing chlor plant on the site. So own maintenance organization was too big for the left plants.

*Which maintenance activities are outsourced / contracted out?*

All activities were outsourced.

*How maintenance activities are outsourced / contracted out?*

The maintenance organization with personnel was sold to the third party. In begin some mistakes were made, e.g. there were limited organizations resources, the control function was not effective. Later on it was changed. The long term contracts were signed. The control function stays within AN.

The demand organization was developed and the modification of maintenance activities was made, e.g. segmentation in maintenance activities, small projects and investments. The small projects and investments is always a grey area.

There were developed "gate keeping system" for maintenance managers. There are "gate keepers" by production, facility and maintenance managers as well. They should decide of the activity is maintenance activity or investment. If this is a maintenance activity then it has to be decided of is it need to do it now or later on. "Gate keepers" give a clear task formulation which is developed in the work order (more detailed on operational level).

In the contracts with suppliers the demand for the same people should work at the plant, who were working on the plant before, is fixed. This guaranteed the keeping of the environmental knowledge.

Every year KPI are revised. It means that you can bring new details in contract if something is changed.

There is an "umbrella contract" for the location signed and there are subcontracts for the production units.

There is always a renegotiation with suppliers and discussing contracts on the details level and they have to compete for the contract.

There are two contracts: mechanical and for facility management. There are different on their nature, because there are different attitudes at the base of the activities. There is only segmentation in the primary and quaternary maintenance activities. The split in the secondary and tertiary maintenance activities is not made, because of difficulties in this segmentation.

There is also a overall steering committee for revising contracts. This group analysed the contracts 3-4 times a year.

Suppliers see a lot of changes in the organization and changing also their attitudes. They became more responsible in delivering better performance.

This changing in the maintenance organization and setting demand organization comes back in the cost savings, approximately 1,6 million euro.

### **3.5. Duren (Germany, Pulp and Paper Chemicals, EKA)**

#### **3.5.1. Background information**

Eka Chemicals is a business unit within Akzo Nobel and a leading supplier of bleaching chemicals, paper chemicals and systems to the pulp and paper industry throughout the world, and supplies certain special chemicals to the pharmaceuticals industry, water treatment, the electronics industry etc.

Eka has a presence in everyday life that most people are unaware of. The range of goods made with paper is enormous, and the range of products made with the help of chemicals from Eka is equally extensive. Papers, juice boxes, tea bags, money, matches are some examples.

#### **3.5.2. Why, which and how the maintenance activities are outsourced/contracted out?**

*Why maintenance activities are outsourced / contracted out?*

To create more knowledge and more effective cost structure, maintenance organization was sold to the third party.

Effective cost structure:

In Germany there are different tariffs for people, who work in the chemical plant and for people who works for technical services. So the saving costs were about 10-20%. That was the main reason to outsource maintenance organization.

Also the possibility to get extra knowledge and experience was the reason to outsource maintenance organization.

*Which maintenance activities are outsourced / contracted out?*

All maintenance activities are outsourced.

*How maintenance activities are outsourced / contracted out?*

The contracts included all details. The guarantee of keeping environmental knowledge (the same people have to work at the plant as before) was included.

The control function was kept by Akzo Nobel. This is provided through production, facility and purchasing department's managers. So it gives possibility to analyse the work orders and necessity of them.

Also it helps to make a split between maintenance operations, projects and investments. The close cooperation of this departments increase efficiency of the maintenance operations. The performance indicators help to execute the control function.

The cooperation of the maintenance engineers and suppliers give possibility to optimize maintenance organization.

## **Appendix 4. External benchmarking (ICI and DSM)**

### **4.1. ICI**

#### **4.1.1. Background information**

ICI is now part of Akzo Nobel, the world's largest coatings manufacturer, the number one in decorative paints and performance coatings, and a leading supplier of specialty chemicals.

ICI products today include specialty polymers for personal care products, adhesives for the electronics and packaging markets as well as a wide range of decorative coatings and specialty products for domestic use and the construction industry. ICI is a member of the FTSE100, FTSE4Good and the Dow Jones Sustainability Index. ICI is now part of a coatings and chemicals Group employing about 43,000 people in more than 80 countries.

ICI Paints has some of the world's top paint and decorative product brands. It aims to inspire consumers to transform their surroundings at home and work with performance and colour. The business makes products to prepare and care for many building materials and provides coatings for cans and packaging.

ICI Paints is headquartered in the UK with manufacturing in 24 countries. National Starch and Chemical Company markets an extensive product range in sectors as diverse as food, healthcare and construction. Four main divisions are grouped around adhesives, specialty starches, specialty synthetic polymers, and electronic materials. National Starch is headquartered in the USA, with manufacturing and customer service centres in 39 countries.

ICI's Regional and Industrial businesses, mainly in Argentina, India and Pakistan, are essentially local in their scope. Products include pure terephthalic acid, polyester, sulphur-related chemicals, wine additives, soda ash, pharmaceuticals and specialty products. Also within the Regional and Industrial businesses is UK-based ICI Imagedata, one of the few businesses in the world manufacturing consumables for thermal dye-sublimation, electro-photographic and inkjet printing technologies.

#### **4.1.2. Maintenance organization at ICI, USA**

##### *Policy for maintenance activities*

The maintenance activities are the core competence for ICI. These activities give a competitive advantage and that is why their "should" be kept in house. All skills and competencies for performing maintenance activities are important and have to be developed in the company.

##### *Which activities are outsourced?*

The logistic services are outsourced, because own people could not guarantee the quality and efficiency, especially with inventories.

Maintenance activities for special equipment contracted out, because it requires a special knowledge which is not available in house.

As consequence of the maintenance policy is 90% of maintenance activities are keeping in house and just 10% is outsourced.

##### *Maintenance organization*

The maintenance organization is quite big at the locations, because for each special activity is one specialist is available, e.g. for pump's maintenance is a pump specialist available and for maintenance of other type installation is another specialist available.

This type of organization is inefficient and expensive. This happens because the level of education and motivation is low. The maintenance philosophy is reactive and this should be changed.

##### *Is outsourcing an option?*

The outsourcing as an option is not really available, because there are not enough firms who can deliver these services and the firms which are available can not deliver good performance. The reason of this situation is that there is no demand for such organizations.

On the other hand, the policy of the organization about possibility to outsource maintenance activities is open only for non – primary maintenance activities. This can be done only when suppliers can guarantee good performance. Primary maintenance activities should be always kept in house, because they require a special environmental knowledge and that can be created only through long-term relationship.

Also there are no fixed procedures for maintenance activities. So it makes a control function difficult. The performance indicators for result measuring are not available and it makes the possibility for outsourcing not realistic.

*So as a conclusion we can say that maintenance organization at ICI is not efficient and there are a lot of possibilities to improve it. Also implementation of the TPM program can help to improve processes and make a shift to preventive and predictive maintenance possible. There is important for ICI to develop demand organization. This will help also to improve efficiency of the maintenance organization.*

## **4.2. DSM**

### **4.2.1. DSM. Background information**

Royal DSM N.V. creates innovative products and services in Life Sciences and Materials Sciences that contribute to the quality of life. DSM's products and services are used globally in a wide range of markets and applications, supporting a healthier, more sustainable and more enjoyable way of life. End markets include human and animal nutrition and health, personal care, pharmaceuticals, automotive, coatings and paint, electrics and electronics, life protection and housing. DSM has annual sales of almost EUR 8.8 billion and employs some 23,000 people worldwide. The company is headquartered in the Netherlands, with locations on five continents. DSM is listed on Euronext Amsterdam.

The activities of DSM are grouped into five clusters: Nutrition, Pharma, Performance Materials, Polymer Intermediates and Base Chemicals and Materials.

#### *Nutrition*

The Nutrition cluster comprises DSM Nutritional Products and DSM Food Specialties. The main customers are food, beverages, feed and flavor/fragrance companies across the world. The activities in this cluster are to a large extent based on DSM's in-depth knowledge of biotechnology (including fermentation, genomics and biocatalysis), organic chemistry and formulation technologies and on the company's broad application knowledge. DSM holds leading positions in the markets for ingredients for human and animal nutrition and health and personal care. The groups in this cluster work closely together in marketing and sales, R&D and production facilities among other things.

#### *Pharma*

The Pharma cluster comprises the business groups DSM Pharmaceutical Products and DSM Anti-Infectives. DSM is one of the world's leading independent suppliers to the pharmaceutical industry, with some 40% of today's top-selling medicines in the world containing ingredients developed and produced by DSM.

#### *Performance Materials*

The Performance Materials cluster comprises the business groups DSM Engineering Plastics, DSM Dyneema and DSM Resins. All of these specialize in the manufacture of technologically sophisticated, high-quality products that are tailored to meet customers' performance criteria. The products are used in a wide variety of end-use markets: the automotive industry, the aviation industry, the electrics & electronics industry, the sports and leisure industries, the coatings industry and the construction industry.

#### *Polymer Intermediates*

The Polymer Intermediates cluster consists of DSM Fibre Intermediates. DSM is the global leader in the supply and production technology of caprolactam, the raw material for Nylon-6. We produce on three continents and supply customers all over the world. And DSM Acrylonitrile is one of the leading manufacturers of acrylonitrile.

#### *Base Chemicals and Materials*

The Base Chemicals and Materials cluster comprises the business groups DSM Agro, DSM Elastomers, DSM Melamine and DSM Energy. DSM produces basic materials for plastics and materials, high-grade construction materials for medical applications, cars and electronic appliances. And we are also among the leading producers of fertilizers and related products in Europe.



#### 4.2.2. Maintenance organization at DSM, Netherlands

##### *Policy for maintenance activities*

The primary maintenance activities are core business for DSM. The guideline is to keep them in house. Other maintenance activities can be outsourced and they are mostly already outsourced.

##### *Which activities are outsourced?*

Non primary activities are outsourced approximately at all locations. Only locations which are small and can not get advantage of the economies of scale keep doing it by themselves and locations which were taken over and have another maintenance philosophy also perform the most activities by themselves.

DSM TechnoPartners (Engineering) is gave up. All activities which we performed through this department now contracted out to external party. This was an dangerous step, because now DSM depends a lot in crucial activities, such as designing of new plants, etc.

##### *Maintenance organization*

The maintenance organization is represented by DMC (DSM Manufacturing Centre). This organization represented at multi site in Sittard and serves 15 plants. Other DSM locations in Netherlands are small and have a classic maintenance organization.

DMC collects orders for maintenance activities from these 15 plants and contracted them further to other suppliers. This is outsourcing on operations just on hour tariffs. There is no try to change it to the efficiency side. Suppliers are not allowed to give any improving suggestion, because people at plants know better how to do things and they are not open for leaning new things.

This makes impossible to learn from best practices and improve maintenance organization. As a consequence of this policy is that 70% is corrective / reactive maintenance and only 30% is preventive maintenance.

##### *Is outsourcing an option?*

Outsourcing is an option for non-primary maintenance activities. There are also "all - inclusive" contracts for activities from cleaning, catering to maintenance of buildings. These contracts with one supplier are not cost and quality effective. So DSM tries to revise it now to get more control on the performing indicators.

Also it was a try to outsource maintenance activities which are closed to primary activities, but there were problems on operational level occur. So that is why these activities were insourced.

Also maintenance of R&D laboratories is outsourced. There is a positive experience and they will keep it on long-term base relationship.

*As a conclusion, maintenance organization at DSM is not really efficient. People are not open to get a new knowledge from outside and that is in the situation when approximately all non-primary maintenance activities are outsourced. The maintenance organization is reactive and not predictive. This can create problems in the production and also provide extra costs. There is a good experience with outsourcing of non – primary activities, but to do it through external organ which is a profit centre makes difficult to realize possibilities for improving of maintenance organization. There is now a new program started DSM Manufacturing Excellence, which aims to reduce the cost and time of building and maintaining DSM facilities by 1/3 and to create value by stimulating best manufacturing practices.*

## Appendix 5. Insight in the maintenance activities cost structure by locations Sassenheim and Deventer.

### 5.1. Insight in the cost structure of maintenance activities by location Sassenheim

This cost structure gives insight in the maintenance activities costs. Costs of projects and investments are not in the scope of this cost structure.

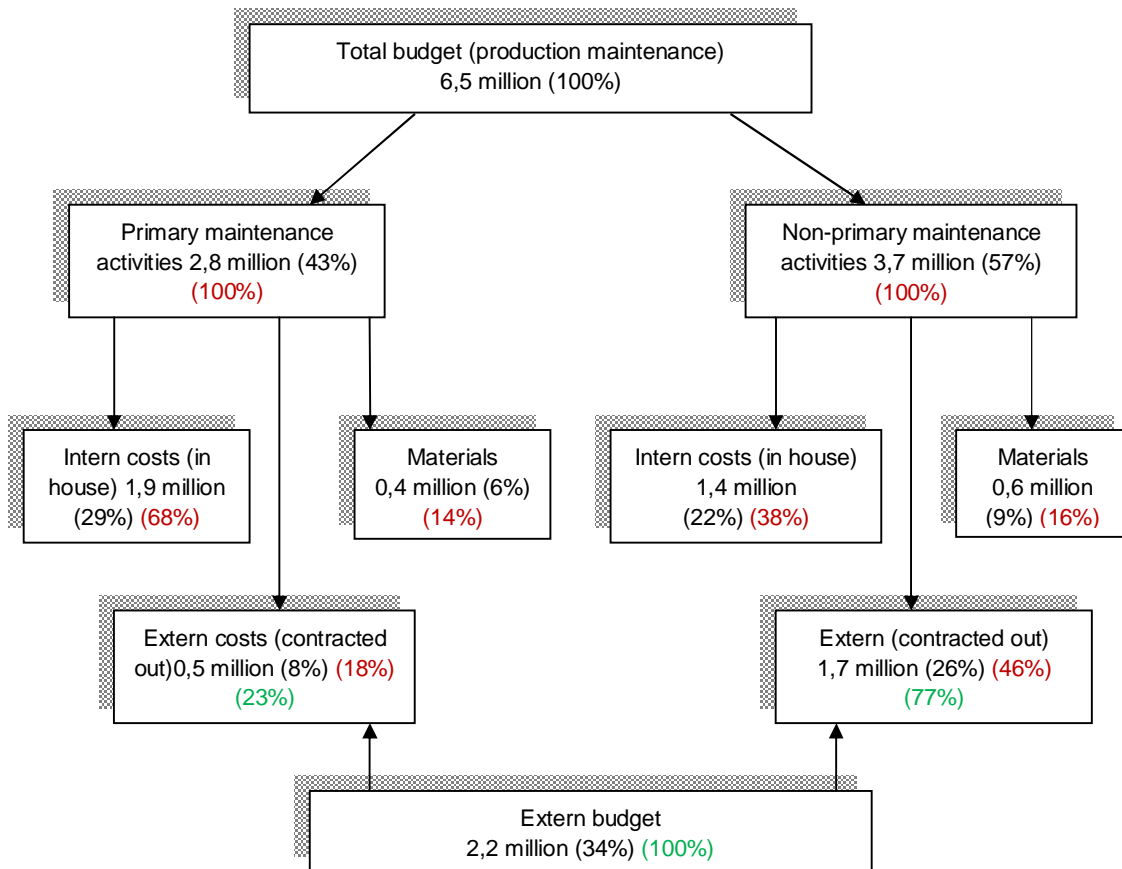


Figure 21. Insight in cost structure of maintenance activities by location Sassenheim

This segmentation in costs between primary and non-primary maintenance activities and in-house or outsourced gives us insight in how budget is spend and what possibilities are for the defining strategy in the decision to outsource or keep in house different types of maintenance activities.

## 5.2. Insight in the cost structure of maintenance activities by location Deventer

This cost structure gives insight in the maintenance activities costs. Costs of projects and investments are not in the scope of this cost structure.

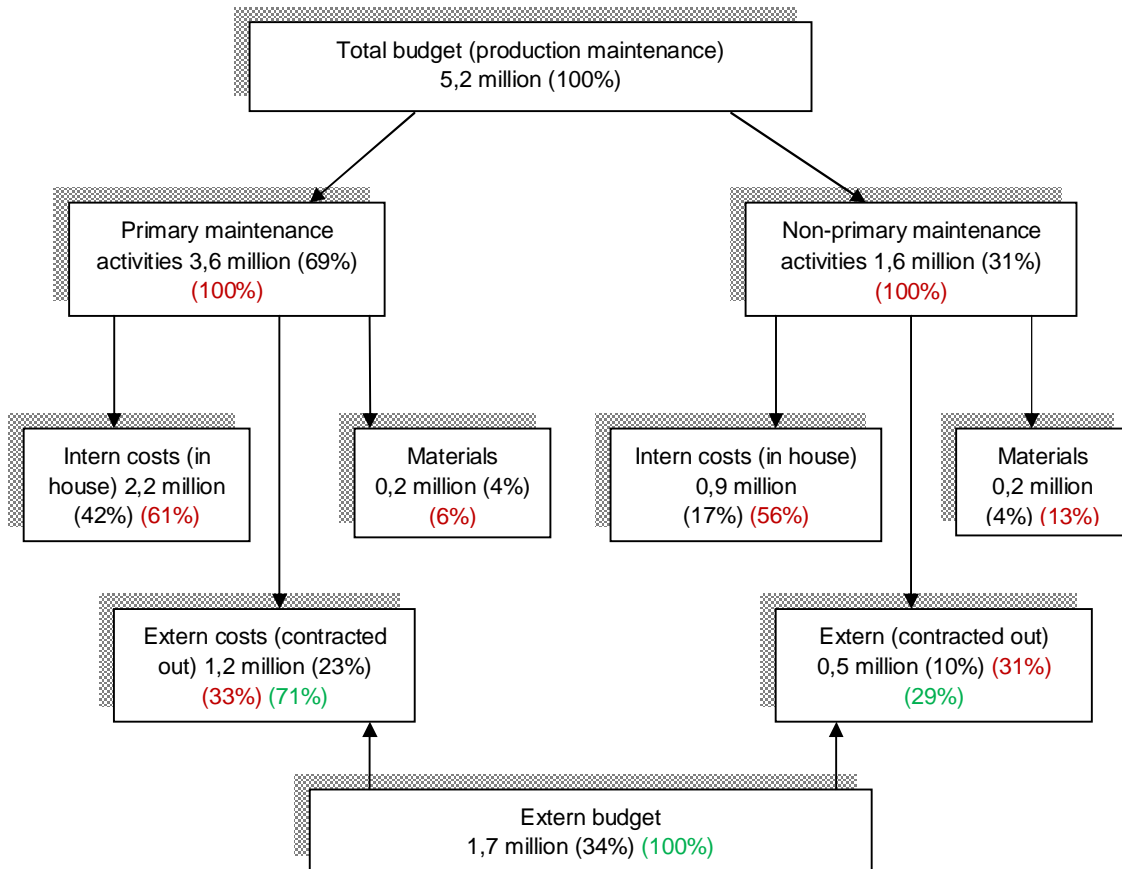


Figure 22. Insight in cost structure of maintenance activities by location Deventer

This segmentation in costs between primary and non-primary maintenance activities and in – in house or outsourced gives us insight in how budget is spend and what possibilities are for the defining strategy in the decision to outsource or keep in house different types of maintenance activities.

*If we look at the segmentation of costs by these two locations, which represent Coatings and Chemicals, then we can see some differences. First of all, the budget for primary maintenance activities is bigger by Chemicals (69%) then by Coatings (43%). By Chemicals is more primary activities contracted out then by Coatings. There are also differences occurs at the segmentation of costs by non primary maintenance activities, e.g. by Coatings (46%) is more contracted out then by Chemicals (31%). So the biggest part of extern costs by Coatings goes to non primary activities and by Chemicals is vice-versa. This can show us the differences in the locations or may be in segments Coatings and Chemicals. For this conclusion two locations are not enough, but they let us thinking about this segmentation. The reason is that after interviews with maintenance and purchasing managers and also suppliers we made a conclusion that non primary activities will be more contracted out and primary maintenance activities will be kept in house. These examples show us that may be this conclusion can be corrected with relation to different segments Coatings and Chemicals. This correction can be made after further research in the trend developing in which type of maintenance activities are going to be contracted out and which type of maintenance activities will be kept in house.*

## Appendix 6. Questionnaire

On the base of this questionnaire we will gather the information for our research.

1. Business Unit
2. Number of employees
3. Why maintenance activities outsourced/contracted out?
4. Which maintenance activities outsourced/contracted out?
5. How maintenance activities outsourced/contracted out?
6. What are experiences of outsourcing/contracting out maintenance activities?
7. What are the possibilities to improve outsourcing process?
8. How detailed is the contract with the suppliers?
9. What percentage of all technical services on site is currently contracted?
10. Annual contracted technical services budget
11. Annual maintenance budget
12. Maintenance organization
13. Maintenance philosophy. What is the maintenance philosophy on corrective versus preventive maintenance?
14. Please elaborate on your strategic point of view regarding contracted technical services?
15. What is the future outlook for maintenance activities?
16. Four levels of contracted services have been identified (Operations, Efficiency, Effectiveness, Asset management). How would you characterize your current level and future level of contracted technical services?