The role of supplier competition in the product life cycle

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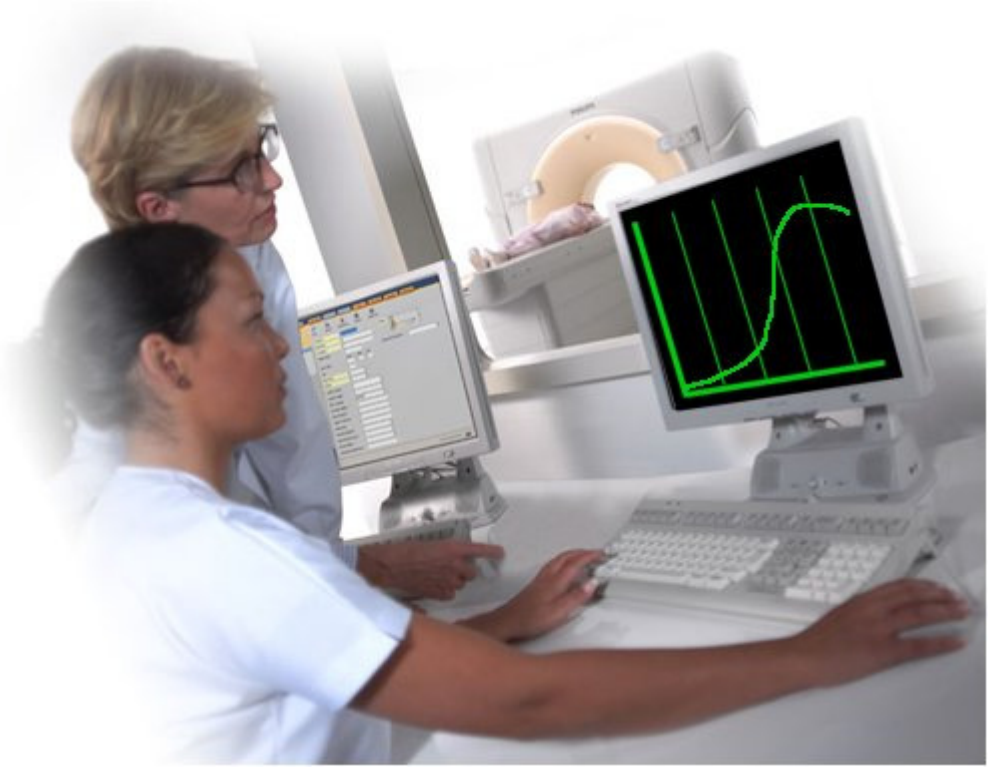

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Confidential

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Abstract

This report describes an exploratory study into the role of supplier competition in the product life cycle. Based on a literature review, interviews, and case studies, the theoretical and practical view on this subject is investigated. Conditions of the application of supplier competition are described for different forms of supplier competition in different stages of the product life cycle. Recommendations are given to Philips Medical Systems to improve and structure the use of supplier competition in the different stages of the product life cycle.

Preface

This report represents the master thesis of my study Industrial Engineering and Management Science, Eindhoven University of Technology. This report is the result of a nine months research into the role of supplier competition in the different stages of the product life cycle at Philips Medical Systems.

During my project there are several people who supported me in different ways. I want to thank everyone who contributed to this research.

I would like to thank my supervisors of the Eindhoven University of Technology for the support they gave me. First, Prof. Dr. A.J. van Weele for his knowledge input and willingness to help during the whole project, and second, Dr. ir. V.A. Gilsing for his useful feedback during the second period of the graduation period.

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Furthermore, I would like to thank the people of PMS who gave me the opportunity to execute my master thesis at PMS, and the people of the Purchasing department, who were interested in my project and were willing to help.

Finally, I would like to thank Fabian, my family and friends, for the patience, encouragement and support they gave me during the whole project.

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Management Summary

As a result of an increasing price erosion in the past years, PMS has to lower their prices, and cost reduction methods have to be used. The Purchasing department is responsible for, among others, the supplier selection of mostly custom made products. If more suppliers are available on the supply market to produce the demanded product, competition between suppliers exists. Based on positive supplier competition experiences in the past, the need to get more insight into the application of supplier competition at the Purchasing department is desired. The purchasing focus differs per stage of the product life cycle (PLC), and therefore the role of supplier competition varies for the different stages of the PLC.

Several research questions are formulated to give more insight into the application of supplier competition in the different stages of the PLC, and to give recommendations to optimize the current situation at the Purchasing department.

The **central question** can be formulated as:

What is the role of supplier competition in the different stages of the product life cycle at the PMS Purchasing department and how can this role be optimized?

The central question can be split into the next sub-questions:

1. Which roles of sourcing strategies in the different stages of the product life cycle are described in literature?
2. Which roles of supplier competition in the different stages of the product life cycle are described in literature?
3. What is the current role of supplier competition in the different stages of the product life cycle at the PMS Purchasing department?
4. What actions have to be taken by the PMS Purchasing department to make an optimal use of supplier competition and on which conditions?

In this exploratory research the theoretical background is investigated, interviews are performed, and three cases are examined. The execution of a within case analysis and a cross case analysis enables linking the theory with practice. Finally, conclusions and recommendations are given.

The aim of the theoretical background is to link sourcing strategies and the PLC. It can be concluded from research, that purchasing executives allocate most sourcing strategies to the growth stage. This is a result of the increasing demand for products, need for flexible production, synchronized and reliable product flow, quick response time, product quality and process innovation in this stage. Only one sourcing strategy is allocated to the decline stage. There is no sufficient focus on this stage. Several opportunities and challenges are found for the decline stage, like product renewal and product abandonment.

The link between supplier competition and the PLC is not described in literature. A supplier competition framework is set up to have a point of departure for the analysis of the current situation at the Purchasing department (see figure 4.10). The products can be positioned in the physical good – service continuum, depending on the degree of service integrated in the product. The position in the physical good – service continuum comes with different levels of supplier's knowledge, trust, supplier integration, and organization's involvement.

Different forms of supplier competition are distinguished. The supplier competition on price involves simple products available off the shelf with standardized quality. Supplier competition on total cost of ownership (TCO) comes with a mix of a physical good and a service. The supplier competition is not only on the purchase price of the product, but involves all the costs during the life of a product, including purchase price, acquisition costs, usage costs, and end-of-life costs. The supplier competition on value concerns products with a high level of service. The supplier competition is about the total solution and the unique knowledge contribution, rather than only price.

Four methods of supplier competition are distinguished; RFx, e-auction, design-in workshop, and threat. RFx and threat can be used independently of the position of the product in the physical good – service continuum. E-auction is used for the more simple products, and the design-in workshop for more complicated and customized products.

Three case studies, with the involvement of the Purchasing department, are executed to link literature with practice. The within case analysis is executed where the cases are discussed one by one to become familiar with each case. The cross case analysis is executed to compare the cases on different factors. From the three case studies can be concluded that the supplier competition framework is comparable with practice, except the application of the form of supplier competition. Lower service contribution comes not only with supplier competition on price, but is preceded by a thorough process of supplier selection. In two cases, the form of supplier competition was expected to be on TCO. However, the supplier competition of these products with a higher degree of service were based on price in one case, and on delivery time of the first prototype in the other case. The trade-off between different factors is not performed, and risks are not considered.

If the findings of the theoretical background are combined with the findings of the case studies, it can be concluded that the development and the maturity stage of the PLC seem the most appropriate stages to apply supplier competition for PMS. Supplier competition can be applied in the development stage, because a new supplier has to be selected. It is important to have a roadmap with the planned actions for the life cycle. If the roadmap is communicated with the supplier, it can prepare on future events. In the maturity stage, supplier competition can be applied, because cost reduction is necessary. The demand is stable and competitive pressure is high. An overview of conditions is given per form of supplier competition in the development and the maturity stage (paragraph 5.3.6). If this list of conditions is checked, a well-considered choice can be made if supplier competition can be applied. The conditions are divided in operational conditions or conditions that can be influenced, and strategic conditions or conditions that cannot be

influenced. The conditions are based on the findings of the case studies and on interviews.

The recommendations are given based on the factors noticed during the case studies and interviews. These recommendations represent actions for the Purchasing department towards an optimal use of supplier competition. A complete list of recommendations is found in section 6.4. Here only a selection of the recommendations are outlined.

- Take time to perform the supplier competition process.
- Develop a roadmap in the development stage of the PLC about future plans, concerning the product's life time and product versions, sourcing (dual sourcing, supplier transfer during product's life time), service, and etcetera. Communicate this with the supplier and internal organization to prepare on future changes.
- Be clear to suppliers about the competitive supply market from the moment of supplier involvement to maximize the supplier competition.
- Be consequent to suppliers about the supplier selection process and make one way of working. Give suppliers the same information and communicate that the supplier only has one chance to offer to prevent non-optimal offers. One person who is responsible for the communication with the suppliers concerning the methods is conductive to the efficiency of working and clearness.
- Claim resources for the implementation already during the supplier competition process to assure a quick implementation process.
- Use the tool developed, including a list of conditions and a process flow, to make a considered choice whether to apply supplier competition or not. The list of conditions is described in paragraph 5.3.6, and the flow diagram with explanation is described in appendix 14. Consider the risks and opportunities with using supplier competition.
- Match the goal of the application of supplier competition with the method of supplier competition. An e-auction on price is useless if a better quality is desired.
- Make one format for supplier offers. This enables PMS to compare the offers efficiently, because the offers contain exactly the same information. If information is missing, it can directly be seen.
- Use benchmarking during all stages of the PLC. Although not all stages are appropriate to apply supplier competition, the sharpness of suppliers can be increased. Using cost modeling gives insight into the costs. Also during the application of supplier competition, cost modeling is a method to control costs.

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1 Research Plan

In this chapter the research plan is explained. First the project background is described. Then the problem definition and the research questions are given. Section 1.3 deals with the research approach used to be able to answer the research questions. It presents the framework that is used as a guideline throughout this report, and a description of the sources of information used in this report; literature review, interviews and case studies. The chapter ends with the structure of this report.

1.1 Project Background

Philips Medical Systems (PMS) is a global leader in diagnostic imaging systems, healthcare information technology solutions, and patient monitoring and cardiac devices. The current competitive environment is forcing Philips Medical Systems (PMS) to find the right strategies to stay one of the best players in the market. In the past years, PMS could sell their products with high margins and there was no need to reduce the prices. In recent years, an increasing price erosion has emerged. This is a consequence of among others the growing competition, the customer who wants the same for less money or more features for the same money, and the budgetary problems in healthcare. As a result of the increasing price erosion, PMS is forced to use methods to achieve cost reduction, for example value engineering or better production efficiency at lower costs.

The medical systems of PMS contain different parts and components. Most parts and components needed for the production of medical systems have specific designs with specific technological features. PMS used to design and produce all the products and components itself. Nowadays, activities that do not belong to the core competence of PMS are outsourced to other parties who are specialized in these activities at lower costs. The parts and components supplied by these parties are mostly fully custom made for Philips, because the designs are specific to perfectly fit the systems. Only a few companies in the world are specialized on these technologies and therefore a strong relationship with the supplier is considered necessary. Besides specific products, also standard parts and components are used. Several suppliers are able to supply these standard parts and components from their catalogue.

The purchasing department is, among others, responsible for the supplier selection and supplier relationships. This department has to choose the right and best supplier for the needed parts and components. For complicated parts, the focus is on quality and total costs of purchasing and maintaining the parts. The supplier selection should be based on the trade-off between price and quality. Partnerships between PMS and suppliers are common for these complicated parts. For simple parts and components, many suppliers are available on the supply market and the components have a standard quality. The focus should be mainly on price.

If more suppliers are available, competition between suppliers exists. This competition can be based on price, but also on quality, innovativeness, and more of these factors. The bargaining power of PMS increases if a supply market is larger. Suppliers are competing to be the cheapest and the best supplier in order to get the business instead of their competitors. For the purchasing department, supplier competition might be a useful concept to achieve cost reduction and to get the best quality. Recently, some large cost savings have been achieved at the purchasing department by using supplier competition. With these examples in mind, there might be possibilities to increase the use of supplier competition in a structured way.

1.2 Problem definition and research question

The purchasing department is aware of the competitive environment and the need for the best suppliers. It is not easy to cut costs for the supplied parts and components. The suppliers often insist on the current price, because the suppliers face with rising material prices and want to keep their margin. The use of supplier competition can change this resoluteness.

A lot of products have been purchased for years at the same supplier if the supplier's performance was acceptable. Medical devices of PMS have a long life cycle and after sales service has to be done till ten years after the product's sale. In the beginning of the life cycle a choice for one supplier has been made and mostly this supplier relation lasts for the total life of the product including the service time. In the past, there was no need for looking for other suitable suppliers, because the margins of PMS were high and the cost savings targets were met automatically. Only a detailed supplier selection procedure was done when PMS decided to introduce a new product or to leave a supplier as a result of bad performance. When the price erosion increased, purchasers negotiated with the suppliers to achieve cost reduction. Then, suppliers wanted to lower their prices with about 2%. This was not enough to cover the price erosion of PMS that rises up to 6%, so other methods must be used to achieve cost reduction.

Lately, the purchasing department tried to bring in some supplier competition to gain lower prices. Suitable suppliers, who were able to produce the specific products, were asked to make a request for quotation (RFQ). An RFQ is a request for bids on a specific product or service. This typically includes price, basic corporate information, financial information and product specific information. Already by confronting the existing supplier with the possibility to switch to another supplier, the existing supplier lowered its price. Apparently, the information from other competitors is very helpful in cost reduction negotiations with existing suppliers.

The role of supplier competition might be different in the different stages of the product life cycle (PLC). During the life time of a product the focus of purchasing can change due to the changes of the product position. In the development stage of the PLC it is important to be innovative and have a short time-to-market. In later stages of the PLC the volumes will increase and cost reduction is more important. Different sourcing strategies

can be effective in the different stages of the PLC (Birou et al., 1997) as well as the application of supplier competition.

The current problem is that the purchasing department has no good insight into the role of supplier competition in the different stages of the PLC and no clear plan is available about when and how to use supplier competition. It is not clear what the consequences are of the use of supplier competition. Of course the business requirements have to be met, meaning that for example the delivery of products has to be reliable, the processes have to be efficient, the quality has to be excellent (zero defect) and the innovativeness of the products has to be of sufficient level.

Research questions have been formulated and will be answered in this report. The **central question** can be formulated as:

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The central question can be split into the next sub-questions:

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4. What actions have to be taken by the PMS purchasing department to make an optimal use of supplier competition and on which conditions?

1.3 Research Approach

1.3.1 Overall framework

This research aims to identify the role of supplier competition in the PLC of PMS products. The research model that will be used to achieve this goal is given below (figure 1.1). The model is based on the method for structuring research by Verschuren and Doorewaard (1999).

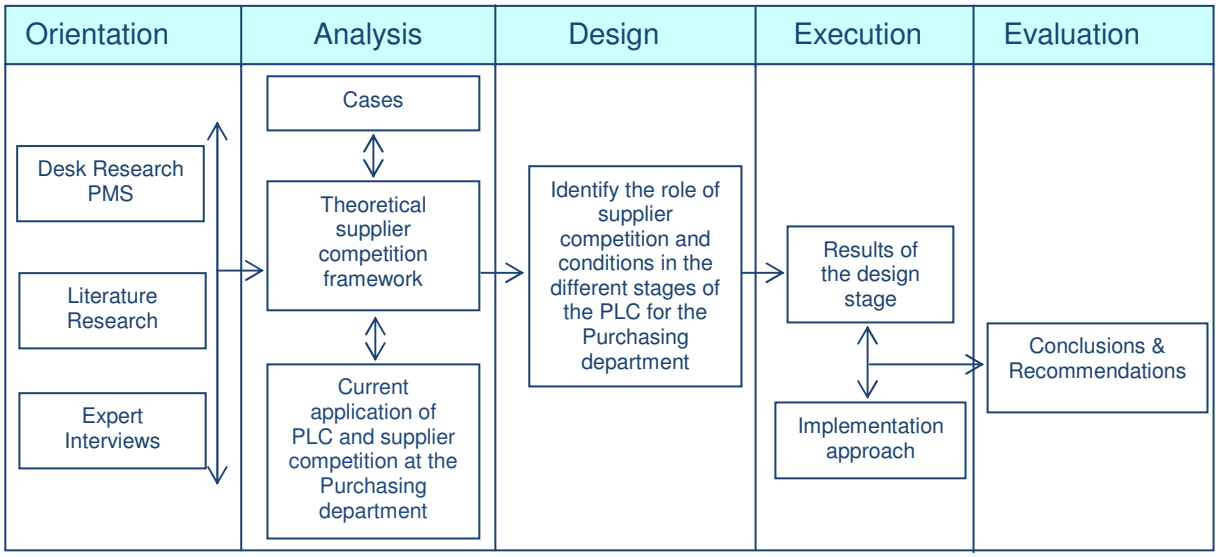


Figure 1.1 Research model

This project is an exploratory research, which means that is looked for patterns and ideas rather than try to test or confirm hypotheses. The research approach that is used to provide an answer on the research questions can be divided into different phases. In the orientation phase, desk research at PMS, literature research and expert interviews are executed to be able to form the supplier competition framework. On the basis of existing literature, a literature review is performed to investigate the role of sourcing strategies in the PLC. In the analysis phase, the current application of supplier competition and PLC is investigated and three case studies are performed. The case studies and the current application of supplier competition can be compared to the supplier competition framework. This results in the identification of the role of supplier competition and the conditions to use supplier competition in the different stages of the PLC for the purchasing department in the design phase. In the execution phase, the results of the design phase are used to make an implementation approach. The conclusions are drawn and recommendations are made about the application of supplier competition in the evaluation phase.

To be able to answer the research questions, different sources of information are used. In the next paragraphs the methods literature review, interviews, and case studies are described.

1.3.2 Literature Review

The literature review aims to get insight into the existing publications about the role of sourcing strategies in the PLC. The PLC theory originated in marketing and Kotler (2002) mentioned that different stages in the PLC need different approaches and strategies of the management and operations. For this project it is relevant to investigate the link between purchasing and the PLC and what sourcing strategies are important to use per stage. This literature can be used as a basis for examining the role of supplier competition in the different stages in the PLC.

Several scientific articles have been used for writing the literature review. In the text of this report is referred to the used publications. At the end of this report a list of references is given. With search engines, like ABI/ Inform and Inspec, relevant literature was searched. Keywords were used, like supplier competition, competitive bidding, sourcing, sourcing strategy, product life cycle and product life cycle management. Through the use of other keywords found in the articles, the searches became more detailed. References in the articles found were used to extend the relevant literature.

Limitations of this literature review include the possible incompleteness of literature about the separate subjects treated. Many authors wrote publications about sourcing, sourcing strategies and the PLC and its use in the marketing and different departments. Due to the limited timeframe and focus it is not possible to treat all these publications. It is tried to include all the existing literature about the link between PLC and purchasing and give a complete overview, but there is a possibility that not all literature about this subject has been found.

1.3.3 Interviews

In this project, the interview is a frequently used method for data collection. By asking questions to people who are related to supplier competition, information about this subject can be obtained. In the orientation phase, the interviews were used as introduction to the problem. In the later phases the interviews were used as a method to gather information about specific subjects involved with supplier competition. Interviews with PMS employees from different departments resulted in more insight into the current role of supplier competition within PMS. Employees of among others purchasing, marketing, development and project management were interviewed to obtain a view from different disciplines within PMS. A few interviews took place outside PMS to get more insight into the application of supplier competition in other industries, like Philips Consumer Electronics, Philips Lighting and ASML. The interviews were semi-structured. A semi-structured interview enables the interviewer to go further in detail dependent on the answers of the respondent. With posing open questions more subjects come up for consideration (Verschuren and Doorewaard, 1999). An interview protocol was set up with broad guidelines and general questions for the interview. For a complete list of interviewees and the interview protocol, see appendix 2.

1.3.4 Case Studies

A case study can be used to get a practical view on a subject. A case study is a research method and used if questions ‘why?’ and ‘how?’ should be answered (Yin, 1994). Eisenhardt (1989) defines a case study as a research strategy, which focuses on understanding the dynamics present within single settings. The goal of the case studies investigated in this project is to get more insight into the practice of why and how supplier competition is used for the supplier selection of different products and what the similarities are with the theoretical supplier framework. Three cases studies are chosen to examine the use of supplier competition for three different products. After a within case analysis, a cross-case analysis is made. The methodology used for the three case studies is further elaborated in section 5.2.1.

1.4 Report structure

After this chapter about the research plan, chapter 2 continues with the project environment. First Royal Philips N.V. is described, followed by a description of PMS, the business environment of PMS and the purchasing department. In chapter 3, theoretical background is given about the role of sourcing strategies in the PLC. Chapter 4 continues with the supplier competition framework and methods for application of supplier competition. In chapter 5, the current use of supplier competition and PLC within the purchasing department is described. The case studies are described resulting in a cross-case analysis and a comparison with the supplier competition framework. The application of supplier competition per stage of the PLC is described with the conditions. In chapter 6 conclusions are drawn and recommendations are made. This report ends with the used references and appendices.

2 Project Environment

In chapter 1, the research plan was described. In this chapter the project environment is given. First, a description of Royal Philips Electronics N.V. is given in section 2.1. In section 2.2, Philips Medical Systems (PMS) is described, followed by the business environment of PMS and a description of the PMS purchasing department.

2.1 Royal Philips Electronics N.V.

In 1891, Gerard and Anton Philips founded Philips & Co to fulfil the increasing demand for light bulbs as a result of the commercialization of electricity. This company has continued to change and grow. In 2006 Philips renounced the product division Semiconductors and now Philips consists of four product divisions:

- Consumer Electronics
- Domestic Appliances and Personal Care
- Lighting
- Medical Systems

Philips offers products in the areas of Healthcare, Lifestyle and Technology. In 2004 Philips started with a massive advertising campaign with its new brand promise of 'sense and simplicity'. The company confirmed its dedication to offering consumers around the world products that are advanced, easy to use and, above all, designed to meet their needs. At the end of 2006, Philips had approximately 121,700 employees and a turnover of 27.0 billion Euro (see figure 2.1).

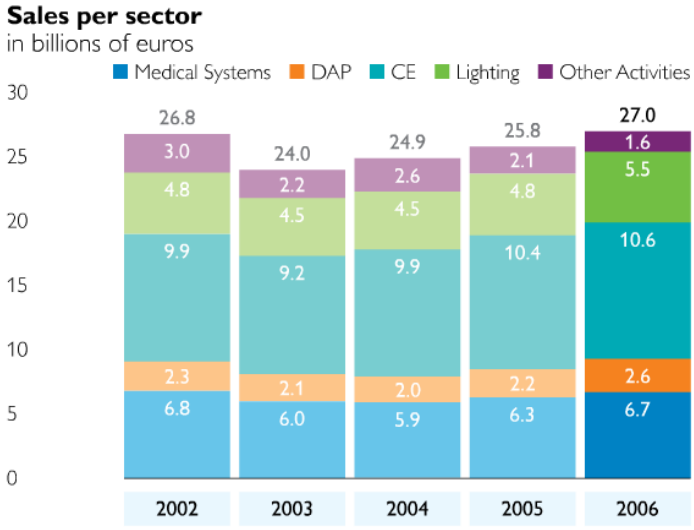


Figure 2.1 Sales of Philips per sector in 2006 (Source: Annual Report Philips, 2006)

2.2 Philips Medical Systems

2.2.1 Company description

In 1918, Philips introduced the first X-ray tubes for medical applications after Wilhelm Röntgen invented the X-ray radiation in 1895. This is electromagnetic radiation with higher energy than visible light and can be used by physicians to see parts of a body that are not visible normally. By 1933, PMS was manufacturing medical X-ray equipment in Europe and the United States. Today, PMS is a global leader in diagnostic imaging systems, healthcare information technology solutions, and patient monitoring and cardiac devices. With a turnover of 6.7 billion Euro in 2006, PMS is the second largest product division of Philips (figure 2.1). PMS has around 31,000 employees and a presence in more than 100 countries worldwide. PMS aims to become a clinically focused company offering complete systems for diagnosing and treatment.

Products and services are sold business-to-business to healthcare providers around the world. In addition, home defibrillators are sold to consumers. The largest healthcare market, currently representing 50% of the global healthcare market, is the USA, followed by Japan and Germany.

The products of PMS are high mix, low volume. The products are offered with a great variety and are sold in quantities of around 400-600 systems per year. A PMS system provides high-technological features and selling prices are around 0.1-2 million. The products of PMS are divided in 12 global commodities (see appendix 3). A commodity team has been set up for every commodity and is lead by an international commodity manager. A commodity team is a multi disciplinary team which determines supply strategies and suppliers needed for the business. The commodity team assesses current and prospective suppliers regarding technical quality, economical and technological potentials and suitability for existing and future PMS' products, goods and services.

2.2.2 Business environment

The forecast for demand of medical systems is quite predictable, because the market is stable. The number of hospitals will not increase or decrease immediately. There are some factors that can influence the demand in the future. Some trends can be detected:

- Ageing population: The market grows slightly because the population is ageing. More hospitals as well as medical systems are necessary.
- Development of technology: The change from analogue to digital images results in more precise images. Diseases can better and earlier be detected.
- Lower market prices: Competition is able to lower its prices, so PMS also has to decrease the prices to stay in the market.
- Improvement of purchasing in hospitals: Hospitals form purchasing groups, which select one company to purchase medical systems for a group of hospitals. Obtaining this order can result in selling several medical systems.

Competitive advantage
Porter (1985) introduced the model of competitive advantage and is described in appendix 4. PMS can be positioned in the differentiation quadrant. PMS sells unique products that are valued by buyers and differentiates on the technology. PMS aims to meet the requirements of the customers. Although the products are unique and PMS follows a differentiation strategy, costs are important as well. PMS tries to reduce its costs to stay competitive, but the development of technology has priority. The right balance has to be found between uniqueness and costs.

Five forces model of Porter
The five forces model of Porter (1985) is a business unit tool that is used to make an analysis of the attractiveness and profitability of an industry. The competitive forces analysis is made by the identification of five fundamental competitive forces (see figure 2.2). Companies' successful strategies can influence the five forces in order to increase the attractiveness of the industry. Not in every industry the five forces are of equal importance, and the structure differs per industry.

The five forces for PMS in specific can be described as follows:

- **The entry of competitors:**
  The entrance barriers for new companies are extremely high. The technology and knowledge needed to enter the market is complicated. Especially in the USA it is difficult to enter the market without an extended sales network and experience.
- **The threat of substitutes:**
  The threat of substitutes for diagnosing is present. Also with techniques of Magnetic Resonance (MR) and Ultrasound internal parts of the body that are not visibly normally can be shown. Around 1999 these techniques were a serious threat for Cardio Vascular (C/V). Later, in addition to diagnosis, treatment became important. MR and Ultrasound are not suitable for the treatment of patients. Also medicines for preventing diseases can be a threat for PMS X-ray. The result can be a decrease in diseases and diagnosing will not be necessary anymore.
- **The bargaining power of suppliers:**
  The suppliers' bargaining power is high. The high-technical, custom made products and components of PMS require excellent quality and only a few suppliers in the world can make the critical products in a medical system. When suppliers also need PMS to put their products in the market, the bargaining power is equal. For the more simple

products, the bargaining power is not that high. If these suppliers cannot supply the best products for the lowest price, it is easy to choose another supplier.

- **The bargaining power of buyers:**
  The buyers' bargaining power is high. More parties are able to deliver healthcare systems. The market characteristics have changed in the past years. The buying decision shifted from the doctors to the board and the financial responsible persons. In the past, price was not the most important factor, but the ease of use and the contact with the company. Nowadays, the price is set under pressure and hospitals are forced to face price as an important factor. Hospitals form purchasing groups and these groups purchase several medical systems at the same time to receive quantity discounts.
- **The rivalry among existing firms:**
  The industry of medical systems is competitive. General Electric and Siemens are the most important competitors. All parties are dealing with the price erosion and demanding customers. In general, the focus of PMS is on technological development. Siemens focuses more on the customer intimacy, so provides customers the dedicated solution. General Electric provides medical systems that are clinical less complete, but are cheaper. The market for these companies is exactly the same and all parties want to have as much market share as possible. Toshiba is a dangerous competitor, although not always distinguished. It can serve low prices and when Toshiba is participating in negotiations with the customer, PMS is forced to lower its prices. In Asia some companies are serving that market partly, but these companies are not seen as a real threat.

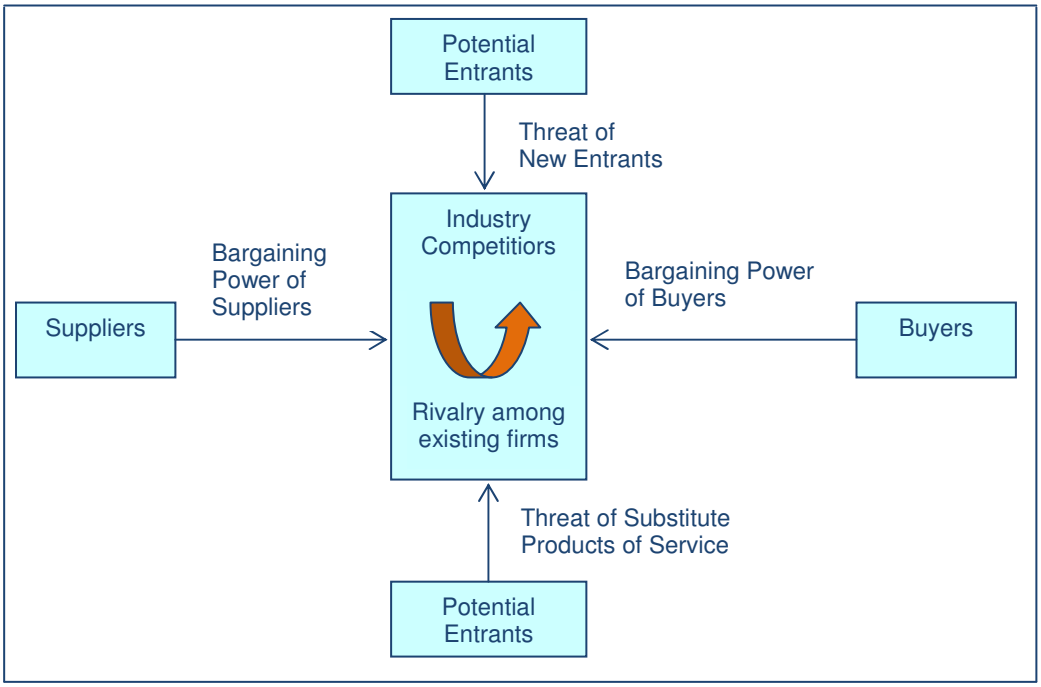


Figure 2.2 Five forces model, (Source: Porter, 1985)

The five forces model gives insight into the complexity, the possibilities to point the crucial factors for competition, and the most profitable strategic innovations for the industry. The different parties can influence decisions of PMS. If the buyer possesses a high bargaining power and it demands a short lead time, the focus of the supplier

selection will be on a supplier who can supply the product with a short lead time. If the competition lowers the price of a certain product, PMS can be influenced to lower the price too. As a consequence, cost reduction is necessary for several components and this may result in new negotiations with the suppliers. The external factors of PMS may influence the application of supplier competition.

2.3 PMS Purchasing Department

This project is executed at a business unit of PMS. The purchasing department is a part of the product division. The purchasing department supports all other divisions (e.g. Logistics, Administration, Services) in case they do not manage to bring into agreement with a supplier. Examples of policies that are applicable within the purchasing department are supply base reduction, cost reduction and time-to-market reduction. At this moment the supply base contains around 450 suppliers, and the goal is to balance the supply base to 100-150 suppliers in the future.

A Supplier Account Manager (SAM) for suppliers. The SAM coordinates and informs about all cross-site activities, like purchasing frame contracts, projects and supplier information and is responsible for the management of the supplier relations. Global SAM's are appointed to manage the global common suppliers across different business units.

During the last ten years, the purchasing department has developed from a purchasing function to a supply management function. The span of expertise broadened by change of management, the improved skills of the purchasing employees, the influence of information technologies, the globalization of PMS and the changing position of purchasing within PMS. The purchasing department consists of two groups; operational purchasing and initial purchasing. The responsibilities of operational purchasing are among others order and incoming goods handling, quality and defects handling, supplier control, forecasting, and partially contracting. The main task is to take care of continuous production. In the future probably more activities are supported by information systems and will make processes more efficiently. Possibly operational purchasing will take over more responsibilities of initial purchasing.

During the years, the role of initial purchasing has become more strategically. A team of 14 buyers in Best is now responsible for among others supplier selection and relations, involvement in the Product Creation Process (PCP), assessments, global commodity strategies, low cost countries, supply base development, road mapping, global leadership, and sustainability. In the future the initial purchasing department will expand.

The purchasing process model of the purchasing department (see figure 2.3) is based on the purchasing process model of van Weele (2005). The responsibilities for initial and operational purchasing are described above. Internal clients for initial purchasing are among others predevelopment and marketing. PMS supports the drive toward world-class excellence in supply management and has adopted an approach developed by dr. Robert

Monczka Ph.D. at Michigan State University (MSU). This model is based on eight strategic processes and six enablers. In appendix 9 an explanation of the Monczka process and the application of the process at the purchasing department are given.

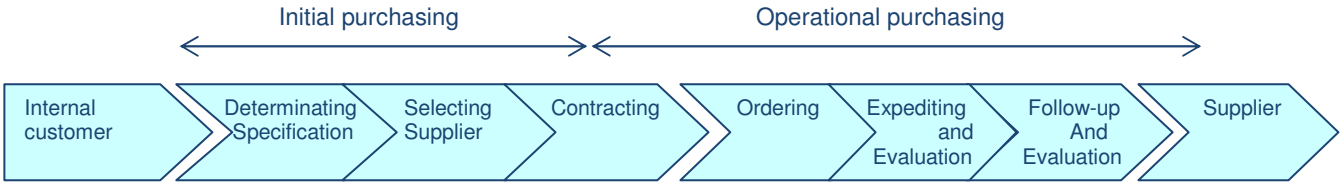


Figure 2.3 Purchasing Process Model (Source: Van Weele, 2005)

2.4 Conclusions

The business environment of PMS is changing and therefore the goals have to be changed as well. PMS wants to grow and be innovative in the future and improve the earnings before interest and taxes (EBIT) by 1-2%. The forces of competition of existing firms, the negotiation power of suppliers and buyers is high. The threat for substitutes is present and the threat of new entries is low. Altogether, PMS aims to stay a technology differentiator and wants to reduce costs to stay competitive. The position of the purchasing department within the organization changed from purchasing responsibilities to supply management. The function is more than only buying components. Possibilities to manage the supply chain and get the best prices of suppliers have to be investigated. In this light, the role of supplier competition is studied to get the best results in a buyer-supplier relationship during the life cycle of a product.

3 Theoretical background

In this chapter the link between purchasing and the PLC is described based on existing literature. The focus is on the role of sourcing strategies in the different stages of the PLC. Supplier competition is not extensively described in literature and no publications about the link between supplier competition and PLC has been found. The characteristics for purchasing and for sourcing strategies per stage of the PLC can be found in literature. Literature about these subjects forms a basis for the further analysis of the role of supplier competition in the different stages of the PLC. To be able to describe the role of sourcing strategies in the PLC, first the definitions of the terms 'sourcing', 'sourcing strategy', and 'product life cycle' are given in section 3.1. Per stage of the PLC the different characteristics are mentioned. After these definitions, in section 3.2 the role of purchasing in the PLC with the matching sourcing strategies as described in literature is given. At the end of the theoretical background, in section 3.3, the conclusions are drawn and the discussion is expounded.

3.1 Definitions

Before proceeding further, it is needed to explain three terms – sourcing, sourcing strategies and product life cycle (PLC).

3.1.1 Sourcing

Various definitions of sourcing have been used over the years. One early definition of sourcing is: '*Buying materials of the right quality in the right quantity, at the right time, at the right price, from the right source*' (Heinritz et al., 1986, p.9).

The role of purchasing has changed over the last decades and sourcing got another meaning (van Weele, 2005; Laseter, 1998; Gadde and Håkansson, 2001; Neef, 2001; Monckza and Trent, 1991). Purchasing broadened by changing from a clerical function to a more strategic function. The focus in purchasing is on the processes, not the function. Executives are trying to improve the purchasing processes to capture the maximum value from their external suppliers of materials and services.

A more suitable definition of sourcing for these days is: '*Sourcing essentially is a cross-functional process, aimed at managing, developing and integrating with supplier capabilities to achieve competitive advantage*' (Axelsson et al., 2005, p.16). This definition does involve both internally oriented activities, such as the development of commodity teams, and externally oriented activities, such as supplier performance measurement and market research. The sourcing activity relates to developing the most appropriate supplier strategy for a type of product (van Weele, 2005).

According to Axelsson et al. (2005) there are three roles of sourcing:

- Rationalization role: Looking at possibilities for the purchasing function to contribute to the company's competitive advantage through acting towards keeping total costs down in production, stocks, prices of raw materials and so on.

- Development role: Systematically matching the company's development or innovation process with those of individual suppliers and the overall supplier network.
- Structure role: Concerning the efforts of the sourcing function to get an optimal balance in term of dependence versus interdependence on suppliers.

The three roles are complementary to each other and partially overlapping.

3.1.2 Sourcing strategies

In literature, the terms purchasing strategy and sourcing strategy are mixed. Kiser and Rink (1976) defined a purchasing strategy as: '*a set of rules that guides the configuration of the firm's purchasing effort over time in response to changes in competition and the environment so as to permit the firm to take advantage of profitable opportunities* (p.21)'. According to Handfield (2006) sourcing strategies are *'the planning and development of key category strategies, design of supply chains, relationship management, and performance measurement associated with improving supply chain performance'* (p.391).

Trent and Monczka (2003) stated that that the development of global strategies, including global sourcing strategies, is an attractive option to respond to the demands of today's business environment to search for new sources of competitive advantage. Cost reduction, quality and delivery improvements, reduced cycle times, and improved responsiveness to customer, competitive and market demands are required to stay successful. '*Global sourcing involves proactively integrating and coordinating common items and materials, processes, designs, technologies, and supplier across worldwide purchasing, engineering, and operating locations.*' (Monczka and Trent, 2003, p.26). Monczka and Trent (2003) investigated how these global sourcing strategies can be achieved and defined the difference in international purchasing and global sourcing. According to Anderson and Katz (1998) the sourcing strategy answers the fundamental question of how to buy. For companies who are able to produce internally, it is intertwined with the make- or buy decision.

Heriot and Kulkarni (2001) stated that the sourcing decision is the make- or buy decision. Their primary purpose is to identify the extent to which manufacturing firms use various intermediate sourcing strategies. In the existing theory, market (outsourcing) and hierarchy (vertical integration) are extremes of a continuum of sourcing strategies (Arnold, 2000).

Based on the mission, vision and strategy of the company the sourcing strategy can be chosen that fits best. From the strategies an action plan can be distracted to allow a firm to enter a market quickly with a better product and at lower total costs (Monczka, Trent, 1991). Examples of sourcing strategies are: supply-base optimization, supplier performance evaluation and early supplier involvement (ESI).

3.1.3 Product life cycle (PLC)

Since its initial conceptualization in the early 1950's, the PLC theory has gained significant recognition as a tool for effective marketing strategy formulation and implementation (Birou et al., 1997; Onkvisit and Shaw, 1986). The PLC displays the

development of the market and product characteristics over time (Fox and Rink, 1977). The PLC approach assumes that the life of a product occurs in distinct phases, just as the life of a human; birth, maturity and death. The PLC framework described in the literature contains four to six stages. In essence, the idea of these different forms is the same. In this review the five stage PLC will be used. The four stage PLC leaves out the first stage and the six stage PLC adds a stage of abandonment at the end.

The stages of the product life cycle are:
1. Development
2. Introduction
3. Growth
4. Maturity
5. Decline

Generally, the PLC is shown in figure 3.1, with vertically sales versus horizontally time. Some authors labeled the stages differently, but the descriptions of the characteristics of each phase are similar (Birou et al., 1997). The PLC customarily is a bell-shaped graph. According to Onkvisit and Shaw (1986) the exact shape of the graph depends on the type of product and the type of industry. Also, the time span of each stage will vary from one product and industry to another. The life cycle stages across product classes show great variation in length. These variations make it difficult to predict when one stage ends and the next one begins. It is also difficult to determine the current stage of the product.

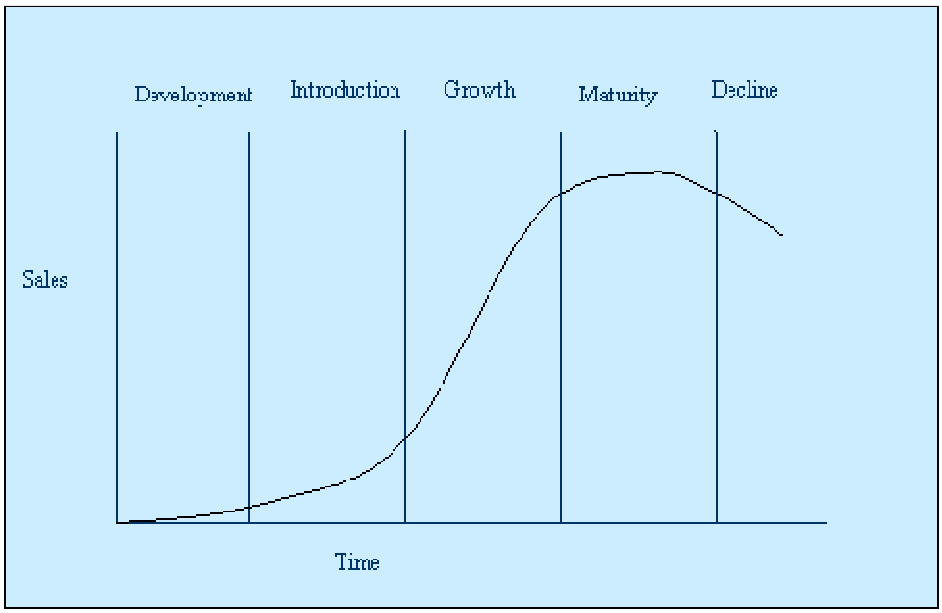


Figure 3.1 The product life cycle curve

Ryan and Riggs (1996) stated that the goal is to maximize the product's value and profitability in each stage of the PLC according to the conventional theory. Some characteristics of the different PLC stages are given in the next paragraphs.

Development stage
In the development stage the product has to be designed. According to Fox and Rink (1977) this stage can be distinguished on heavy R&D expenditures, uncertainty of the success of the proposed innovation and the preparation of a marketing plan. Rink and Fox (2003) mentioned that except for revenues incidental to possible test marketing, the developer realizes no sales in the development stage. A wide variety of test materials is needed in small quantities.

Introduction stage
In the introduction stage the full-scale marketing of the product or service in its intended market or in a large region is started. The sales per unit are low and losses or low profits are present (Swan and Rink, 1982). The product is vulnerable to attack from competing items or services. The personnel is not experienced with manufacturing the product and are debugging the products (Fox and Rink, 1977). In this stage the number of competitors is still minimal, but there is free entry to the market and entry barriers are lacking (Onkvisit and Shaw, 1986). According to Ryan and Riggs (1996) the strategy is to create widespread awareness. People hope that the investments made in the new product pay off and the product or service moves to the growth phase. The introduction stage ends when management decides to support the new product or not as a new part of the business (Rink and Fox, 2003).

Growth stage
The growth stage begins when unit sales start increasing at a growing rate or at more than one percent monthly (Fox and Rink, 1977). In this stage the first substantial profits are achieved, the product is less vulnerable and full-scale production lines are developed. Ryan and Riggs (1996) mentioned it is important to build market share or profitability. The strategy is to make differential changes that add value to the product and to target new markets. The market is more competitive and the marketing focuses on more mass media advertising. The manufacturing costs start to decline and workers move down the learning curve. A firm tries to stay in the growth phase as long as possible. In this stage the diversity of competing versions of the product and the number of product innovations and producers tend to reach a peak (Onkvisit and Shaw, 1986; Klepper, 1996).

Maturity stage
In the maturity stage sales volume continues to increase, but at a decreasing rate. Unit sales may fluctuate within the range of plus or minus one percent monthly (Fox and Rink, 1977). This stage is also represented by aggressive competitors, production facilities or processes in need of heavy repair, cost-price squeeze and the beginning of development of new markets or new product models and sizes. R&D emphasis shifts from product innovation toward process innovation (Roberts and Liu, 2001). Ryan and Riggs (1996) described that in the maturity stage the sales growth is decreasing and cost reduction is needed as competitors start lowering their prices and introduce improved versions of the product. The competition is stable or decreases slightly (Onkvisit and Shaw, 1986).

Decline stage
According to Fox and Rink (1979) the unit sales decline at an increasing rate or at more than one percent monthly in the decline stage. The products are substituted by distributors and the R&D budget is canceled. Ryan and Riggs (1996) explained that it is hoped that competitors will discontinue selling the product. A different strategy they gave is to maximize profit by eliminating as many products as possible as sales slow, or else to eliminate the product altogether. Onkvisit and Shaw (1986) mentioned that a few specialized firms choose to remain in the market.

Over time the duration of the PLC for most product types became shorter because of the increasing number of technological innovations and the rapid rate of new product introduction (Parlar and Weng, 1997; Qualls et al., 1981; Ryan and Riggs, 1996; Slater, 1993).

3.1.4 Usage of PLC

In the marketing the PLC is already a known approach. PLC is an effective planning tool (Berenson, 1967), a management tool for directing or integrating activities (Fox and Rink, 1977) and as noted above it can serve as a useful tool to coordinate strategies (Birou et al., 1998). Birou et al. (1998) address its simplicity as one strength of the PLC. According to Saaksvuori and Immonen (2005), product life cycle management makes it possible to control the whole lifespan of a product and the information connected with it. Companies are able to compete successfully in international markets using efficient life cycle management. Fuller (2004) discuss that the product life cycle can be used to calculate the total costs involved with one asset during its life. Life cycle costing considers the full-cost profile over the lifetime of an asset and is concerned with the full cost of ownership of a capital acquisition.

In general, the PLC approach can be seen as a valuable tool, but also has its limitations (Onkvisit and Shaw, 1986). The PLC provides broad generalizations, that make the validation of the concept almost impossible (Onkvisit and Shaw, 1986). They state that the concept must be more specific with regard to the variables that will affect the PLC curve. It should be taken as a basis for product analysis, but not followed on blind faith. Swan and Rink (1982) mention that the application of the classical PLC for marketing decisions can be misleading. Research of Swan and Rink (1982) show that there are eleven different product life cycles for different marketing strategies and in addition, a particular product life cycle is not fixed. Despite its popularity, according to Klepper (1996) there are many skeptics about the PLC, both in terms of its logic and its universality.

3.1.5 Conclusion

Definitions of ‘sourcing’, ‘sourcing strategies’ and ‘PLC’ are found in literature. The definition of sourcing changed over time. From only operational buying, sourcing developed to a cross-functional process and it became more important to make the best use of supplier capabilities. A sourcing strategy is a set of rules that have to be used to be able to handle changes in the environment of purchasing. The PLC is a wide used approach with its origin in marketing and shows the life cycle of a product.

Characteristics within the different stages are described to get more insight into the situation during the life cycle of a product. The general PLC cannot be applied to every product, because every product is different. For each product a separate PLC can be made. This is also one of the limitations of the PLC approach. In the next section, the purchasing function is linked to the PLC and the role of sourcing in the different stages of the PLC becomes clearer.

3.2 Role of sourcing strategies in product life cycle

The PLC has been useful in many areas of firm's operations, like planning, design, R&D and Marketing. Berenson (1967) established the first conceptual model linking PLC with purchasing. He mentioned that each phase in the PLC is identified with different market characteristics and, therefore, needs a different purchasing strategy. Berenson identified per stage of the PLC the characteristics, the principal strategy, and the actions the purchasing executive has to accomplish. Kiser and Rink (1976) tested the different purchasing strategies empirically by presenting the strategies to a group of purchasing executives who placed these strategies into the stages of the PLC. This resulted in an acceptation of Berenson's conceptual model.

Further research revealed that PLC is a management tool for directing or integrating activities. Fox and Rink (1977) developed an expanded list of 82 purchasing strategies according to nine departmental functions and five PLC stages. They stated that if a company can determine in which stage of the PLC the product is, the purchasing executive could ascertain the set of purchasing strategies to be used in intradepartmental, interdepartmental, and external relations. The researches offered concrete strategies to follow in a specific situation. As a result of the changing purchasing function in the last decades, the data have been changed and so the strategies.

Building on this research, Birou et al. (1997) investigated the relationship between purchasing strategies and the PLC. A list of 43 purchasing strategies was developed and a survey was distributed to diverse organizations. Respondents were asked to place each purchasing strategy into the most appropriate PLC stage and to rate the level of implementation of each strategy within their firm. The result of this survey was a division of the purchasing strategies over the different stages of the PLC (figure 3.2). In figure 3.2, it can be seen that the most strategies were attributed to the growth stage. Birou et al. (1997) stated that the reason of awarding most purchasing strategies to the growth stage was due to the fact that purchasing executives are expected to support a variety of competitive dimensions in this phase. These competitive dimensions include flexible production, delivery dependability, quick response time, product quality, and process innovation. According to Birou et al. (1997) the model as showed in figure 3.2 strives to meet two objectives. The first is to provide managers with a tool for integration of the PLC and purchasing strategies. The second objective is to give purchasing managers a proactive prescriptive guideline for the effective use of purchasing resources.

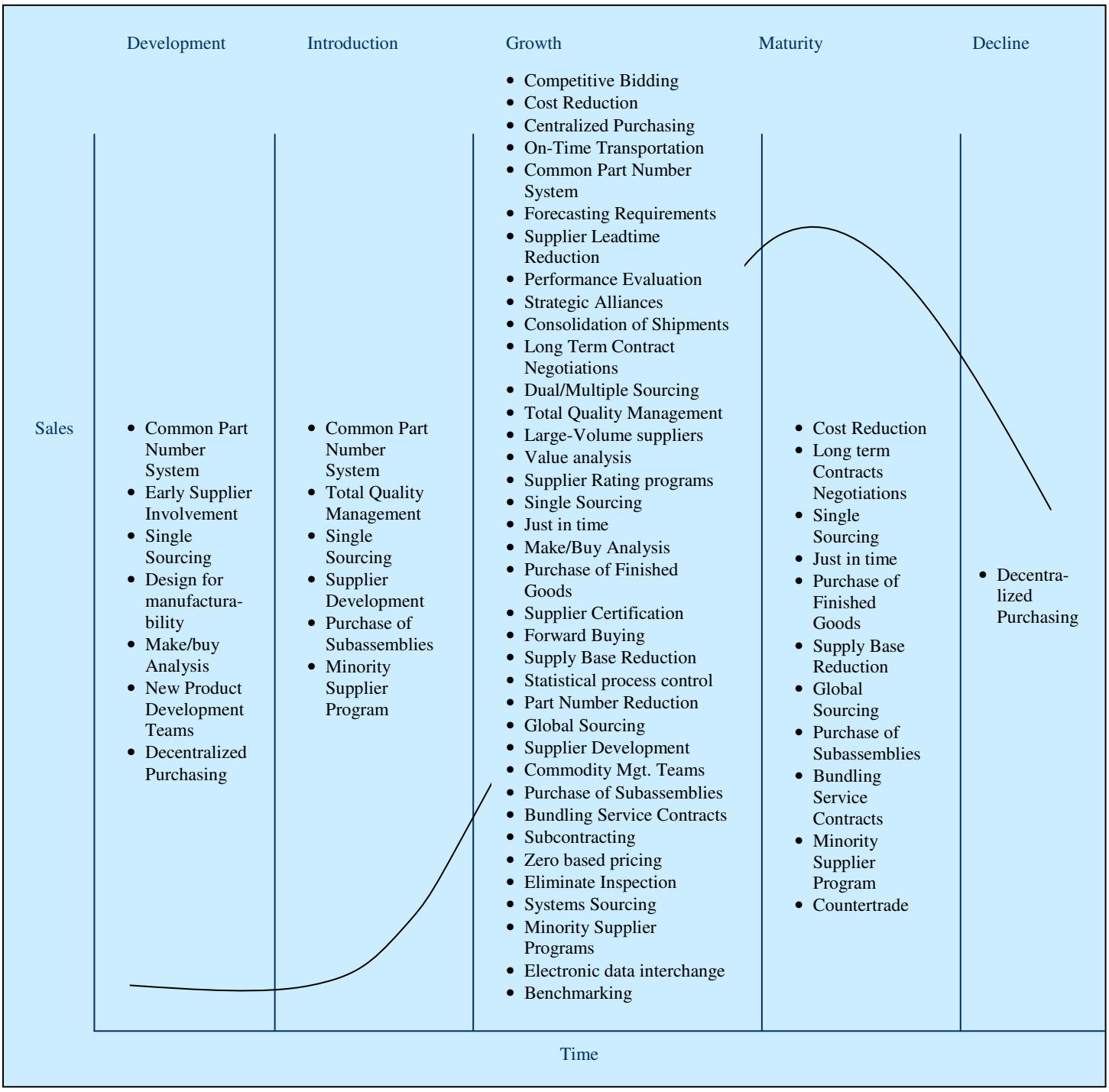
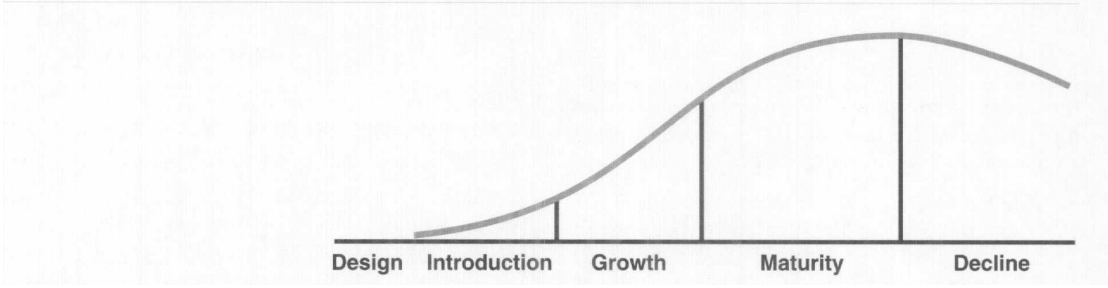


Figure 3.2 Categorization of Purchasing Strategies by PLC Stage (Source: Birou et al., 1997)

Another approach linking purchasing and the PLC was done by Birou et al. (1998). They investigated the importance of the competitive competences per PLC stage for logistics, operations and purchasing departments. The research was based on the answers of 418 executives from the different areas. In figure 3.3 the competitive competences are given per stage of the PLC of the purchasing departments. The purchasing executives were

asked to indicate the stage of the PLC where each of the competences has the greatest impact on their firm's competitive advantage. The figure reflects the frequency distribution of the answers. The PLC stage where each competence was placed most frequently is indicated with bold numbers. This research demonstrates a general consensus about the influence of the competitive environment throughout the different stages of the PLC. Firms need to react on changes in competitive demands rather than focusing on one competitive competency over the entire PLC.



Purchasing:					
Low cost	13.1	9.0	27.9	**45.9**	4.1
Product quality	21.3	23.0	**33.6**	22.1	0.0
Delivery speed	5.7	25.2	**50.4**	16.2	2.4
Delivery dependability	2.5	22.1	**47.5**	27.1	0.8
Product innovation	30.6	**35.5**	23.1	8.3	2.5
Process innovation	22.1	24.6	**30.3**	19.7	3.3
Flexibility	8.2	14.8	**48.4**	27.9	0.8

Figure 3.3 Importance of Competitive Competence by PLC Stage (Source: Birou et al., 1998)

Also in this research of Birou et al. (1998) can be seen that most competitive competences are attributed to the growth stage. This corresponds with the finding that purchasing managers consider the growth stage as the critical stage in the PLC. Market penetration and acceptance is vital to survive the growth stage and move on to the maturity stage.

After these findings in literature about the link between sourcing and the PLC, a more in-depth exposition of the role of purchasing and sourcing strategies per stage of the PLC is given in the next paragraphs.

3.2.1 Development stage

In the development stage purchasing can play an important role. With early involvement in the development process, purchasing can contribute to the process with controlling costs and managing suppliers (Teague, 2006). 80% Percent of the cost of a new product is determined during the development stage (Teague, 2006; Saaksvuori and Immonen, 2005). Continuous changes during the development stage in product structure, documentation and product specifications affects component and software acquisition. Sourcing decisions will affect the product mostly at this stage (Saaksvuori and Immonen, 2005). It will be most difficult to make sourcing decisions during the development stage, because the uncertainty of the further success of the product. The delivery time of some

components needed for testing can be very long, suppliers can suddenly change and costs increase with buying components based on outdated information.

The development stage is dominated by strategies that are meant to facilitate the involvement of purchasing and the supply base in a proactive way in the new product development process, such as early supplier involvement (ESI) and design for manufacturability (DFM). Decentralized purchasing accelerates decision making about make/buy and sourcing strategy (Birou et al., 1997).

Berenson (1967) stated that in the development and introduction stage the principal strategy of a purchasing manager should be directed toward helping the new product through its initial stages, while not committing too many resources to a product. According to Rink and Fox (2003) the policy of the design phase is to de-emphasize unit costs. In this phase a diversity of testing materials is needed and obtaining small quantities of the materials is important. Relations with suppliers should be flexible and future-oriented. Potential suppliers are selected who can meet the firm's specifications and quality standards.

3.2.2 Introduction stage

The introduction stage is associated with low-volume production and unit sales. Rink and Fox (2003) indicated that the main task of purchasing in the introduction stage is to balance the high likelihood of failure of the innovation with the urgency of adequate resources if it succeeds.

The strategies used in this stage are fundamental for later growth. The implementation of total quality management (TQM) focuses on the continuous improvement of the purchasing process for the duration of the PLC. A common part number system (CPNS) is recognized to make effective growth possible (Birou et al., 1997). Birou et al. (1998) investigated that product innovation is most important in the introduction stage. The purchasing strategy of buying subassemblies is in line with this competitive competence.

The policy for the purchasing department in this stage is to work closely with suppliers to resolve material defects and implement engineering changes (Rink and Fox, 2003). A list is developed with preferred and standby sources. With the preferred suppliers a long-term relationship is established. Suppliers are encouraged to develop new technologies that can be incorporated into their firm's operations. When sales are increasing, a shift takes place from subcontractors to owned facilities. At the end of this stage, a supplier certification is implemented to improve quality and reduce inventory, order processing, and inspection costs.

3.2.3 Growth stage

Rink and Fox (2003) stated that during the growth period problems can occur, such as temporary shortages, shipping delays, and similar rapid growth problems. Despite pressure from others in the company for speedy deliveries, purchasing maintains strict service and quality standards on procured items. Purchasing assists in revising lead times, minimum stocks, and reorder points, as well as participates in the installation of

Economic Order Quantities (EOQs). Purchasing makes the make/buy decision and phases out some subcontractors in favor of in-house production. To prevent temporarily shortages, purchasing shifts to suppliers with large capacity. According to Saaksvuori and Immonen (2005) the sourcing concerns contain the same challenges during the growth stage, where mass production starts, as in the introduction stage, but the focus moves to the larger volume of components and products.

In literature the most purchasing strategies are attributed to the growth stage. Purchasing executives are expected to support a variety of competitive dimensions, such as flexible production, synchronized and reliable product flow, quick response time, product quality and process innovation (Birou et al., 1997). This is in accordance with the findings of Birou et al. (1998) who investigated that product quality, delivery speed, delivery dependability, process innovation and flexibility are the most important competitive competences in the growth stage. Birou et al. (1997) described the purchasing strategies which can help in supporting these dimensions. The product volume is changing rapidly and therefore the production has to be flexible. Because of the changing environment, purchasing strategies that simplify the processes are desirable, such as common part number reduction and make/buy analysis. To remain competitive there is a need to have a reliable product flow. Consolidation of shipments, just-in-time delivery and on-time transportation strategies contribute to reliable and synchronized product flows. Time can be a competitive advantage and can be supported by forecasting requirements, supplier leadtime reduction. To improve product quality, sourcing strategies with the focus on suppliers or with the focus on the internal organization can be applied. Supply base reduction, supplier development, supplier certification, single sourcing, and supplier rating programs are examples of strategies with the focus on suppliers. A strategy with an internal focus includes statistical process control which is necessary to eliminate incoming inspection. Process innovation strategies are electronic data interchange, commodity management teams, benchmarking and performance evaluations. Strategies like cost reduction and competitive bidding does not have the emphasis in this stage, but are a preparation for the competitive pressure of the maturity stage.

All the strategies that are mentioned in the growth stage cannot be applied at the same time. The company will lose the strategic focus and will spread scarce resources too thin over the purchasing strategies. To avoid this, a purchasing function should identify which competitive dimensions are the most crucial to their firm, and select the strategies that support those dimensions (Birou et al., 1997).

3.2.4 Maturity stage

In the maturity stage of the life cycle, profit margins are declining as a result of a variety of forces acting in the environment. The competition is increasing, the prices are declining and the market growth is slowing down (Birou et al., 1997). According to Rink and Fox (2003) the purchasing policy in the maturity stage is to stabilize materials' commitments and improve the efficiency of routines of workers. They mentioned that as a result of stabilizing demand, the purchasing department installs automatic reordering of standard quantities, provides quality standards and consistent customer service levels, and conducts research about substitute materials and alternative sources. Other activities

ascertain the feasibility of long-term contracts with fewer sources and cost reduction at long-term suppliers.

Most strategies used in the maturity stage are related to achieve cost reduction (Birou et al., 1997). These strategies include cost-cutting strategies, such as cost reductions and global sourcing, and strategies aimed at volume discount, such as supply base reduction and bundling service contracts. The purchasing of subassemblies and finished goods from original equipment manufacturers (OEM) is a market-based strategy that is designed to gain access to markets or increase value of products. Birou et al. (1997) pointed out that this results in a cost reduction if the external manufacturing costs are lower than internal operating costs. Birou et al. (1998) investigated that low costs is the main competitive competence in the maturity stage.

Rink and Fox (2003) indicated that the increase of competitive pressure results in a trigger to improve techniques of negotiation with suppliers to get lower prices and to propose simplifications of component materials for the existing product.

3.2.5 Decline stage

In the decline stage the sales are rapidly declining, which causes challenges for the purchasing department. The product and inventory becomes obsolete, the level of service and support inventory level determines and the supplier relations end. Rink and Fox (2003) mentioned that in the decline stage, when the product's sales trend turns down, the focus should be on cost elimination. Some earlier decisions are reversed, like reducing inventories and service and converting to subcontractors if possible. Purchasing makes plans for the disposal of recycled materials and consider ecological and legally factors.

In the research conducted by Birou et al. (1997) purchasing executives only indicated decentralized purchasing as the appropriate strategy for the decline stage. Birou et al. (1997) stated that this stage of the PLC has not received the proper focus by industry or purchasing professionals. The development of flexible purchasing systems (FPS) to support flexible manufacturing systems (FMS) is desired to accommodate the rapid changes in market demands. Other possible strategies they mention are product reengineering, product substitution or donations to charitable organizations. As shown in figure 3.3, the purchasing executives did not assign any competitive competence to the decline stage (Birou et al., 1998). According to Birou et al. (1998) product renewal and product abandonment present unique challenges and opportunities. Factors as obsolete inventory and equipment, determination of adequate levels of service and support inventory and maintaining positive supplier relations need to be addressed more.

3.2.6 Conclusion

As can be seen, some research has been done about linking the PLC with purchasing. Birou et al. (1997) published a categorization of purchasing strategies by PLC stage. Based on existing literature about linking purchasing and the PLC Birou et al. (1997) set up a survey. Purchasing executives were asked to put purchasing strategies in the most appropriate PLC stage. In figure 3.2 the results of this research are shown and it can be concluded that most purchasing strategies are attributed to the growth stage. Birou et al.

(1998) investigated that also the competitive competences are most important in the growth stage. This is a result of the increasing demand for products, need for flexible production, synchronized and reliable product flow, quick response time, product quality and process innovation. A more in-depth exposition of the role of purchasing and sourcing strategies per stage of the PLC is given. Only one purchasing strategy was attributed to the decline stage and no competitive competences. There is not sufficient focus on this stage. Several opportunities and challenges are found for the decline stage, like product renewal and product abandonment.

3.3 Conclusions and reflection

In literature the PLC is seen as an effective planning tool (Berenson, 1969), a management tool for directing and integrating activities (Fox and Rink, 1977), and it can serve as a useful tool to coordinate strategies (Birou et al., 1998). It can be concluded that per stage of the PLC different characteristics are important for purchasing. The sourcing strategies found important by purchasing executives differ per stage of the PLC. Not only internal factors determine the PLC with the matching sourcing strategies, but also external factors, like competition and customer market developments. The categorization of purchasing strategies by PLC stage (Birou et al., 1997, figure 3.2) may contribute to a better understanding of the application of purchasing strategies and guides purchasing executives in the use of purchasing resources.

Limitations of the PLC are also mentioned. The general PLC is not applicable for every product, because every product follows a different life cycle line. For every product a separate PLC has to be followed that fits to the changing environment and characteristics of the product. Klepper (1996) mentioned that there are many skeptics about the PLC, both in terms of its logic and its universality.

A limitation of the used literature is the generalization of the PLC and link with purchasing. As mentioned before, the PLC cannot be standardized and used for every product. In the literature about linking the PLC and purchasing, the general PLC is used. This is a good point of departure, but not applicable for all products. In the medical system industry no real growth stage is present. The product is developed, put on the market and will last for 20 years at vast quantities. The demand is not changing strongly and competition is quite stable. It is possible that different sourcing strategies are needed to improve supply chain performance in different industries.

Further research could be executed on possible sourcing strategies for the decline stage. The purchasing executives indicate that there is no focus on activities in this stage, but opportunities are present. To develop the opportunities to real possibilities, research has to be executed in order to verify the practical use. Another possibility for further research concerns the number of sourcing strategies in the growth stage. In literature, the need for focus was indicated, but a more detailed research can be executed to find out on which strategies should be the focus for different products. A last idea for further research concerns the applicability of the PLC for products of different industries. As mentioned

above, it is not evident that all sourcing strategies proposed in the existing literature are applicable to all products in different industries. Further research can reveal this issue.

The role of supplier competition in the PLC is not described in literature. Only the definition of supplier competition and the need of using competition to get the best offer are present in literature. Further elaboration on how and when to use supplier competition, and the dependences and conditions of using supplier competition lacks. The theoretical background of sourcing strategies per stage of the PLC forms a basis for the explanation of the role of supplier competition in the PLC. To be able to examine this role, supplier competition has to be defined. In the next chapter the definition of supplier competition and a conceptual model for the application of supplier competition are given. After the explanation of the current application of supplier competition and the PLC at the purchasing department, case studies are executed to verify the conceptual model for the application of supplier competition.

4 Supplier competition framework

In this chapter a conceptual model for the application of supplier competition is discussed; the supplier competition framework. This framework is set up to form a point of departure in order to explain and investigate the use of supplier competition. In section 4.1, the definition of supplier competition is described followed by three different forms of supplier competition and dependences of supplier competition. In section 4.2, the methods for application of supplier competition are described and the realization of the supplier competition framework. Section 4.3 describes the conclusions of this chapter.

4.1 Input for the supplier competition framework

In this section, input for the supplier competition framework is described. The definition of supplier competition and importance of the degree of service contribution to a product is explained in paragraph 4.1.1. In paragraph 4.1.2 different forms of supplier competition are explained, followed by dependences of supplier competition in paragraph 4.1.3.

4.1.1 Definition of supplier competition

According to Lilly et al. (2005), the definition of supplier competition is:
'The sellers will compete with one another in order to obtain market share as much as possible. As a result of this competition the sellers try to differentiate their products and services in terms of price, quality, or customer service'.

Supplier competition is applied to motivate suppliers to use their knowledge and experience, in order to get the best offer. Suppliers contribute in different ways to the final product and this influences the way of supplier competition. In the marketing a distinction is made between a physical good and a service. Murray and Schlacter (1990) concluded from previous research (Davis, Guiltinan, and Jones, 1979; Johnson, 1969; Lewis, 1976; Weinberger and Brown, 1977) that consumers may evaluate and purchase services in a different manner, compared to goods. A good is a physical thing, while a service is relatively intangible, inseparable and perishable (Perreault et al., 2000). They mention that a product may be a physical good, or a service, or a hybrid form of both.
The physical good – service continuum is shown in figure 4.1.

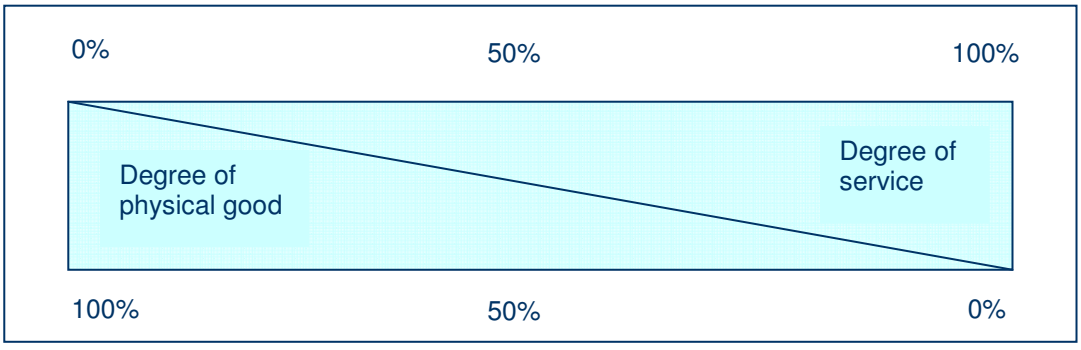


Figure 4.1 Physical good – service continuum (Based on source: Perreault et al., 2000).

This distinction between physical goods and services can also be made for the purchasing of components for medical systems. The focus is on the product-related components and services. The non product-related goods and services are out of the scope. So this research excludes the purchasing of staples, catering, window-cleaners, etcetera. Examples of physical goods are screws and bolts, while complicated medical solutions represent examples of products with a higher degree of service.

On the left side of figure 4.2 the 100% physical goods are placed, which have fixed requirements and are available off the shelf. A mixture of a physical good and a service in the middle of the figure comes with specific and customized designs based on functional specifications. The services of medical systems are based on the needs of PMS. In practice the extreme forms of product or service hardly exist and often it is a mixture of both extremes.

These different product forms come with a certain level of supplier's knowledge contribution, level of trust, level of supplier integration and organization's involvement. These factors are indicated to get more insight into how these factors change with the different product forms and are based on interviews and knowledge of employees. In figure 4.2 the arrows represent these factors.

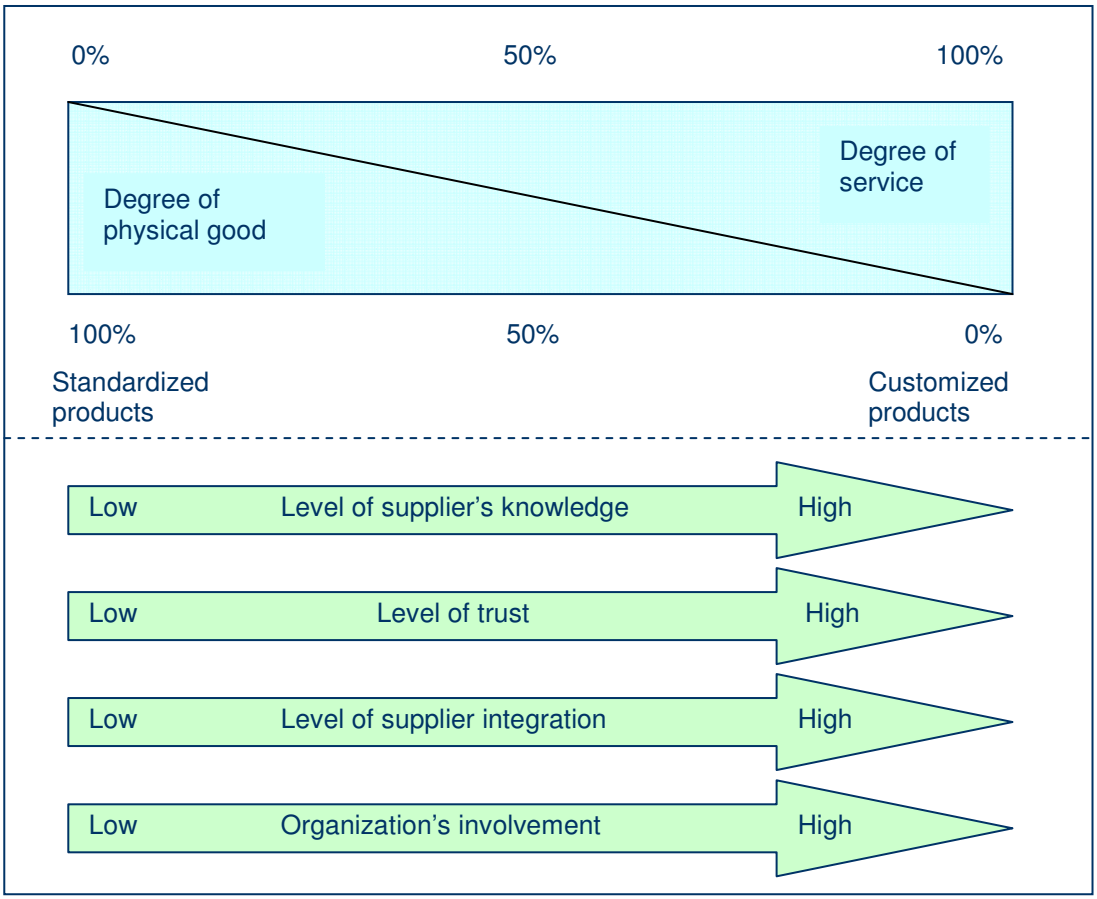


Figure 4.2 Physical good – service continuum with several factors

The supplier's knowledge contribution is low for physical goods without any service component. These products can be produced by several suppliers, because the standardized products are supplied off the shelf. If the price is perceived as being unreasonable for a product, the buyer can simply turn to another supplier to buy that same item (Forker and Stannack, 2000). The relationship between the supplier and the company will predominantly be arm's length. The traditional arm's length buyer-supplier relationships are often marked by infrequent interaction, mutual distrust, self-serving behavior, and a 'win-lose' attitude towards the exchange terms negotiated between the buying and the supplying parties (Forker and Stannack, 2000). Minimal information is revealed to the other side and often this arm's length relation is a result of traditional competitive bidding practices based on price.

The exchange of knowledge for supplying services or more complicated products requires a buyer-supplier relationship with mutual benefits for both parties. These relationships enforced through extensive, formal contractual arrangements but also include sufficient shared interests that make it attractive for both parties to continue the exchange relationship over time. Higher levels of trust and openness are usually displayed between buyers and suppliers in this relationship type (Forker and Stannack, 2000). The number of available suppliers may be limited in cases where the technology is critical to the product (Handfield et al., 1999). A detailed technical assessment may take place with the aim to develop and improve the supplier's capabilities. This should be done early in the development process, where decisions have a significant impact on the resulting product quality, cycle time, and cost (Handfield et al., 1999).

The position in the physical good – service continuum also influences the degree of supplier integration. Supplier integration can be defined as 'the combination of internal resources of the buying firm with the resources and capabilities of suppliers through the inter-company business processes to achieve competitive advantage' (Wagner, 2003). Different levels of supplier integration can be distinguished (figure 4.3). Handfield (2006) identified:

- None integration: No supplier integration for 'makes to print' products
- White box: Informal supplier integration for products of buyer's design
- Gray box: Formalized supplier integration for joint development between buyer and supplier
- Black box: Complete supplier integration where the supplier designs the product on buyer's specifications

Figure 4.3 can be placed below the physical good – service continuum. No supplier integration is necessary if only simple products are supplied. The black box approach is corresponding with the 100% service approach where the total value added solution is important. The arrow in figure 4.3 indicates the increasing supplier responsibility. The supplier will be more responsible if the supplier is more integrated.

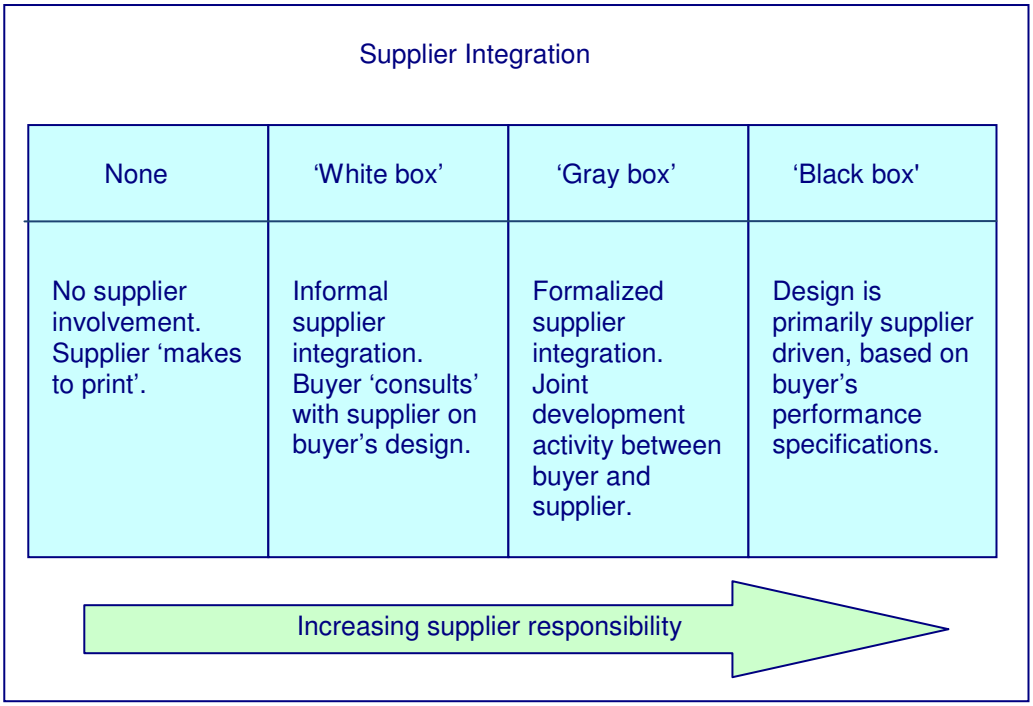


Figure 4.3 Supplier integration (Source: Handfield, 2006, p.58)

The involvement of different departments of the organization might differ for physical goods and services. The simple products only have to be bought; the drawings and designs are known and the organization's involvement is low. The main department involved in this action is Purchasing. The suppliers manage their own inventories and the forecast data will be given through electronic systems.

Different departments are involved when customized products are bought and adjustments within the organization have to be made. The development of new products is a complex process requiring varying cross-functional involvement early and throughout the process (Fredericks, 2005). Resources have to be assigned to introduce the changes. Different departments of the organization are involved, like development to integrate the obtained knowledge into the process, marketing to control answering the voice of the customer, and purchasing to manage the relations and the costs.

Different levels of supplier competition come with different product forms. The supplier competition framework enables to get more insight into the position of a product in the physical good – service continuum and the matching level of supplier competition.

4.1.2 Forms of supplier competition

Different positions in the physical good – service continuum come with different forms of supplier competition. In figure 4.4 the physical good – service continuum and three different forms of supplier competition are shown. The dotted line shows that the different forms of supplier competition might have some overlap.

Supplier competition on price: The products are simple and available off the shelf with a standard quality. The relation with the supplier is arm's length and more suppliers are available on the supply market. There is a low supplier dependency, low supplier integration which makes the transfer to a different supplier easy. The supplier competition is only on price. The supplier with the lowest bid to supply the product gets the business.

Supplier competition on total cost of ownership: The products are a mix between on the one hand, a physical good with fixed drawing specifications and on the other hand, service as the input from the supplier. The supplier competition should not only be on price, but on total cost of ownership (TCO). Formerly the TCO is defined as the present value of all costs associated with a product, service or capital equipment that are incurred over its expected life (Handfield, 2006). The supplier competition is not only on the purchase price of the product, but involves all the costs during the life of a product, including purchase price, acquisition costs, usage costs, and end-of-life costs.

Supplier competition on value: The products or services are unique and especially designed or exclusively performed for the company. The supplier has to use its experience and knowledge to create a value proposition. The relationships are tight and both parties trust each other. The supplier dependence is high, because the knowledge is rather unique. Only a few suppliers are able to produce the special products and services, and high investments from both sides have to be made to establish a good relationship and to set up the development. If supplier competition is mentioned in a partnership, the trust might be affected and the relation for the future is risked. A transfer to another supplier also means again high investments. An example of a product with a high service contribution is the establishment of third-party logistics (3PL). This is an external provider who manages, controls, and delivers logistics activities on behalf of a shipper (Hertz, Alfredsson, 2003). The intention is that is should be a mutually beneficial and continuous relationship. Third party logistics providers typically specialize in integrated warehousing and transportation services that can be customized to customer's needs.

If supplier competition is used in such partnerships to put some pressure on the supplier, the choice should be to apply supplier competition on value. 'Value is what buyers are willing to pay, and superior value stems from offering lower prices than competitors for equivalent benefits or providing unique benefits that more than offset a higher price' (Porter, 1985, p.15). 'Value creation is an objective for sourcing to contribute to an organization's competitive position' (Axelsson et al., 2005, p.16). The supplier competition is about the total solution and the unique knowledge contribution, rather than only price.

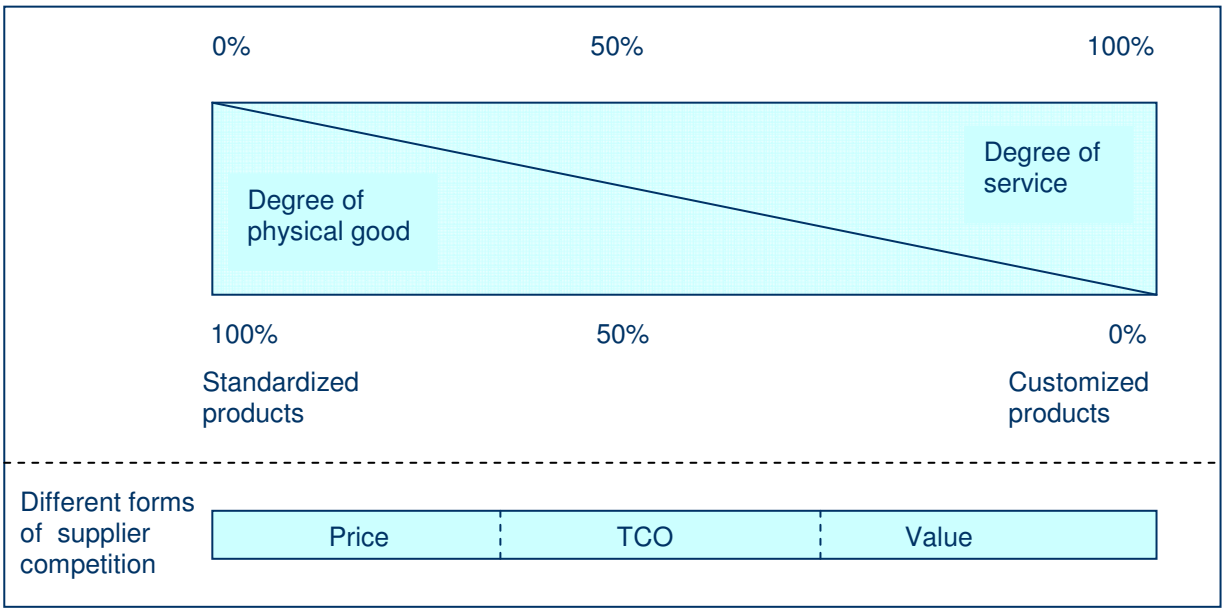


Figure 4.4 Physical good – service continuum with different forms of supplier competition

4.1.3 Dependences of supplier competition

Three levels of supplier competition are distinguished: supplier competition on price, TCO and value. On the basis of information from interviewees, a set of dependences for the application of supplier competition is distracted. These dependences give more insight into the characteristics of the product and have to be taken into account before supplier competition is applied. These dependences include: level of outsourcing, classification of the product in the Kraljic portfolio (see appendix 7), classification of PMS according to the supplier and the stage in the PLC (figure 4.5). These four concepts are explained in this paragraph.

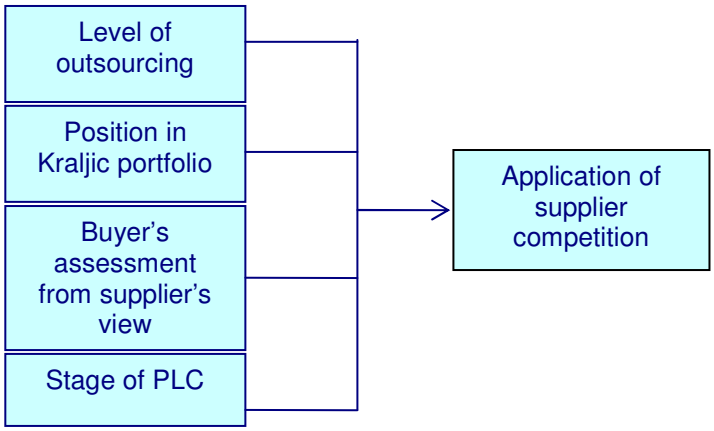


Figure 4.5 Dependences of supplier competition

Level of outsourcing
If the decision has been made to outsource a product, the next steps have to be taken into consideration (see figure 4.6).

1. Define what to outsource (product and/or service)
2. Define why to outsource (to achieve cost reduction, to reduce time-to-market, to be innovative, or to follow a strategy)
3. Define how to outsource (partnership, short-term contracts)

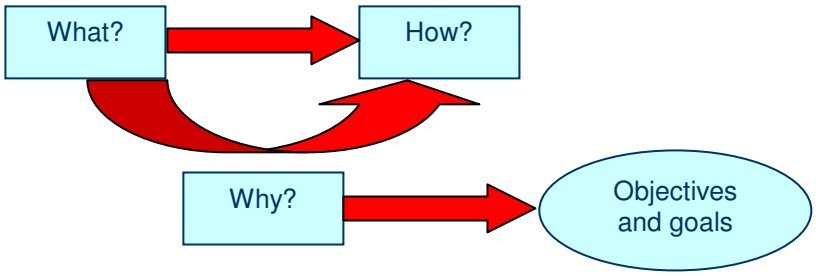


Figure 4.6 Outsourcing

If the objective and goals are clear, a distinction can be made between different levels of outsourcing and an outsourcing strategy can be made. According to Heikkilä and Cordon (2002) the outsourcing decision should be based on the contribution to the overall success of their business. This decision can be based on the 'core or non-core' distinction or by analyzing the firm's value chain as described by Porter (1985). Analyzing the value chain reveals the value created by the various activities in its chain and the linkages among activities. In figure 4.7, an overview of the different levels of outsourcing is given. The arrow represents the amount of trust. The higher the outsource level, the higher is the need for trust between two parties. The business goals of both companies have to be in the same direction and both companies will aim for a win-win situation. In appendix 6 the explanation per level is given. If it is decided to outsource a simple, standard component, the reason of outsourcing can be to achieve cost reduction. Then outsourcing is through an arm's length relationship based on negotiation and the level of outsourcing is lower. If it is decided to outsource a complex, high tech product, then the reason is for example to use the suppliers' extended knowledge of unique technologies, because of the lack of know-how within the company (Heikkilä and Cordon, 2002). It is more desirable to have a strong relationship where knowledge can be shared easily. In these strong relationships, a joint roadmap is conducted for the future, including a joint planning of the direction and investments to make. This is a higher level of outsourcing.

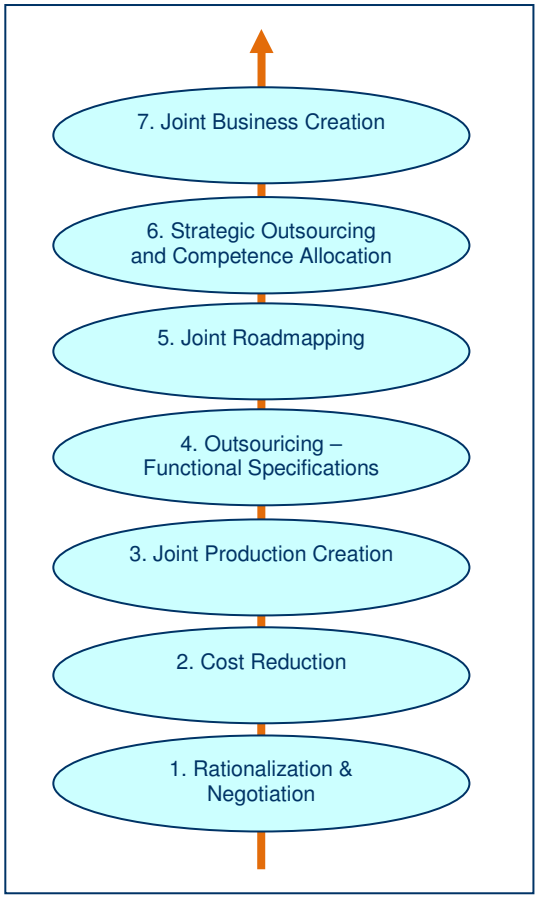


Figure 4.7 Levels of outsourcing

At the lower levels of outsourcing, the relationships are at arm's length and the application of supplier competition is more obvious. The supplier's contribution is in the form of physical goods. For higher levels, if supplier competition is applied, it will be on total cost of ownership and value, not on price only. The products are specific and the supplier contributes to the total product with knowledge as input. If during the life cycle the transfer to another supplier is mentioned to a supplier, the relation is risked.

Kraljic portfolio

Within PMS, the Kraljic portfolio (1983) is used to classify products leverage, strategic, routine or bottleneck. In figure 4.8 the Kraljic portfolio is shown with horizontally the supply risk and vertically the spend. In appendix 7, the positioning of several commodities of PMS within the Kraljic portfolio is given. Depending on the product segment of the portfolio, the supply strategy and the application of supplier competition should differ. For strategic products, supplier competition only on price does not seem a good solution, because other factors, like quality and innovativeness, have to be taken into consideration. Supplier competition on price seems a good solution for routine products, where quality is standard and no additional knowledge is needed. The bottleneck and leverage products have to be examined per product to conclude the possible type of application of supplier competition. The positioning of the products in

the Kraljic matrix is subjective, so only an indication for the type of application of supplier competition can be provided.

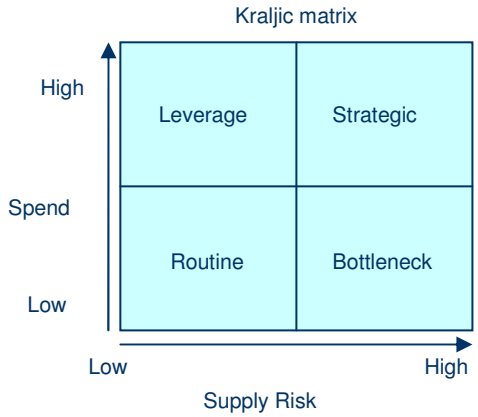


Figure 4.8 Kraljic portfolio (Source: Kraljic, 1983)

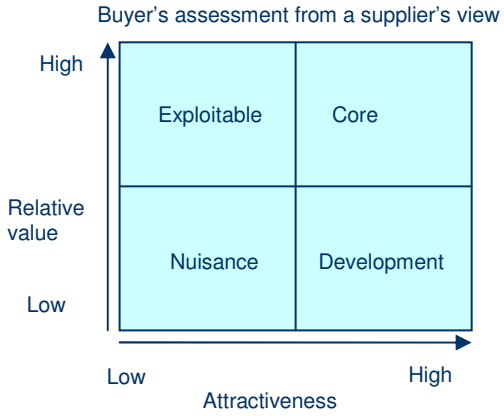


Figure 4.9 Buyer's assessment from a supplier's view

Supplier's view towards PMS

For the Purchasing department it is important to know the suppliers' position from its perspective. The company can decide how much time, money and how many people to invest in that relationship. It is also important for a company to get insight into the position of a company from a suppliers' perspective. In figure 4.9 the buyers' assessment from a supplier's view can be seen with horizontally the attractiveness of the business for the supplier and vertically the relative value of the supplier's total business. The nuisance position should be avoided, because the negotiation power decreases dramatically. Putting pressure on the supplier and using supplier competition make no sense in this part of the portfolio. If the position is core and the supplier is eager to keep the business, these approaches have more chance to succeed. In appendix 8 an explanation of the buyers' assessment from a supplier's view is given.

Stage of PLC

To apply supplier competition it is important to define in which stage of the PLC the product is. The supplier competition will be different in the first stages, where the emphasis is on the development of a good qualitative product, than in the latter stages where the emphasis is on cost reduction. In the development stage, a roadmap for the total life cycle of the product has to be made. A structured plan and strategy for the life of that product will avoid problems in later stages. The company and supplier can prepare on future changes. If it concerns a more strategic product, the supplier can be involved from the beginning and can adjust its planning. If the supplier knows from the very first moment of involvement that it must decrease its prices with a certain percentage in the maturity stage, the supplier is out of business if it does not meet this cost reduction. Also for the decline stage, agreements about service have to be made in the first phase. If the company has a structured plan beforehand, it will not be surprised by sudden price increases at the end of a life cycle.

4.2 Methods for supplier competition

As mentioned before, supplier competition on price, TCO and value are different forms of supplier competition. These forms require different methods for application. Because the factors' influence is different for on the one hand 100% physical goods or on the other hand 100% service, the way of supplier competition application will differ. For simple products of low value with an existing design, the price is the main issue to compete on. Many suppliers can deliver these products with a required quality. This form of supplier competition requires a different approach than supplier competition based on the total best solution. Request for x (RFx), e-auction, design-in workshop, and threat are different methods for the application of supplier competition and are described in this section. The different methods are positioned in the supplier competition framework, which indicates when the different methods can be used.

4.2.1 Request for x

A request for x (RFx) is the acronym for a request for quotation (RFQ), request for information (RFI), or request for proposal (RFP).

In traditional competitive bidding a written RFQ is sent by the buyer to a limited number of suppliers. An RFQ contains supplier's information about price, payment terms, quality level per item and more factors on which PMS wants to compare the suppliers. The RFQ is prepared to make an estimation of the supplier's possibilities. These suppliers respond in writing with a single 'best offer' bid (Hartley et al., 2004). The actual number of bids is not revealed to competing suppliers. The purchaser can decide how many suppliers are asked for an RFQ.

The RFQ can be preceded by a RFI, or a RFP. The goal of an RFI is to collect written information about the capabilities of a supplier. The RFP is a proposal typically based on more than only price. The RFP's are usually sent to approved suppliers to check the suitability of that supplier to supply the product.

An advantage of using an RFx is that the competitive advantage of the different suppliers can be seen. Disadvantages of an RFx are the difficulty of comparing offers and the long time it will take to receive and judge all the offers. This results in a longer total purchasing process.

Supplier competition is present if suppliers know that other suppliers can do an offer too and are trying to make the best offer to get the business. The offers can be compared on different factors, like price and cycle time. A balance should be found between the costs, quality, reliability and more factors that are regarded as important. Products with fixed requirements will mostly be judged on price, the offers on knowledge will be compared on value added and total cost of ownership.

4.2.2 E-auction

A possible tool to gain the best price is an e-auction. An e-auction provides an online, real-time exchange for commodities in a particular vertical or horizontal industry (Neef,

2001, p. 88). It is often used as a downward price auction or reversed auction via the Internet, where suppliers lowering the prices at the same time as other suppliers in order to make the best offer. Participants from all over the world can be involved, which results in an increasing number of supplier participants and the potential for finding the most capable suppliers. Most auctions are completed within an allotted amount of time, for example an hour. During the auction suppliers may be able to follow the actual bids made, but buyers can also choose to reveal the bid prices and only show the ranking (van Weele, 2005). Suppliers know their position and this triggers them to give the best offer, so the supplier competition will increase. The requirements for the product are given via the tool and therefore the process becomes more transparent. These requirements must be stated clearly and precisely to avoid a misunderstanding between buyer and supplier (Smeltzer and Carr, 2002). An e-auction is most appropriate for high-volume, generic goods, where the requirements are fixed. To avoid that a supplier is not only selected on the best price, a TCO- approach has to be applied (Hur et al., 2006). All bids should be weighed against a set of predefined criteria.

Advantages of online auctions include lower transaction costs, shorter order-cycle times, many potential suppliers on the supply market, and competitive purchase prices (Hartley et al., 2004). Supplier benchmark information can be gained. Although there are also benefits for suppliers, not all suppliers are positive about the use of e-auctions. The focus on real-time pricing undermines the added-value nature that differentiates one supplier from another (Neef, 2001). Disadvantages include less personal interaction, the risk that the supplier cannot meet requirements, and the risk of negatively affecting the buyer-supplier relationship.

E-auctions are widely applied in business-to-business (B-2-B). With the possibility of adding capable suppliers worldwide, the supplier competition increases. The suppliers are aware of the competition and try to give the best offer. The time before the e-auction, the suppliers are preparing their bids for the e-auction and have to meet all the service, quality and technical requirements. During the e-auction, the suppliers see their ranking or even the price the competitors bid. Although the e-auction takes place within an allotted amount of time, supplier competition is applied through the whole supplier selection process from the moment the supplier is involved. The e-auction tool is suitable for products that can be transferred easily and are not core for the company. The supplier competition is on price and TCO, so e-auctions are applicable for products that fall in the left side of the physical good – service continuum (figure 4.2).

4.2.3 Design-in workshop

For the more complicated products with a lot of suppliers' knowledge contribution, an e-auction is not a suitable tool. The information is too complex to just compare the prices. More insight into the total value added of one supplier can be obtained through a design-in workshop.

A design-in workshop is a meeting of several potential suppliers together with a team of multi functional employees of PMS. The goal is to get insight into the possibilities of the different suppliers. The suppliers can be current suppliers, but also unknown suppliers.

The suppliers are asked to propose several ideas of developing a certain product based on functional requirements. During the workshop suppliers see their competitors and are willing to win. During the introduction, the suppliers are in a joined room, but for the detailed design the suppliers are separated. With his team the supplier tries to get the best solution with the use of their knowledge. The duration of a design-in workshop can differ from 1-2 days. Two weeks after the workshop the suppliers are expected to do an offer. This offer includes the development time, expected price, risks, expectations for cooperation, expected resources needed from PMS, and more factors that are important for the development and production of the product. Based on this offer and weighting criteria, the team can make a decision which supplier is the most suitable.

An advantage of a design-in workshop is the insight the company gets into the capabilities of the supplier to be able to form a good proposal in a few days. If a long development time is needed before the product can be produced, it can be a sign of incapability. This activity can be used as a benchmark for PMS. Another advantage is the insight into the possibilities for the design of the product. Different suppliers with dedicated knowledge are present and the suppliers may come up with innovative ideas. A non-disclosure agreement (NDA) will be signed to keep the knowledge between both parties. The design-in workshop forces the project team to have clear requirements in time, because these are required to get proposals from the suppliers. A disadvantage could be that there are many resources needed from different parties to make the design-in workshop a success. A secure preparation is needed to achieve the goals set. The involvement of different departments of the organization is needed.

The suppliers see the competition physically at the workshop and this creates a game environment. The suppliers want to be the best in their industry and want to have the business, so do the best they can. The supplier competition influences the willingness to make an offer. The supplier's contribution is knowledge and the supplier competition is based on value and total cost of ownership.

4.2.4 Threat

Threat can be used for all types of buyer-supplier relations, regardless if it concerns a physical good or a service. If the supplier is not willing to give in with a negotiation, the threat of transferring to another supplier can be used. Threats must be based on real possibilities, otherwise the company's credibility decreases enormously and the relation is risked. The threat of switching suppliers can increase the negotiation power of the company and may result in admission of the supplier, because it wants to get the business.

An advantage of using threats is that it increases the negotiation power. If the supplier feels that the threat is serious, the supplier may change its mind. Cost reductions can be achieved. A disadvantage of using threat is risking the relationship with the supplier. The supplier might not want to invest in new developments if serious threats have been used.

4.2.5 Realization of supplier competition framework

The four methods for supplier competition can be positioned in the supplier competition framework. In figure 4.10 the supplier competition framework is shown with the physical good – service continuum, the arrows representing different factors which differ for the service contribution, the different forms of supplier competition, and the methods to use supplier competition.

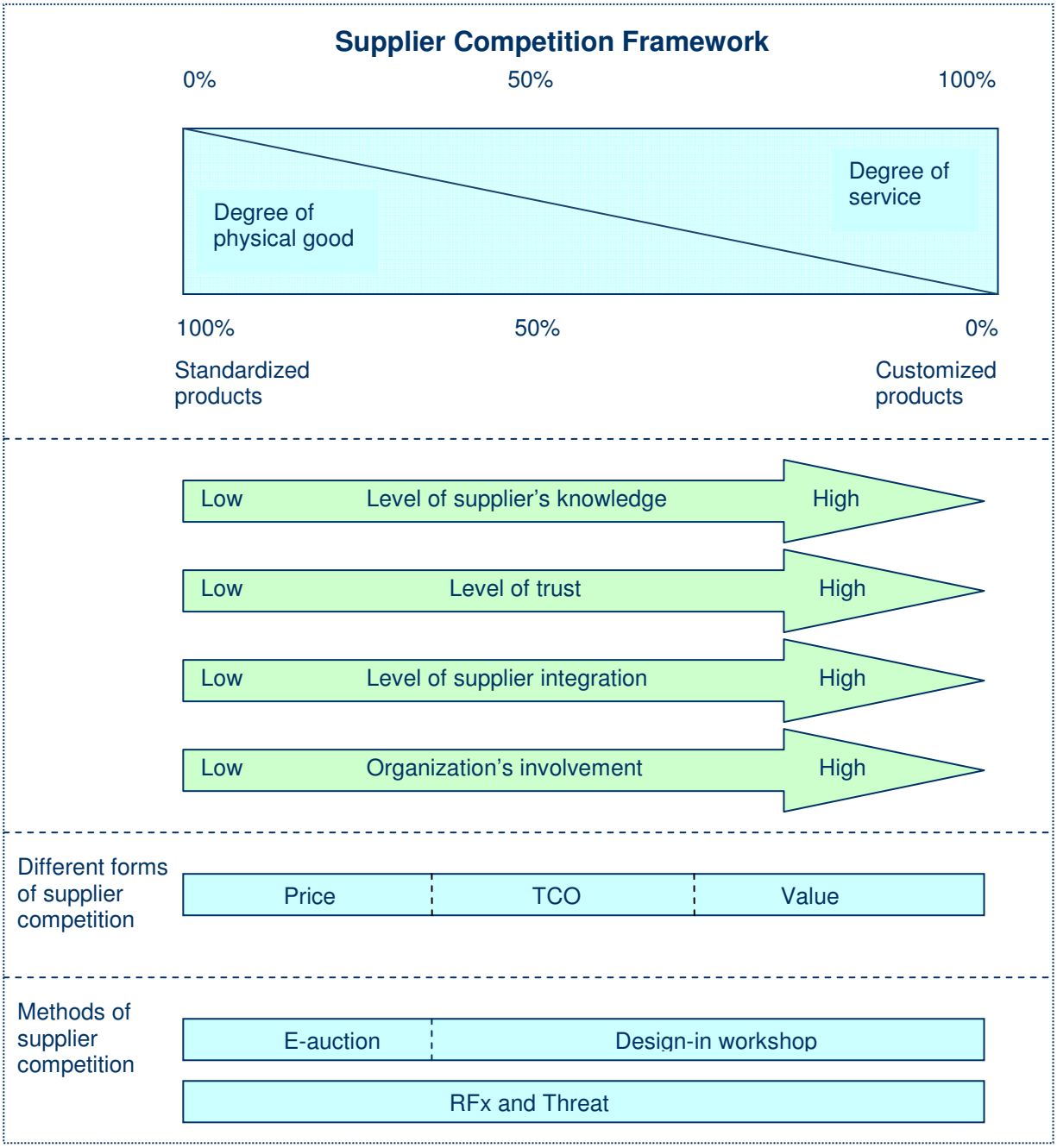


Figure 4.10 Supplier competition framework

4.3 Conclusions

The supplier competition framework is set up to form a basis for the definition of supplier competition. The physical good – service continuum from marketing literature is the point of departure for the supplier competition framework. Four factors are indicated which change as the product contains more service components. Three forms of supplier competition can be distinguished that differ with the level of physical good or service: supplier competition on price, TCO and value. Four dependences for the application of supplier competition can be mentioned: level of outsourcing, position in the Kraljic portfolio, buyer's assessment from supplier's view, and the stage in the PLC. The different forms of supplier competition might demand different methods for the application of supplier competition. Four methods are described here; RFx, e-auction, design-in workshop, and threat. E-auctions are mostly used for supplier competition mainly on price, the design-in workshops are mainly used for supplier competition on TCO and value, and RFQ's and threat can be used for all types of supplier competition. In the next chapter the application of supplier competition and the PLC at PMS is explained.

5 Supplier competition and PLC at PMS Purchasing Department

In previous chapters, the theoretical background about the sourcing strategies in the PLC is given, followed by the supplier competition framework, and the dependences and methods to apply supplier competition. In this chapter the supplier competition and PLC at the Purchasing department is analyzed and case studies are executed. In section 5.1 the current application of supplier competition in the supplier selection process is analyzed. In section 5.2 the case studies are described and in section 5.3 the conditions to use supplier competition are given. In section 5.4 the conclusions are drawn.

5.1 Supplier competition at PMS Purchasing Department

This section describes the current application of supplier competition at PMS. Paragraph 5.1.1 explains the supplier competition in the supplier selection process, followed by paragraph 5.1.2 where the application of the different methods within PMS is described. Paragraph 5.1.3 characterizes the current application of the PLC within PMS.

5.1.1 The supplier competition in the supplier selection process

One step in the purchasing process (as mentioned in section 2.3) is the supplier selection. PMS strives for a world class supply base with a balanced number of preferred suppliers. A preferred supplier is a classification for a supplier who has excellent capabilities and performance on costs, quality and delivery performance. The commodity team credits this classification. For every supplier selection at the Purchasing department the process of supplier selection needs to be followed. In figure 5.1 the supplier release process can be seen.

At the beginning of the supplier selection process the technological requirements and the stakeholders' needs have to be identified. After a sourcing and supply base analysis and market research a long list of suppliers can be defined. The long list contains suppliers who might be able to supply the product. Request for information (RFI) will be provided from the suppliers. In this document, criteria are mentioned to what the supplier have to satisfy. This results in a reduced long list. Based on self assessments and a request for quotation (RFQ), a short list can be composed. The short list exists of suppliers who satisfy the criteria set by PMS and who are suitable to supply the product. To mitigate risk and to identify the level of compliance with predefined requirements, an on-side assessment will be performed. The supplier selection team is responsible for final selection based upon the information gathered during the process. This will result in a request for supplier release towards the Purchasing Management Team. A supplier account manager (SAM) will be appointed who is responsible for the management of the relation with the supplier and for the follow up factors of the assessments.

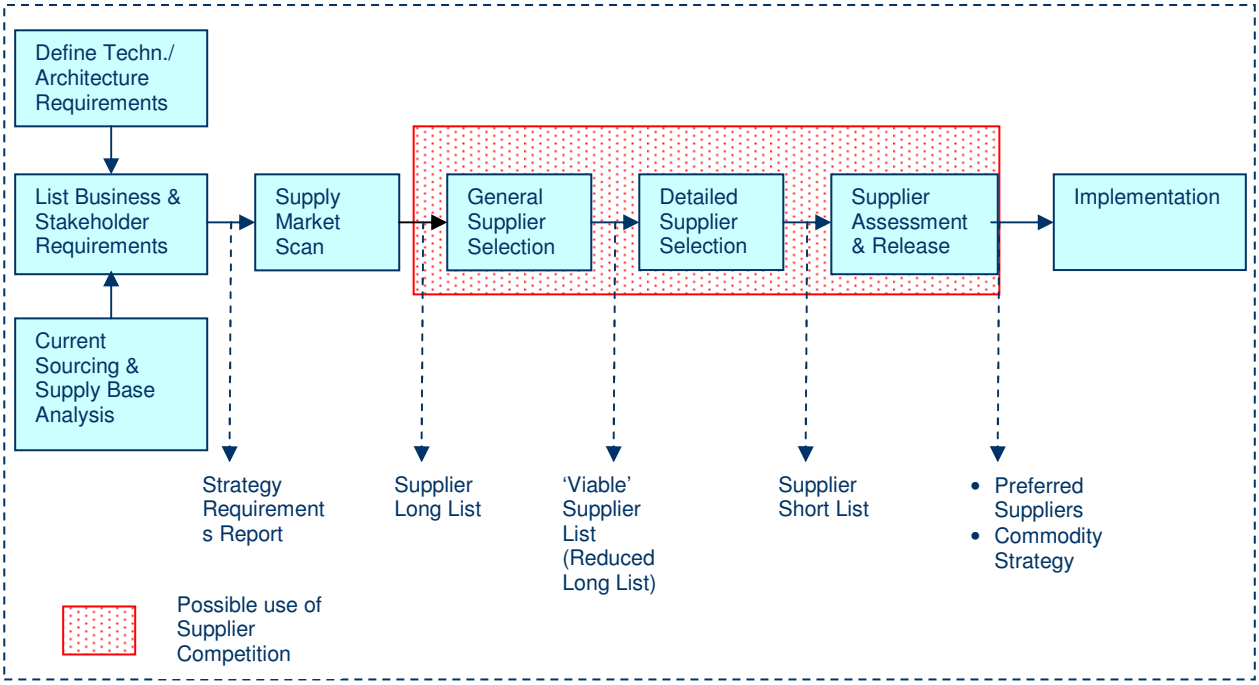


Figure 5.1 Supplier Release Process (Based on presentation supplier release process: 2006)

In most cases, the supplier selection for products follows this process. The exact fulfilling can differ and is dependent on the product. For low volume products with low value, the supplier selection process is not always performed in detail. If possible, the supplier choice will be between existing suppliers. Suppliers are aware of competition from the moment that the suppliers are involved in the process. If a purchaser emphasizes that the supply market is competitive, the supplier reacts on this fact and might be extra alert on the whole process. For example, it poses more detailed questions. The role of the purchaser is important in this situation. If the purchaser communicates clearly from the beginning that competition is present, supplier competition starts already at that point. Some supplier competition methods are used within PMS. In the next paragraph, the application of these methods will be analyzed.

Most purchasers of the Purchasing department are convinced that supplier competition can contribute to get the best out of suppliers. In the past different projects showed that the application of supplier competition results in positive results for PMS. For example, lower prices, better quality, and a better TCO were reached. The use of supplier competition can be in conflict with key performance indicators (KPI). One KPI at the Purchasing department is creating a supply base with preferred suppliers. Thus, this might be in conflict with using supplier competition, if not only preferred suppliers are participating in the supplier selection processes. Although most persons are positive about the application and the benefits of supplier competition, it is not always applied. Reasons for this are listed below:

- Based on the attribution of specifications to one supplier, the choice has automatically been made. Supplier competition is not possible anymore, because only that supplier is able to make the product. Sometimes persons from other departments already have

one specific supplier in mind and already involved it before purchasing is involved in the development process.
- There are hardly any suitable suppliers available on the supply market. The product is too complicated or specialized that only one or a few suppliers can supply the product.
- Supplier competition is not possible if an internal supplier is the predefined supplier. The business line Components can be seen as the internal supplier. Other suppliers might be able to produce the same components, but for some products these suppliers are never taken into consideration.
- One goal of PMS is to have only preferred suppliers in the supply base. A new supplier has to be chosen out of this supply base. If available suppliers are not classified as preferred suppliers and not present in the supply base, possibly the supplier will not be considered as a potential supplier.
- To apply supplier competition, time is needed to pass the process of supplier selection. Sometimes, decisions for one supplier have to be taken fast and there is not enough time is available to apply supplier competition.

The reasons mentioned above are valid for the supplier selection of new products. Some additional reasons are given why supplier competition is not applied later in the PLC at the Purchasing department:
- If the reason to apply supplier competition is cost reduction and the switching costs exceed the possible cost reduction at a new supplier, the product should stay at the current supplier.
- To transfer a product to another supplier, many resources are needed and risk is involved. Many departments are involved with changes of supplier and product. If a new supplier is selected, adjustments to the systems have to be made due to differences in the product. The organization has to support this transfer.
- If the product is designed with dedicated parts and only the current supplier can supply these parts, supplier competition is not possible. The supplier has a monopolistic position and will probably use this position to persist on its prices and other conditions. Its bargaining power is high.

Based on a set of criteria, the suppliers are evaluated on their performance. The Purchasing department strives for a proactive attitude to suppliers, and improvements and steps to be taken are discussed. The Purchasing department can act immediately if irregularities are signalized.

Most products of PMS are a mixture of a physical good and a service. 100% products off the shelf are hardly used for medical systems. Some screws appear to be standard, but often the component is adjusted for PMS. If all requirements, like quality, are met, these products are suitable to use supplier competition on price. Also pure services hardly exist for the product-related part of the Purchasing department. If a service is bought, it is often complicated. For example, the apparent simple transportation service of medical system's modules from supplier 1 to supplier 2 involves more factors than expected. Due to medical industry's prescriptions, the transportation has to follow specific regulations. The supplier's knowledge contribution is high.

For the majority of the products supplier competition on TCO and value are more appropriate, than only on price. The products are complicated and the supplier and PMS cooperate to design and develop the product. The supplier brings in knowledge and if supplier competition is used, the total life cycle of the product has to be taken into account. A supplier selection is often based on the trade-off between price and other factors.

5.1.2 Application of methods for supplier competition at PMS

Supplier competition is used at the Purchasing department in different forms based on interviews with initial buyers:

- **RFx**: It is common to demand information and quotations at the Purchasing department to get information about supplier's possibilities. Supplier competition is not always applied at the Purchasing department and often only one supplier is asked for an RFQ. If supplier competition is applied, more suppliers are asked for an RFQ. Only if the purchaser emphasizes the existence of other suppliers, the supplier will be informed about supplier competition. The supplier might use the flexibility and willingness of PMS to adjust their first offer if it realizes that competitive parties also do an offer. The Purchasing department takes the second offer into consideration for the further supplier selection process.
- **E-auction:** For the simple and standard components, the e-auction is a useful tool within the Purchasing department. First, a detailed supplier selection process is executed to assure the quality of the supplier's performance. Due to the real-time bidding process, the suppliers are aware of competition and are willing to reduce the prices to get the business. In the past, an e-auction has been used several times and a cost reduction up to 60% has been achieved. The cost reductions reached with e-auctions were not possible with face-to-face negotiations.
- **Design-in workshop:** A design-in workshop was executed at the Purchasing department a few times in the past. Several suitable suppliers were invited to see what their possibilities were. The ideas the suppliers proposed were surprising and based on these positive experiences a target is coupled with the number of workshops given. For the future more workshops will be planned.
- **Threats:** Besides RFx's, threat is the most used supplier competition method at the Purchasing department at this moment. During negotiations, the use of threats or bluff might result in a new agreement on the price or contract between supplier and PMS. Transferring suppliers only happens in the situation the supplier is not willing to change the insufficient performance.

These four methods are structured methods, which are applied to put pressure on suppliers for a specific project or product. Two other applications of supplier competition are used at the Purchasing department; supplier ratings on the pin board, and supplier awards. Supplier ratings are put on the pin board in the coffee corner, and suppliers who visit the Purchasing department are able to see their rating, but also their competitors' ratings. This might influence the future performance and willingness of suppliers to perform better than their competitors. The supplier award is given to the supplier with the best performance. This might influence the suppliers to improve, in order to receive the

award. These applications might cause supplier competition, but are not specifically used for the improvement of one supplier.

5.1.3 Current use of PLC at PMS

At the Purchasing department, the purchasers are aware of the life cycle of the product, but this concept is not used consequently. The PLC of PMS looks different than the general PLC used in the consumer world. There is no typical growth stage where the demand grows immensely from a few prototypes to a few thousands. The medical systems are produced with a constant volume of about 400 products a year and the market is stable. In figure 5.2 the PLC of PMS can be seen in comparison with the general PLC used in literature.

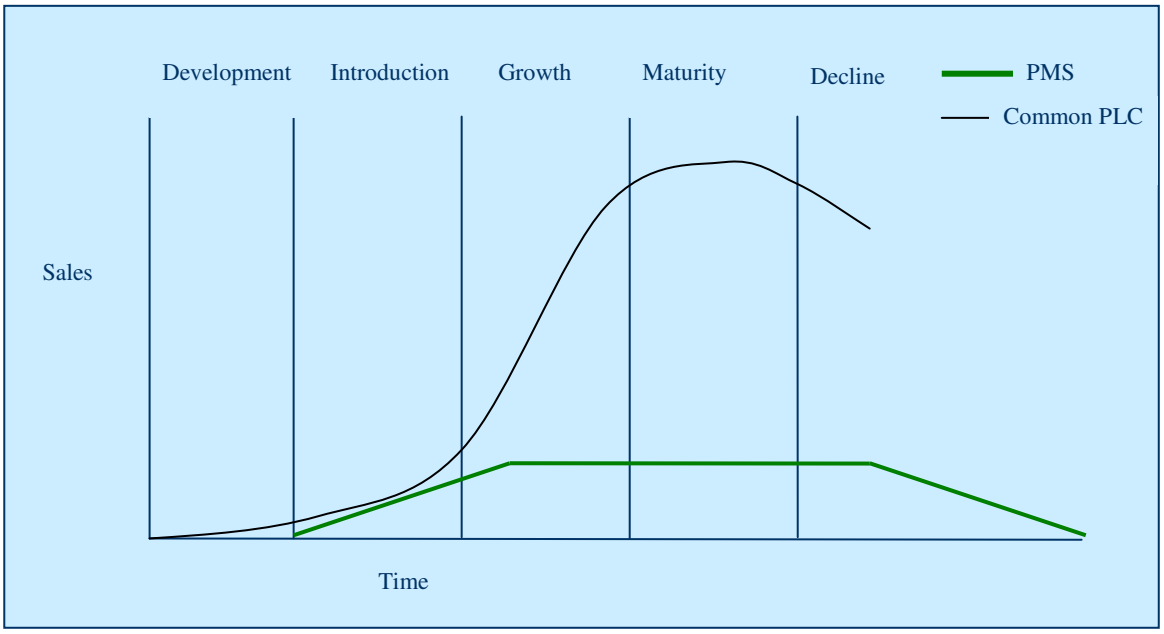


Figure 5.2 Common PLC versus PLC PMS

The life cycle of medical products is around twenty years. The medical system is developed, introduced, and after point of sale, PMS is required to give ten years of service. In later stages, the medical system will be upgraded or replaced. When the medical system is in the field, a defect might appear during its use. If components for the defects in the field are not used in production anymore, special arrangements for these components have to be made. Because of the low volumes, the components are really expensive in the service period and suppliers are not enthusiastic to supply them. When supplier competition is present, and the suppliers have the prospect of possible business, the suppliers will be more willing to sign for the service period than at the end of the life cycle. The supplier can already anticipate on this service period in the future. The current situation at the Purchasing department is that too little attention is given to the decline phase. The purchasers have targets based on cost reductions of Bill of Material (BOM); the total list of components of the medical system. The focus is not on the service issue, because it results not directly in target meeting. The contracts with suppliers in the development phase should contain arrangements about the service period.

The PLC can also be used to plan supplier relations. For example, at Philips Consumer Electronics it is planned to first select a supplier who is specialized in the development. In the growth phase a different supplier will be selected who is specialized in the production of big volumes. In the maturity and decline phase the focus will be on suppliers who produce in low cost countries at lower costs. PMS has not set up a structured plan for the choice of suppliers for the whole life cycle in advance. At the start a choice for one supplier is made, with or without supplier competition. If the supplier performs well during the PLC, no transferring takes place. In the past, margins were high and the agreed cost reduction was acceptable. If problems occurred with the supplier, purchasing tried to solve them in cooperation with the supplier. When the problems could not be solved, a transfer was an option. Nowadays, the margins are declining and the importance of having the best supplier at any time in the PLC is increasing.

As concluded from the theoretical background in chapter 3, different sourcing strategies are important in different stages in the PLC. Also the application of supplier competition might be different per PLC stage. If a structured plan and strategy is made in advance about the goals per stage of the PLC, the application of supplier competition can be adjusted. Within the Purchasing department more attention should be given to the total life cycle of a product and strategies and application of supplier competition should be fixed and planned. If supplier competition is applied at the right moment, it might result in the best offers and cost reductions.

In the next section three case studies are executed to see the practice of the use of supplier competition for different products in different stages in the PLC.

5.2 Case studies

In the previous section, the current use of supplier competition at PMS was described in general. To go more in detail how supplier competition is used at the Purchasing department, three case studies are executed. The case studies are analyzed to test if the supplier competition framework and its dependences hold in practice. In paragraph 5.2.1, the methodology of the case studies is given. In paragraph 5.2.2 a within case analysis is executed, in which for every case is investigated how supplier competition is used and what the consequences are for the organization and the supplier relationship. In section 5.2.3, a cross-case analysis is executed, in which the cases are compared to each other and to the supplier competition framework.

5.2.1 Methodology

To be able to compare the supplier competition framework with practice, an exploratory research focus is necessary. A case study is an appropriate method, because an answer is desired on the question ‘how and why’ to apply supplier competition within the Purchasing department. Direct observation and interviewing is possible with case studies, in contradiction to historical methods, where documents are the main source of evidence. A unique strength of a case study is that it deals with a full variety of evidence (Yin, 1994). A within case analysis and a cross-case analysis is executed and explained in the

next paragraphs. This is followed by a description of the case selection, construct validity, internal validity, external validity, reliability and limitations.

Within case analysis
First a within case analysis is executed where the cases are discussed one by one. The overall idea is to become intimately familiar with each case as a stand-alone entity (Eisenhardt, 1989). The cases contain the same subjects, in order to be able to compare the cases. The familiarity with each case might accelerate the cross-case analysis (Eisenhardt, 1989). According to Yin (1994) the individual case reports are used to draw cross-case conclusions and modify the theory, and result in writing the cross-case report.

Cross-case analysis
The central idea of the cross-case analysis is to go beyond initial impressions in a structured way (Eisenhardt, 1989). The goal of this cross-case analysis is to define similarities and differences between the different cases to be able to compare them to the theoretical framework. To prevent premature or even false conclusions from the different cases one should look at the data in different ways and different tactics should be used (Eisenhardt, 1989). In this research two different tactics are used. Tactic 1 is to select categories or dimensions and then look for within-group similarities. Dimensions can be suggested by the research problem or by existing literature, or the researcher can simply choose some dimensions (Eisenhardt, 1989). Tactic 2 is to select pairs of cases and to list the similarities and differences between each pair. This forces researchers to see subtle similarities and differences (Eisenhardt, 1989). From this cross-case analysis conclusions are drawn about the comparisons with the supplier competition framework.

Case selection
According to Eisenhardt (1989) selecting cases is an important aspect of the case study approach. The goal of the case studies is to examine products with different characteristics on the application of supplier competition and to link them to the supplier competition framework. As a result, more insight is obtained into when and at which level supplier competition can be used. Three projects are selected to study the application of supplier competition. *(*** description of the cases is removed here for reasons of confidentiality ***).* In the within case analysis (paragraph 5.2.2), the cases are explained in detail. The Purchasing department is involved in the supplier selection and supplier management for these different projects. The cases have different characteristics and are positioned at different places in the supplier competition framework.

One characteristic is the supplier's knowledge contribution. In case 1 the supplier's knowledge contribution is relatively low. The supplier is not expected to contribute on design issues and no specific knowledge is necessary to supply the product. The position in the physical good – service continuum is on the left side. In case 3 the supplier is expected to contribute with their knowledge for the design and application of the product. The position in the physical good – service continuum is around the middle, thus a hybrid form. In case 2 the supplier's knowledge contribution is high. The supplier is required to develop and think about the occurring problems during the life time of a product and is

therefore positioned between the middle and the right side of the physical good – service continuum. In the supplier competition framework different levels of supplier competition are mentioned. The case analysis examines if products with different supplier's knowledge contributions fit the described level of supplier competition.

Another characteristic of the cases is the products' position in the PLC. The case 3 project is in the development phase, while case 1 and case 2 projects are in the maturity phase. In literature is found that the stage of the PLC influences the choice of purchasing strategy. In this case study is examined what the consequences of the different stages in the PLC are for the application of supplier competition.

A last characteristic on which the cases are selected is the application method of supplier competition. Possibly the use of a different method may result in different conditions and consequences for supplier competition. In case 1 the method used is e-auction, in case 2 threat, and in case 3 design-in workshop.

Each of the case studies represents a different situation as a consequence of the difference in characteristics, and therefore the cases are complementary. In table 5.1 the projects and their characteristics can be seen.

Project	*Supplier's knowledge contribution*	*Stage in PLC*	*Current used application*
Case 1	Low	Maturity	E-auction
Case 2	High	Maturity	Threat
Case 3	Hybrid form	Development	Design-in workshop

Table 5.1 Case studies with characteristics

Construct validity
Construct validity is the establishment of correct operational measures for the concepts being studied (Yin, 1994). By combining the findings of the different independent sources, data triangulation occurs and contributes to enlarged construct validity. Data triangulation is the rationale for using multiple sources of evidence (Yin, 1994). Evidence for case studies may come from six sources (Yin, 1994): documents, archival records, interviews, direct observation, participant-observation, and physical artifacts. If only one method is used, the outcome may suffer from shortcomings. The combination of different methods can correct and complete the outcome (van Aken et al., 2003). In table 5.2 can be seen which sources of information are used for the different cases.

Project	*Sources of information*
Case 1	Documents, archival records, interviews, direct observation, participant-observation
Case 2	Documents, archival records, interviews
Case 3	Documents, archival records, interviews, direct observation

Table 5.2 Sources of information

Case 2 started in August 2005 and documents, archival records and interviews were sources of evidence. In addition to these sources of evidence, direct observation was possible for case 1 and case 3, due to the fact that these cases took place during the investigation period. For case 1, also participant-observation was feasible, because there was the possibility to be a team member. People, who were involved closely with the different cases, were spoken with. The list of interviewees per case is illustrated in appendix 10. The case studies are reviewed by key informants to avoid subjectivity and it increases the construct validity.

Internal validity
Yin (1994) defines the internal validity as establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from false relationships. The cross-case analysis contributes to a higher internal validity. In the cross-case analysis the cases are compared. Based on the findings, conclusions can be drawn about the supplier competition framework and practice. Several conditions are examined to apply supplier competition.

External validity
The external validity is the establishment of the domain to which a study's findings can be generalized (Yin, 1994). The case studies are mainly focusing on the application of supplier competition at the Purchasing department and PMS. Although some similarities can be seen for the application of supplier competition at PMS and different companies, the products and the customer market differ too much to generalize the outcome of this research to other companies and industries.

Reliability
According to Yin (1994) reliability is demonstrating that the operations of a study, such as the data collection procedures can be repeated, with the same results. The methodology for the case study is described in this report and contributes to a higher reliability. All interviews are elaborated and stored in a database, and the used documents are gathered, so that other people can enter the database and look up these notes and evidence. Other investigators can review the evidence and are not limited to the written report. A case study database increases the reliability (Yin, 1994). Data triangulation also contributes to a higher reliability, if data from different sources are consistent.

Due to the qualitative method of information gathering, the exact replication of the interview is not possible. The answers depend on the motivation of both the interviewee and the interviewer, their interpretation of questions and answers, and the situation and surroundings.

Limitations
One limitation of this case study is that the research is performed by one investigator. Multiple investigators enhance the creative potential of the study and may have complementary insights, which can enrich the data (Eisenhardt, 1989). Although one investigator performed the research, conversations with supervisors and other people involved resulted in some input which contributed to the research.

According to Eisenhardt (1989) another limitation is that with less than four cases it is often difficult to generate theory with much complexity. The choice for three cases in this study is made because these cases are complementary and cover the supplier competition framework. Executing three cases was possible in the limited timeframe.

Yin (1994) mentioned the occurrence of possible informal manipulation as the danger of participant-observation and is a third limitation. In case 1 the participant-observation was one of the sources of evidence, and it is tried not to influence the decisions or results, but only to be close to the decision moments and to get feeling for the situation.

5.2.2 Within case analysis

In the next paragraphs a short description of the cases is given with the results and remarks for the different cases. In appendix 11 the cases are described one by one with a more extended explanation, including a general project description, analysis of the application of supplier competition, consequences and conditions of the use of supplier competition, and the results of the project.

Case 1:

Project description

****** for confidentiality reasons the content of the cases has been removed partially******

The first case concerns mature and simple products with fixed requirements. No specific knowledge from the supplier is necessary and the relation with the supplier is arm's length. The method used in this project is e-auction, preceded by a thorough supplier selection process. An e-auction enables a transparent supplier selection process and forces the internal organization to have clear requirements. Two suppliers are selected to bid on four packages during an e-auction. The supplier, who can supply the package for the lowest price, gets the business for a specific period. After this period a new selection process will take place.

The supplier competition is not based only on price, as was the expectation beforehand. First a thorough supplier selection process took place to prevent bad performance during production, before the price based comparison was executed during the e-auction. As a consequence of a late retreat of one supplier, the two remaining suppliers thought three suppliers were joining the e-auction. Several consequences of using supplier competition can be seen; signed service contracts, sharper questions, achieved cost reduction, and a winning spirit at supplier's side. Also the e-auction has direct consequences; sceptism about e-auction turned into acceptance, processes became more transparent, and before the e-auction no optimal offer was given. Several conditions are connected with the application of supplier competition. The explanation of the consequences and the conditions are found in appendix 11.

The relation with both suppliers did not change after the e-auction. The suppliers are satisfied about the whole process and communication. Both suppliers have a part of the business. The achieved cost reductions of the separate packages is added up and in total,

8.8% cost reduction is achieved by using supplier competition. The changes in prices have to be implemented and resources are claimed for the implementation process.

Remarks
During the analysis of the components it appeared that it was too risky to include all the components in the e-auction, due to incomplete drawings or high costs of transfer. The total number of components in this project has been reduced to mitigate risk. A next project comprises these risky components, which need specific attention with extra attention. The analysis was an important factor here and contributed to a better result.

The supplier selection process before the e-auction was well organized and necessary to get the best results from the e-auction. Other suppliers were rejected because of their inability for one or more of the selection criteria. At PMS supplier competition on only price is hardly possible. Even for the simplest components, a thorough process for supplier selection is necessary. From the beginning of the project, the suppliers knew that there were other suppliers who might have the business. Also during the process it was clear that supplier competition was applied.

E-auction is a tool to help in using supplier competition, but the use of the tool should not be the goal. During the preparation it should be checked if this is an appropriate tool to use supplier competition for the product. In this case, for example, the choice was made to bypass the e-auction for two out of six packages, because the bid of one supplier was not competitive.

The resources for the implementation have to be claimed before the real e-auction, because a quick follow-up results in faster application of the cost reduction. An evaluation was not done. For next projects this can be useful, in order to improve the process and evaluate the learnings.

Case 2:

Project description
****** for confidentiality reasons the content of the cases has been removed partially ******

The second case concerns a highly customized and critical component. This mature product is difficult to transfer to other suppliers. The supply risk is considerably high, because the supply market is small, the product is high-tech and is applied to customer specification. This case focuses on the cost reduction project and aims for 30% cost reduction.

A brainstorm session with PMS and supplier 1 was organized to achieve cost reduction, but without results. A second party (supplier 2) conducted a should cost analysis and together with a benchmark from Internet it formed a serious price comparison. Supplier 2 did an offer and this offer was used as threat for supplier 1. The combination of the cost analyses and threat influenced the monopoly position of supplier 1. After negotiations it was agreed to decrease costs with 30%.

The supplier competition was not planned in advance, because it was planned to achieve cost reduction at supplier 1. The supplier competition used in this project is based on price. The offer of supplier 2 is only used as a price benchmark, although it concerns complicated products based on functional requirements. Specific knowledge from the supplier is necessary and the relation with the supplier is a partnership. Consequences of using supplier competition were the cost reduction achieved and the blemished monopoly position of supplier 1. The use of the cost analyses and threat resulted in an increasing negotiation power for PMS. To use threat, several conditions have to be taken into account, which are also explained in appendix 11.

The relation with the supplier is cooperative and the communication is open and flexible. During the negotiation the distance was larger. Supplier 1 realized it had to agree the cost reduction to keep the business. Supplier 2 was a possible alternative, but was never assessed. The transfer was possible, but it would involve many resources, costs and effort. The implementation is still proceeding and supplier 1 is not pro-active to implement the changes. If the new agreed cost reduction is not implemented yet, supplier 1 receives the old price for the products.

Remarks
In theory, it is possible to achieve good results and cost reduction with negotiations. However, the practical performance of the implementation is often more complicated and harder to realize. It is important to have a good follow-up with available resources; otherwise the results are not achieved.

In this case the positive result can be ascribed to the combination of the use of threat and the cost analyses. The supplier competition seemed only to be on price. Supplier 2 was not thoroughly assessed on other factors than price. The goal of this case was to achieve cost reduction at the current supplier, not to execute a new supplier selection process. If supplier 1 did not want to change and PMS had to go to supplier 2, problems might have occurred, because no thorough supplier assessment was executed.

PMS intends to stay at supplier 1 and supplier 1 knows this. An advantage is that the level of trust is higher and more cooperation from both sides is expected. A disadvantage is that the monopoly position is still there and the negotiation power will decrease. It has to be said very clearly that the supplier has to perform well to stay with that supplier. Also the price has to be competitive, otherwise a supplier transfer is considered.

Case 3:

Project description
****** for confidentiality reasons the content of the cases has been removed partially******

The third case concerns a custom made product, which can be placed in the development stage of the PLC. The supplier's core knowledge is demanded. The goal of the project is to select the supplier with the best solution and the supplier who is able to enter the market as soon as possible.

The supplier competition in this project is based on the total cost of ownership. The knowledge contribution of the supplier is important and the costs are not the first priority. A trade-off between different factors is made for supplier selection.

The method used for applying supplier competition in this project is a design-in workshop. The choice for a design-in workshop was made to save time, to immediately solve unclear technical issues, and to get to know the suppliers. Internal people were present as well as the two supplier teams.

Consequences of using supplier competition in this project are the possible effects for other projects, risk of too optimistic bids, pro-active attitude of supplier, and the flexibility of both parties. Direct consequences of using a design-in workshop are physically presence of competitors, pressure for requirements, direct reflection of the requirements, presentations result in extra supplier competition, obtaining new knowledge from suppliers, and the direct reaction of the suppliers can be seen. A further explanation of these factors and the conditions are described in appendix 11.

The relation with both supplier 1 and supplier 2 is cooperative. Till this moment in the process, the relation between PMS and the suppliers did not change noticeably due to the application of supplier competition.

Remarks
A good preparation is essential for a good process development. In this design-in workshop a clear overview of requirements was made, but still some important decisions were not made. The suppliers are not able to calculate these parts, because there is too much uncertainty. A lot of questions appeared about unclear requirements. Information was sent to the suppliers, but it was not always clear for the suppliers. One supplier had to ask many questions to be able to understand the demand of PMS. So the preparation have to be good from both PMS and supplier to make it a successful day.

The design-in workshop is among others an efficient way of supplier selection. The suppliers can pose questions about different issues and get an answer immediately. Suppliers see the competitors and their presentations, and this influences the supplier competition. Both parties are willing to get the business and will try to make a good offer. After the design-in workshop, PMS have to give clear instructions about the design of the offer. This will guarantee providing comparable offers from different parties. In this case, both parties used their own format for the offer and no clear comparison could be made, because different pricing was used, and different factors were illustrated. A clear process and follow-up has to be made to guarantee flexible developments. A clear list of knock-out criteria and trade-off criteria has to be set up and filled up to make a supplier selection. The suppliers also know that the choice of supplier is based on TCO. The different perspectives and interests of the people involved can cause problems for the supplier selection, and has to be taken into account.

5.2.3 Cross-case analysis

After the within case analysis, the cross-case analysis is done. The different cases are compared with each other and the supplier competition framework. Two tactics described by Eisenhardt (1989) are used to execute the cross-case analysis. The first tactic is to select categories or dimensions and then to look for within-group similarities. The second tactic is to select pairs of cases and to list the similarities and differences between each pair. In the next paragraphs the conclusions of the cross-case analysis are drawn and differences and similarities with the supplier competition framework are given. The extended analyses are described in appendix 12.

With the focus on product-related products, the division of physical goods and services can be made for the Purchasing department. The physical good represents a product with little supplier's knowledge contribution and can be delivered off the shelf. The products with service contribution represent complicated, customized products.

It can be concluded that the arrows in figure 4.10 corresponds with the findings in the case studies. A lower level of supplier's knowledge contribution, lower level of trust, lower level of supplier integration, lower level of organization's involvement comes with a product positioned on the left side, in the direction of the physical good. More service contribution comes with a higher level of supplier's knowledge contribution, a higher level of trust, a higher level of supplier integration, and a higher level of organization's involvement.

The application of the forms of supplier competition in practice differs from the positioning of the forms of supplier competition in the supplier competition framework. The expectation was that supplier competition on price is possible for simple and standardized products. In case 1, supplier competition on price could be applied on the simple components, but first a thorough supplier selection process was executed to check all the other factors to mitigate risk. The application of supplier competition on price is possible, but with a preceding process of supplier approval.

Another expectation was that supplier competition on TCO and value is applied for more complicated and customized products with a higher level of service included. In case 2 it appeared that the form of supplier competition was rather on price, than on TCO. Threat with transferring to supplier 2 and a should cost analysis was used to put pressure on the product's price of current supplier 1. Supplier 2 was not assessed on quality aspects, but used as a means to show that a lower product price was possible. In this case, supplier 1 agreed on cost reduction. However, if supplier 1 did not agree on cost reduction, supplier 2 was given the opportunity to produce prototypes and problems might have been occurred. If a serious threat to switch to another supplier was done, a thorough supplier assessment has to be executed to prevent problems of incapability.

The expectation for case 3 was that the supplier competition was based on TCO. In the design-in workshop this impression was given and it is said that several factors were taken into account with the supplier selection. A complete list with criteria for the supplier selection was made, but during the supplier selection this list is not filled up.

Due to the short time to make an offer, information lacked and the offers were not completely comparable, due to supplier's own offer format. The project needed to start quickly, so the team decided that the supplier with the shortest delivery time of prototypes gets the opportunity to produce the prototypes. Even price was not considered in this case. At this moment the whole business is not yet allocated, but the chance that this supplier gets the total business increased.

The methods used in the different cases for the products with different service contribution are comparable with the methods described in the supplier competition framework. The e-auction is applied for simple, standardized products and the design-in workshop for a more customized product. The use of threat is always possible according the supplier competition framework and here it is applied for a product with more service contribution.

The supplier competition framework is comparable with practice, except the use of the forms of supplier competition. Not every case is similar and there is not one best solution how to apply supplier competition. It cannot be concluded that the way supplier competition is applied at the Purchasing department is wrong, but recommendations are given to optimize the use of supplier competition. In comparable future cases people might make the same choice, but it is recommended to consider several factors before making the decision. For every case a well-considered trade-off has to be made before it is decided if and how to apply supplier competition. In the next section the application of supplier competition per stage of the PLC is given with conditions when to use supplier competition for the different forms of supplier competition.

5.3 How to apply supplier competition per stage of the PLC?

In the preceding sections, more insight is gained into the application of supplier competition at PMS. A detailed view on practice is provided through the execution of case studies. This section elaborates the application of supplier competition per stage of the PLC. The literature review about sourcing strategies per stage of the PLC (chapter 3) forms a basis for this section in combination with the case studies and interviews, and thus a coupling with theory and practice is done. Per stage the application of supplier competition is discussed. This overview is followed by a set of conditions. This list can be checked if it is considered to apply supplier competition.

5.3.1 Development stage

The development stage is characterized by heavy R&D expenditures and uncertainty of the product success (Fox and Rink, 1977). The expenditures to develop a medical system are considerably high. PMS management should have a clear overview of the total product portfolio to prevent redundant expenditures. The development stage for medical systems is long, because these are complex high-tech systems with many health regulations. Mistakes in the compilation of the systems are tried to minimize. Sourcing decisions will affect the product mostly in this stage (Saaksvuori and Immonen, 2005), thus a precise supplier selection process is important.

The early involvement of the Purchasing department in the supplier selection process is crucial. At PMS, sometimes a supplier is chosen without the interference of the Purchasing department. This supplier selection is for example based on good experiences of the development department with the supplier of the latest version, or an internal supplier.

If timely involvement of the Purchasing department is assured, suppliers can be involved early to develop together and work efficiently. The supplier selection takes place in this stage of the PLC and supplier competition can be applied.

In this stage a roadmap with actions for the further life cycle of the product has to be made. This has several advantages:

- The internal organization can prepare the actions needed. If a supplier transfer is planned in advance, the different departments can make for example a process description for a flexible knowledge transfer.
- The supplier can prepare the actions needed. If it is planned in the roadmap to have an upgrade after two years, the supplier can take this change into account and forecast the needed components. Otherwise obsolete stock can be the consequence and results in higher costs.
- If a roadmap contains a plan for a new supplier selection process in the maturity stage, and if this plan is communicated to the supplier in early stages, the supplier is not surprised in a later stage. The buyer-supplier relation is not blemished then. The supplier knows that it has to perform competitively to keep the business, and a monopoly position is prevented. Clearness about the relation and the future to the supplier gives a supplier's view on the future in return. More openness between supplier and buyer is present.
- Due to a stable market, the expectations for the future can be forecasted quite easily for some products. Even if a transfer in a later stage is not desirable due to high transfer costs, a plan can be developed how to keep the supplier competitive. The experience of the Purchasing department includes the reserve of suppliers in later stages to reduce costs. Possibilities are arranging a fixed percentage of cost reduction yearly, or converting the production to a low cost country with low wages, in a defined time period.

A supplier selection can be based on positive effects for the short term. Clearly, in case 3 the supplier choice was based on short term effects; the quick production of a prototype. For this product a long term planning for the number of systems is present, but with the supplier selection this was not taken into account. In these kinds of cases a trade-off between short-term, quick delivery of prototypes and factors that are important for later stages has to be done.

5.3.2 Introduction stage

This stage is characterized by low sales and is vulnerable to attack from competing items or services. The personnel is not yet experienced with the processes and the product (Fox and Rink, 1977). The main task of purchasing is to balance the high likelihood of failure of the innovation with the urgency of adequate resources if it succeeds (Rink and Fox,

2003). If the product of case 3 is introduced on the market, it may be a success which requires a high production capacity, or it may be not successful which causes problems to cover the costs.

The goal of this stage is to introduce the product on the market, preferably before the competitor enters the market, cheaper and with more value than the competitor. The competition arises, but for medical systems the entry barrier is rather high, thus mainly the current competition is important to recognize. The policy of this stage is to work closely with suppliers to resolve material defects and implement engineering chances (Rink and Fox, 2003). It is not wise to switch suppliers and it is better not to apply supplier competition in this stage. Benchmarking can be used to control the situation.

5.3.3 Growth stage

In the growth stage, the first substantial profits are achieved and full-scale lines are developed. In literature, most purchasing strategies are attributed to the growth stage, due to a increasing variety of competitive dimensions. At PMS this stage is present, but not in the shape of an immense growth. The competition is present, the business is profitable and thus the business receives attention. The development of an efficient process is important. Cost reduction and competitive bidding does not have the emphasis in this stage, but are a preparation for the competitive pressure of the maturity stage (Birou et al., 1997). Supplier competition is not of significance, but preparations for the next stage can be done. Benchmarking can be used to control the situation.

5.3.4 Maturity stage

Fluctuating demand, aggressive competitors, cost-price squeeze are terms which characterize the maturity stage (Fox and Rink, 1977). The R&D will focus from product innovation to process innovation, and start to replace the product with newer versions (Roberts and Liu, 2001). Cost reduction is needed as competitors start lowering their prices and introduce improved versions of the product (Ryan and Riggs, 1996). According to Rink and Fox (2003) the increase of competitive pressure results in a trigger to improve techniques of negotiation with suppliers to get lower prices and to propose simplifications of component materials for the existing product. This is a good moment to apply supplier competition.

5.3.5 Decline stage

Sales are rapidly declining and substitution of products is planned. Ten years after the point of sale the service is still obligatory. At PMS different products form the product portfolio, ranging from low end to high end. New products and innovations are already on the market and often integrated in the high end systems. The established products are still in the market and represent the low end systems. The competition is declining, due to the decreased demand on the market. Suppliers are responsible for the spare parts. A break down in the field means that patients cannot be treated, and therefore a short time to repair is important. The spare parts have to be of good quality, due to high costs of non-quality. For example, if a spare part is not working properly after a repair in the field, the service mechanic has to return to get a new spare part. This results in extra costs.

Agreements about these spare parts have to be made when the business is still attractive for the supplier, thus in the development stage or maturity stage of the PLC when new contracts are established. The volume of medical spare parts is considerably low and it might be expensive to produce. If no agreements are made before the decline stage, the price of the spare parts will be very high. Supplier competition on these items will not succeed, because the negotiation power of PMS is low. The supplier might produce extra components during the production and might hold a stock for the life time period of the products.

If the product is in the decline stage and no agreements have been made about these components, it is possible to include the service components of the older system in the contract with the supplier who produces the new version of the product.

5.3.6 Conditions to apply supplier competition

A distinction in 'operational' and 'strategic' conditions is made. 'Strategic' conditions are external conditions which cannot directly be influenced by the project team, which uses supplier competition. An example of a strategic condition is the amount of suppliers on the supply market, because the project team cannot influence this on the short term. 'Operational' conditions are internal conditions, which the project team can influence directly. An example of an 'operational' condition is the clear communication about the whole process to a supplier.

The conditions are distracted from the case studies, supplemented with information from interviews. It is tried to give a complete list of the conditions necessary to apply supplier competition in the different stages of the PLC. To prevent incompleteness, all the interviewees were asked for conditions where applicable and the case studies are read by the people involved to complete the list of conditions. Not all conditions mentioned are applicable for all projects, but this list can be used as a checklist.

Sometimes in practical situations not all conditions can be satisfied. If one condition cannot be met, the application of supplier competition still can be successful. There might be a reduced chance of success. The project team always have to consider the conditions and the possible consequences and risks if these cannot be met.

A distinction of supplier competition on price, and on TCO and value is made. The conditions for supplier competition on TCO and value are comparable.

Supplier competition on price:
Operational conditions:

- *Complete and available drawings in English*; the drawings must be documented completely in an accessible database.
- *Standardized drawings*; the drawings should contain standardized agreements about used codes, that can be read all over the world and is not only applicable to PMS.

- *Detailed supplier selection process*; a detailed supplier selection process has to be executed before the supplier competition on price is done. Companies must be willing to join the supplier competition process and to bid on the components
- *Competitive quotes for all packages*; in the case 1 project, the initial offers for two out of six packages differed more than 20% in price. If these two packages were auctioned, the price would not further decrease as a result of lack of competition. It is decided to bypass the e-auction and an extra cost reduction of 3% was achieved by negotiations.
- *Good preparation*; the supplier competition process result in better outcomes.
- *Clear communication about the application of supplier competition*; all parties must know from the beginning of the process that supplier competition is applied to gain maximum advantages.
- *Clear communication about the used process*; no misunderstandings can occur about the use of the supplier competition method, the way of working and the supplier selection criteria on which the supplier selection is based.
- *Availability of resources within PMS*; these resources have to be available for the process before the e-auction, but also afterwards for the implementation. Planning the resources in advance results in a more efficient implementation process.
- *Contracting adjusted to roadmap*; if it is planned to have a new supplier selection process within for example two years, the contracts have to bridge this time period. Contracts for a longer period exclude the possibility to switch suppliers as planned.
- *Support from management*; to be credible and to be able to make decisions or compromises support from the management is necessary.
- *Equal information distribution*; all suppliers should get the same information to have a fair process.
- *Non Disclosure Agreement*; due to sensitive information shared between the suppliers and PMS a non disclosure agreement must be signed in advance.

Strategic conditions:

- *Sufficient suitable suppliers on the supply market*; with only one suitable supplier on the supply market who is willing to participate, no supplier competition can be applied.
- *Supply chain*: When considering switching suppliers also the supply chain will be affected. The second tier supplier stays not automatically in that position. If the Purchasing department insists on the same second tier supplier, new agreements have to be made with the new first tier supplier.
- *Global capacity of supplier*: Suppliers have to be capable and own enough capacity for the production or delivery for the world market and volumes PMS asks for. The processes have to be efficient and registered well to be able to supply with competitive prices.
- *Position in the supplier capability matrix (see appendix 13)*: It is preferred that suppliers have the desired level of production capabilities and level of development activities. If these levels are too low, the suppliers have to develop their capabilities which means high development costs. If these levels are too high, the supplier might be too expensive for the demanded product, due to the

extra supplier's capabilities. It is important to know the future direction of desired capabilities during the supplier selection.
- *Position in the matrix of the buyer's assessment from supplier's view (see figure 4.9)*: The negotiation power of the buyer will decrease if the supplier judges the business concerned as unimportant, due to low volumes for example.
- *Forecast*: The product has to have forecast for the future. If the product is only needed for one year, the time might be too short to earn more than the transfer costs.

Supplier competition on TCO or value:
Operational conditions:
- *Possibility to transfer*; the threat should be used on real possibilities to transfer and not only on bluff. If the supplier is not interested in the business anymore or cannot meet the requirements, big problems can occur if there are no serious alternatives.
- *Total overview of costs*; the costs of transferring should not exceed the costs of staying at the same supplier. The return on investment has to be within time constraints.
- *Precise preparation*; supplier competition methods require precise preparations to achieve the desired results.
- *Support from management*; to be credible and to be able to make decisions or compromises support from the management is necessary.
- *Availability of resources within PMS*; these resources have to be available for the implementation process. Planning the resources in advance results in a more efficient implementation process.
- *Detailed supplier assessment*; using threat requires an alternative suitable supplier. To assure the suitability of the competitor an assessment has to be executed.
- *Consider the relation*; if the relation with the supplier is based on trust, threat might influence the relation.
- *Agreement on requirements*; every department has to give their specific requirements and needs for the supplier selection and the product. Eventually one list of requirements has to be available with the trade-offs between the different departments' needs.
- *Different disciplines have to be involved to judge the bids*; a complete picture from different perspectives is necessary to make the best choice.
- *Clear and complete requirements in English*; before the supplier competition process starts it is important to have clear and complete requirements to follow an efficient process. If important decisions have to be made after the supplier competition process, this can influence the requirements and results in extra effort and time.
- *Clear communication about information distributed to a supplier in advance*; if information is distributed in advance to suppliers, all people involved should know what information is communicated. Sometimes it can be decided to release not all the existing information for specific reasons. It is recommended that one

person is responsible for the information to the supplier, and one complete package of information can be distributed.
- *Equal information distribution*; all suppliers should get the same information to have a fair process and to make the results comparable.
- *Do not express a possible preference*; if there is a preference for one supplier, the involved people do not appear to know this preference to all suppliers.
- *Non Disclosure Agreement*; due to sensitive information shared between the suppliers and PMS a non disclosure agreement must be signed in advance.
- *Multi-functional supplier team*; from supplier side also different departments are necessary at the design-in workshop. For example, only a salesman is not enough.
- *Time*; the whole process of the design-in workshop is time consuming. Enough time has to be reserved to prepare the design-in workshop, to wait for supplier's proposals and to select the supplier and to implement the solutions.
- *Clear communication about the used process*; no misunderstandings can occur about the use of the supplier competition process, the way of working and the supplier selection criteria on which the supplier selection is based. Both for the internal people and the suppliers this process has to be clear.

Strategic conditions:
- *Sufficient suitable suppliers on the supply market*; with only one suitable supplier on the supply market who is willing to participate, no supplier competition can be applied.
- *Level of outsourcing*: higher levels of outsourcing might result in difficulties of transferring suppliers.
- *Supply chain*: When considering switching suppliers also the supply chain will be affected. The second tier supplier stays not automatically in that position. If the Purchasing department insists on the same second tier supplier, new agreements have to be made with the new first tier supplier.
- *Global capacity of supplier*: Suppliers have to be capable and own enough capacity for the production or delivery for the world market and volumes PMS asks for. The processes have to be efficient and registered well to be able to supply with competitive prices.
- *Forecast*: The product has to have forecast for the future. If the product is only needed for one year, the time might be too short to earn more than the transfer costs.
- *Position in the supplier capability matrix (see appendix 13)*: It is preferred that suppliers have the desired level of production capabilities and level of development activities. If these levels are too low, the suppliers have to develop their capabilities which means high development costs. If these levels are too high, the supplier might be too expensive for the demanded product, due to the extra supplier's capabilities. It is important to know the future direction of desired capabilities during the supplier selection.
- *Position in the matrix of the buyer's assessment from supplier's view (see figure 4.9)*: The negotiation power of the buyer will decrease if the supplier judges the business concerned as unimportant, due to low volumes for example.

- *Tools and assets property*: If the tools are suppliers' property, the total costs of transferring might rise. PMS or the new supplier have to buy or to develop new tools.
- *Intellectual property*: Knowledge is needed to develop a product. If PMS cooperates with a supplier to develop a product, both parties contribute by putting in their knowledge. One party can claim the Intellectual Property (IP) for an idea and is entitled to exercise various exclusive rights subject to that product. Before considering switching suppliers PMS has to know who possesses the IP. If the IP is in hands of the supplier, alternatives have to be found to produce the product or use the technology, because the design of the product cannot directly be transferred.
- *Willingness to change*: Sometimes for years, the employees developed or produced systems together with a supplier. The organization has to be willing to build a new relation with a new supplier.
- *Innovativeness*: If products often are switched to other suppliers, a decrease of innovativeness can be a consequence. The supplier is uncertain about the future with PMS and it will not invest in innovations if it is not sure of payback.

5.4 Conclusions

This chapter reflects the application of supplier competition at the Purchasing department. A supplier selection process is available in which the long list is comprised to a short list and finally one supplier is chosen based on comparing offers. During the supplier selection process, supplier competition is not always applied at the Purchasing department. Reasons for this are among others that only one supplier is available, the choice already is made by other departments, or the contribution of specifications is done to one supplier. The products of PMS generally are a mixture of a 100% physical good and a 100% service. Methods of supplier competition used at PMS are RFx, e-auction, design-in workshop, and threat. The products follow the PLC, but a clear growth stage like in other industries is not present, due to stable demand and lower volumes per year.

The case studies are performed to compare practice with the supplier competition framework. The supplier competition framework is comparable with practice, except the application of the form of supplier competition. Lower service contribution comes not only with supplier competition on price, but a thorough process of supplier selection precedes. The supplier competition on products with a higher degree of service is not on TCO as expected, but in one case on price, and in the other case on delivery time of the first prototype. The trade-off between different factors is not performed, which results in more chance of problems.

The development and the maturity stage of the PLC seem the most appropriate stages to apply supplier competition. Supplier competition can be applied in the development stage, because a new supplier has to be selected. It is important to have a roadmap with the planned actions for the life cycle. If the roadmap is communicated with the supplier, it can prepare on future events.

In the maturity stage, supplier competition can be applied, because cost reduction is necessary. The demand is stable and competitive pressure is high. Supplier competition can be used in this stage to achieve cost reduction. An overview of conditions is given per form of supplier competition in the development and the maturity stages. The conditions are divided in operational conditions or conditions that can be influenced, and strategic conditions or conditions that cannot be influenced. In the next chapter, the research questions are answered and recommendations for the Purchasing department are given about the application of supplier competition.

6 Conclusions and recommendations

This report started with the explanation that in recent years, an increasing price erosion has emerged at PMS. This is a consequence of among others the growing competition, the customer who wants the same for less money or more features for the same money, and the budgetary problems in healthcare. As a result of the increasing price erosion, PMS is forced to use methods to achieve cost reduction. Competition between suppliers on price, quality, innovativeness, and more factors appeared to be a useful concept, due to positive experiences. The expectation was that the role of supplier competition differs in the different stages of the PLC. The focus during the life cycle of a product changes due to changes of the product position. The current problem is that the Purchasing department has no good insight into the role of supplier competition in the different stages of the PLC and no clear plan is available about when and how to use supplier competition. It is not clear what the consequences are of the use of supplier competition. A central research question is formulated to give more insight into the application of supplier competition:

What is the role of supplier competition in the different stages of the product life cycle at the PMS Purchasing department and how can this role be optimized?

The central question is split into the next sub-questions:

1. Which roles of sourcing strategies in the different stages of the product life cycle are described in literature?
2. Which roles of supplier competition in the different stages of the product life cycle are described in literature?
3. What is the current role of supplier competition in the different stages of the product life cycle at the PMS Purchasing department?
4. What actions have to be taken by the PMS Purchasing department to make an optimal use of supplier competition and on which conditions?

This chapter combines the results of previous chapters to answer the research question by means of answering the sub-questions. Section 6.1 describes the role of sourcing strategies in the different stages of the PLC as investigated in literature. In section 6.2 the question about the role of supplier competition in the different stages of the PLC described in literature is answered. Section 6.3 describes the difference between the application of supplier competition at the Purchasing department and the supplier competition framework. Section 6.4 amplifies the possibilities to optimize the role of supplier competition in the different stages of the PLC at the Purchasing department, and conditions and recommendations are discussed. The last three sections discuss the implications, limitations and the several opportunities for further research.

6.1 Theoretical background on the role of sourcing strategies in the PLC

A sourcing strategy is '*a set of rules that have to be used to be able to handle changes in the environment of purchasing*' (Kiser and Rink, 1976, p. 21). The sourcing or purchasing strategies differ per stage of the PLC, due to different characteristics per stage. The PLC is a wide used approach with its origin in marketing and shows the life cycle of a product. Some research has been done about linking the PLC with purchasing. Birou et al. (1997) published a categorization of purchasing strategies by PLC stage based on a survey in which purchasing executives participated. A result of this research was the finding that most purchasing strategies are attributed to the growth stage. Birou et al. (1998) investigated that also the competitive competences are most important in the growth stage. This is a result of the increasing demand for products, need for flexible production, synchronized and reliable product flow, quick response time, product quality and process innovation. Only one purchasing strategy is attributed to the decline stage and no competitive competences. There is not sufficient focus on this stage. Several opportunities and challenges are found for the decline stage, like product renewal and product abandonment. The categorization of purchasing strategies by PLC stage (Birou et al., 1997, figure 3.2) may contribute to a better understanding of the application of purchasing strategies and guides purchasing executives in the use of purchasing resources.

6.2 Theoretical background on the role of supplier competition in the PLC

Except the definition of supplier competition and the need of using supplier competition, the role of supplier competition in the PLC is not described in literature. Also further elaboration on how and when to use supplier competition is absent as well as the dependences and conditions of using supplier competition. Due to this gap in literature, a conceptual model to define supplier competition is set up; the supplier competition framework (figure 4.10).

Publications about the PLC characteristics and the link between the PLC and purchasing strategies as described in section 6.1 form a basis for the analysis of the role of supplier competition in the different stages of the PLC.

6.3 Application of supplier competition at Purchasing department

As described in the supplier competition framework (figure 4.10), different levels of supplier's knowledge contribution, trust, supplier integration, and organization's involvement correspond with the product's position in the physical good – service

continuum. Supplier competition on price, TCO, and value are the three forms of supplier competition distinguished, and depends on the product's position in the physical good – service continuum too. The products of PMS generally are a mixture of a 100% physical good and a 100% service. In the supplier competition framework, supplier competition on price comes with simple, standardized products, supplier competition on TCO comes with more customized and more complicated products, and supplier competition on value comes with highly customized products with a high degree of service. These different forms of supplier competition require different application methods of supplier competition. At the Purchasing department, four methods of supplier competition can be distinguished; RFx, e-auction, design-in workshop, and threat.

The execution of three case studies aims to compare the application of supplier competition at the Purchasing department with the supplier competition framework and to get more insight into the application of supplier competition at the Purchasing department. Three products with different positions in the physical good – service continuum, different methods of supplier competition, and different positions in the PLC are selected to perform the case studies, all with the involvement of the Purchasing department. The case studies consist of a within case analysis and a cross-case analysis.

It can be concluded that the supplier competition framework and practice are comparable, except the application of the form of supplier competition. One case was expected to apply supplier competition on price, but a thorough supplier selection process preceded to assure the capabilities of the suppliers. A second case was expected to apply supplier competition on TCO, but without the trade-off between different factors, the supplier with the shortest delivery time of the prototype was selected. A third case was also expected to apply supplier competition on TCO, but as it was aimed to achieve cost reduction, only supplier competition on price was applied.

The most appropriate stages to apply supplier competition at PMS are the development stage and the maturity stage. One case study described a product in the development stage of the PLC, and two case studies described products in the maturity stage. In the development stage supplier competition can be applied, because a new supplier has to be selected. Suppliers have the opportunity to get new business and are willing to win at the expense of competitors. Depending on the level of service included in the product, all different forms and methods can be applied in the development stage. The introduction and the growth stage are not appropriate to use supplier competition, due to the focus on the market introduction and on making the processes more efficiently. In these stages it is recommended to work closely with suppliers (Rink and Fox, 2003), and therefore not recommended to switch suppliers. Preparations for the maturity stage can be done, where supplier competition is appropriate. In the maturity stage, the focus is on cost reduction and the competitive pressure is high. Supplier competition can be used to achieve this cost reduction or to put pressure on the supplier on other factors. The decline stage is not appropriate due to a decreasing product demand and the decreasing negotiation power of PMS. The contracting for service parts has to be done during earlier stages as the business is in demand.

Supplier competition is not always applied at the Purchasing department. Reasons for this are among others that only one supplier is available, the choice already is made by other departments, or the contribution of specifications is done to one supplier. Several recommendations can be done to optimize the use of supplier competition at the Purchasing department and are discussed in the next section.

6.4 Recommendations

This section describes recommendations concerning the Purchasing department about the application of supplier competition. The recommendations are given based on the factors noticed during the case studies and interviews. These recommendations represent actions for the Purchasing department towards an optimal use of supplier competition.

- Take care of the early involvement of purchasing in projects to assure a good supplier selection process.
- Take care of the early involvement of suppliers in projects including customized products to assure the timely tuning of the production process between supplier and PMS on feasibility and efficiency. The early supplier involvement enables the use of the innovative supplier's ideas too.
- Take time to perform the supplier competition process.
- Assure management support for the choice of suppliers. During negotiations for example, the PMS team who is performing the negotiation has to be able to make decisions.
- Develop a roadmap in the development stage of the PLC about future plans, concerning the product's life time and product versions, sourcing (dual sourcing, supplier transfer during product's life time), service, and etcetera. Communicate this with the supplier and internal organization to prepare on future changes.
- Assess and benchmark internal suppliers and compare the performance and prices with external suppliers. Sometimes internal suppliers are selected automatically without a benchmark.
- Be clear to suppliers about the competitive supply market from the moment of supplier involvement to maximize the supplier competition.
- Be consequent to suppliers about the supplier selection process and make one way of working. Give suppliers the same information and communicate that the supplier only has one chance to offer to prevent non-optimal offers. One person who is responsible for the communication with the suppliers concerning the methods is conductive to the efficiency of working and clearness.
- Claim resources for the implementation already during the supplier competition process to assure a quick implementation process.
- Convince development to design standardized products to prevent the automatically attribution of the business to one supplier, and make transferring in later stages possible. If development applies modularity with clear interfaces, the transfer of the modules can be outsourced separately and transferring in later stages is easier.

- Use the tool developed, including a list of conditions and a process flow, to make a considered choice whether to apply supplier competition or not. The list of conditions is described in paragraph 5.3.6, and the flow diagram with explanation is described in appendix 14. Consider the risks and opportunities with using supplier competition.
- Match the goal of the application of supplier competition with the method of supplier competition. An e-auction on price is useless if a better quality is desired.
- Balance the supply base and take care of more than one available supplier per product to guarantee the possibility of the application of supplier competition.
- Make one format for supplier offers. This enables PMS to compare the offers efficiently, because the offers contain exactly the same information. If information is missing, it can directly be seen.
- Make a trade-off between different short- and long term factors during supplier selection, in order to make a well-considered decision.
- Use benchmarking during all stages of the PLC. Although not all stages are appropriate to apply supplier competition, the sharpness of suppliers can be increased. Using cost modeling gives insight into the costs. Also during the application of supplier competition, cost modeling is a method to control costs.
- Evaluate the projects, which can result in useful information about experiences and learnings for future projects.

6.5 Contribution

This section describes the literature contribution in paragraph 6.5.1 and the contribution to practice in paragraph 6.5.2.

6.5.1 Theoretical contribution

Publications exist about the link between the PLC and sourcing strategies, but the link between the PLC and the application of supplier competition lacks. Only a definition of supplier competition and the note that it is important to use supplier competition is described in literature. This research focuses on the role of supplier competition in the different stages of the PLC and how to apply supplier competition. The literature about the link between the PLC and sourcing strategies is used to make the comparison of the supplier competition framework and the application of supplier competition in practice.

6.5.2 Contribution to practice

On the basis of positive experiences with supplier competition, the Purchasing department wanted to know more about the application of supplier competition in detail. This research provides the Purchasing department more insight into the use of supplier competition in the different stages of the PLC in their company. Although not one best way of applying supplier competition can be given, conditions and methods how to use supplier competition are helpful for the application of supplier competition. The comparison of the supplier competition framework and the case studies resulted in conclusions and recommendations for the Purchasing department.

6.6 Limitations of this study

A limitation of the used literature is the generalization of the PLC and link with purchasing. The PLC cannot be standardized for all industries. This literature is used for this research to create a link between the application of supplier competition and the PLC. The findings are adjusted to the situation of the Purchasing department and therefore it is tried to overcome this limitation.

Due to the focus on the use of supplier competition for the product-related products at the Purchasing department, this research cannot be generalized to other companies and industries. The use of supplier competition might be different in other industries, which have more standardized products for example. Then the supply market is large and the ease to switch supplier increases. These products differ too much from the specific medical system industry to generalize.

A third limitation is the number of case studies used. Three case studies are investigated and compared with each other and the supplier competition framework. Although these cases have different characteristics, a highly customized product with a very strong service contribution is not investigated. As a consequence, the supplier competition on value is not investigated in detail.

6.7 Options for further research

In this section three options for further research are discussed. A first option for further research entails the empirically testing of the supplier competition framework. The supplier competition framework is based on a combination of existent marketing literature and existing purchasing literature. More research can be done to verify the three forms of supplier competition and the connected methods of application of supplier competition.

Another possibility for further research is the investigation of the division of purchasing strategies in the different stages of the PLC for different industries. Literature about the link between a generalized PLC and purchasing strategies exists, but this is not investigated for the medical industry in particular.

A last option for further research that is mentioned here is the further extension of research about supplier competition. This report investigated the role of supplier competition in the different stages of the PLC for the Purchasing department, and further research on the application of supplier competition can be done for other industries.

References

Scientific literature

Anderson, M.G., Katz, P.B., (1998), 'Strategic Sourcing', *International Journal of Logistics Management*, 9(1), 1-13.

Arnold, U., (2000), 'New Dimensions of Outsourcing: a Combination of Transaction Cost Economics and the Core Competences Concept', *European Journal of Purchasing & Supply Management*, 6 (1), 23-29.

Berenson, C., (1967), 'The Purchasing Executive's Adaptation to the Product Life Cycle', *Journal of Purchasing*, May, 62-68.

Birou, L., Fawcett, S.E., Magnan, G.M., (1997), 'Integrating Product Life Cycle and Purchasing Strategies', *International Journal of Purchasing and Materials Management*, 33(1), 23-31.

Birou, L., Fawcett, S.E., Magnan, G.M., (1998), 'The Product Life Cycle: a Tool for Functional Strategic Alignment', *International Journal of Purchasing and Materials Management*, 34(2), 37-51.

Eisenhardt, K.M., (1989), 'Building Theories from Case Study Research', *The Academy of Management Review*, 14(4), 532-550.

Forker, L.B., Stannack, P., (2000), 'Cooperation versus Competition: Do Buyers and Suppliers Really See Eye-to-eye?', *European Journal of Purchasing & Supply Management*, 6(1), 31-40.

Fox, H.W., and Rink, D.R., (1977), 'Coordination of Purchasing With Sales Trends', *Journal of Purchasing and Materials Management*, Winter, 10-16.

Fredericks, E., (2005), 'Cross-functional Involvement in New Product Development: A Resource Dependency and Human Capital Perspective', *Qualitative Market Research*, 8(3), 327-341.

Fuller, N., (2004), 'Costs in the Round', *Supply Management*, 9(8), 35.

Gadde, L.E., Snehota, I., (2000), 'Making the Most of Supplier Relationships', *Industrial Marketing Management*, 29(4), 305-316.

Handfield, R.B., Ragatz, G.L., Petersen, K.J., Monczka, R.M., (1999), 'Involving Suppliers in New Product Development', *California Management Review*, 42(1), 59-82.

Hartley, J.L., Lane, M.D., Hong Y., (2004) 'An Exploration of the Adoption of e-auctions in Supply Management', *IEEE Transactions on Engineering Management*, 51(2),153-161.

Heikkilä, J., Cordon, C., (2002), 'Outsourcing: a Core or Non-core Strategic Management Decision?', *Strategic Change*, 11(4), 183-193.

Heriot, K.C., Kulkarni, S.P., (2001), 'The Use of Intermediate Sourcing Strategies', *Journal of Supply Chain Management*, 37(1), 18-26.

Hertz, S., Alfredsson, M., (2003), 'Strategic Development of Third Party Logistics Providers', *Industrial marketing Management*, 32(2), 139-149.

Hur, D., Hartley, D.L., Mabert, V.A., (2006), 'Implementing Reverse e-auctions: A Learning Process', *Business Horizons*, 49(1), 21-29.

Kiser, G.E., Rink, D., (1976), 'Use of the Product Life Cycle Concept in Development of Purchasing Strategies', *Journal of Purchasing and Materials Management*, 12(4), 19-24.

Klepper, S., (1996), 'Entry, Exit, Growth, and Innovation over the Product Life Cycle', *The American Economic Review*, 86(3), 562-583.

Kraljic, P., (1983), 'Purchasing must become supply management', *Harvard Business Review*, Sept/Oct, 109-17.

Lilly, J.D., Gray, D.A., Virick, M., (2005), 'Outsourcing the Human Resource function: the environmental and organizational characteristics that affect HR performance', *Journal of Business Strategies*, 22(1), 55-73.

Monczka, R.M., Trent, R.J., (1991), 'Evolving Sourcing Strategies for the 1990s', *International Journal of Physical Distribution & Logistics Management*, 21(5), 4-12.

Murray, K.B., Schlacter, J.L., (1990), 'The Impact of Services versus Goods on Consumer's Assessment of Perceived Risk and Variability', *Journal of the Academy of Marketing Science*, 18(1), 51-65.

Onkvisit, S., Shaw, J.J., (1986), 'Competition and Product Management: Can the Product Life Cycle Help?', *Business Horizons*, July-Aug, 51-62.

Parlar, M., Weng, Z.K., (1997), 'Designing a Firm's Coordinated Manufacturing and Supply Decisions with Short Product life Cycles', *Management Science*, 43(10), 1329-1344.

Qualls, W., Olshavsky, R.W., Michaels, R.E., (1981), 'Shortening of the PLC – An Empirical Test', *Journal of Marketing*, 45 Fall, 76-80.

Rink, D.R., Fox, H.W., (2003), 'Using the Product Life Cycle Concept to Formulate Actionable Purchasing Strategies', *Singapore Management Review*, 25(2), 73-89.

Roberts, E.B., Liu, W.K., (2001), 'Ally or Acquire?', *MIT Sloan Management Review*, 43(1), 26-34.

Ryan,C., Riggs, W.E., (1996), 'Redefining The Product Life Cycle: The Five Element Product Wave', *Business Horizons*, 39, Sept-Oct, 33-40.

Slater, S.F., (1993), 'Competing in High-Velocity Markets', *Industrial Marketing Management*, 22, Nov, 255-263.

Smeltzer, L.R., Carr, A., (2002), 'Reverse Auctions in Industrial Marketing and Buying', *Business Horizons*, 45(2), 47-52.

Swan, J.E., Rink, D.R., (1982), 'Fitting Market Strategy to Varying Product Life Cycles', *Business Horizons*, 25, January-February, 72-76.

Teague, P.E., (2006), PLM Boost Buyers' Product Development Role', *Purchasing*, 135(3), 48.

Trent, R.J., Monczka, R.M., (2003), 'International Purchasing and Global Sourcing – what are the differences?', *Journal of Supply Chain Management*, 39(4), 26-37.

Wagner, S.M., (2003), 'Intensity and Managerial Scope of Supplier Integration', *Journal of Supply Chain Management*, 39(4), 4-15.

Books

Aken, J.E. van, Bij, J.D. van der, Berends, J.J., (2003) *Collegedictaat Bedrijfskundige Methodologie, collegejaar 2003/2004*.

Axelsson, B., Rozemeijer, F.A., Wynstra, F., (2005), *Developing Sourcing Capabilities, Creating strategic change in purchasing and supply management*, Chichester: John Wiley & Sons Ltd.

Gadde, L.E., Håkansson, H., (2001), *Supply Network Strategies*, Chichester: John Wiley & Sons Ltd.

Handfield, R., (2006), *Supply Market Intelligence, a Managerial Handbook for Building Sourcing Strategies*, U.S.: Taylor & Francis Group LLC, p. 391.

Heinritz, S.F., Farrell, P.V., Smith, C.L., (1986), *Purchasing: Principles and Applications*, New Jersey: Prentice Hall, Englewood Cliffs, p.9.

Kotler, P., (2001), *Marketing Management*, New Jersey: Pearson Education, Ch.11.

Laseter, T.M., (1998), *Balanced Sourcing*, New York: Booz·Allen & Hamilton.

Neef, D., (2001), *E-procurement: from Strategy to Implementation*, Upper Saddle River: Prentice Hall PTR, Ch.4.

Porter, M.E., (1985), *Competitive Advantage*, *Creating and Sustaining Superior Performance*, The Free Press, New York.

Saaksvuori, A., Immonen, A., (2005), *Product Life Cycle Management*, Springer Berlin Heidelberg, New York, second edition, p.47.

Verschuren, P., and Doorewaard, H., (1999), *Het ontwerpen van een onderzoek*, Lemma BV, Utrecht, 2nd edition.

Weele, A.J. van, (2005), *Purchasing & Supply Management: Analysis, Planning and Practice*, London: Thomson Learning, 4th edition.

Yin, R.K., (1994), *Case Study Research, Design and Methods*, Thousand Oaks: Sage Publications, 2nd edition, vol. 5.

Internal references

Alfrink, J. C.A., *'Purchasing Span of Expertise XRD Best; development in 10 years'*, 2004.

Annual Report Philips, '*Innovating to Grow'*, 2005.

Annual Report Philips, '*Driving Change, Delivering Value*', 2006.

Jong de, A., 'Supplier capability positioning description', 2004.

Philips, (1999), *Process Survey Tool for Purchasing and Supply Management*.

Philips, (2000), Presentation: *Purchasing & Supplier Involvement in the Product Creation Process*.

Philips, (2005), Presentation: *Purchasing Management*.

Philips, (2006), Presentation: *Supplier Release Process*: Albert de Jong.

Websites

http://www.philips.com, last viewed: 24-03-2007
http://pww.supplymanagement.philips.com, last viewed: 01-05-2007

Appendices

Appendix 1 List of appendices

Appendix 2 List of abbreviations

Abbreviation	Explanation
B-2-B	Business to Business
BOM	Bill of Material
C/V	Cardio Vascular
CPNS	Common Part Number System
DFM	Design for Manufacturability
E-auction	Electronic auction
EBIT	Earnings Before Interest and Taxes
EOQ	Economic Order Quantities
ESI	Early Supplier Involvement
FMS	Flexible Manufacturing Systems
FPS	Flexible Purchasing Systems
HRM	Human Resource Management
IP	Intellectual Property
KPI	Key Performance Indicator
MR	Magnetic Resonance
MSU	Michigan State University
NDA	Non-Disclosure Agreement
NIH-syndrome	Not Invented Here Syndrome
OEM	Original Equipment Manufacturers
PDM	Product Development Management
PLC	Product Life Cycle
PMS	Philips Medical Systems
PCP	Product Creation Process
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Quotation
SAM	Supplier Account Manager
SQA	Supplier Quality and Assurance
TCO	Total Cost of Ownership
TQM	Total Quality Management

Table A. 1 List of abbreviations

Appendix 2 List of interviewees and interview protocol

****** for confidentiality reasons the content has been removed ******

Interview protocol

Introduction
- Respondent: Name of respondent, contact information.
- Interviewer: Explanation of the research project and the background of the project.

General
- What is your function?
- What are your main activities in the organization?

Supplier competition
- How would you define supplier competition?
- Based on which criteria do you decide to apply supplier competition?
- How is supplier competition applied?
- What are conditions to apply supplier competition?
- What are experiences with supplier competition in the past?
- What are the expected developments for the future for supplier competition?
- How do suppliers react if they get to know that there is competition between suppliers?

Product life cycle (PLC)
- How is the PLC used in the organization?
- Do you use the concept PLC in your activities? How?
- Do you use the concept PLC when defining the sourcing strategy? How? Or why not?
- How would you describe the PLC of the products of PMS?
- How would you define the sourcing strategy per stage of the PLC?
- In what stages of the PLC is it possible to use supplier competition? Why?
- In what stages of the PLC is it impossible to use supplier competition? Why?
- What are experiences with the PLC in the past?
- What are the expected developments for the future for the PLC?

Context
- What are relevant developments in terms of: clients, demand, technology, legislation, economics, geography, suppliers, competition and products?
- Are there any problems occurring in your industry?
- What does or could the PLC or the right sourcing strategy contribute to solve problems in your industry?
- To what extent do you have contact with other departments?
- Do you have direct contact with suppliers? How much?
- To what extent is your department involved in supplier selection?

Appendix 3 Global commodities PMS

	Global commodities PMS
M	**Mechanical commodities**
M1	Plastics
M2	Cabling and Wiring
M3	Sheet Metal
M4	Machining
M5	Mechatronics
M6	Fiber related plastics
E	**Electronical commodities**
E1	Contract Manufacturing
E2	Power supplies
E3	PC Hardware
E4	Software
E5	Displays
E6	User Interfaces

Table A. 2 Global commodities PMS

Appendix 4 Competitive advantage

Competitive advantage originally proceeds from the value the company is able to create for its buyers and which exceeds the costs for the creation of the value. Value is what the buyer is willing to pay for. Porter (1985) described the model of competitive advantage. There are two basic types of competitive advantage:

- Cost leadership: a firm sets out to become the low cost producer in its industry.
- Differentiation: a firm seeks to be unique in its industry among some dimensions that are widely valued by buyers.

Both can be more broadly approached or narrow, which results in a third type of competitive advantage: focus. This focus-strategy has two variants: cost focus and differentiation focus. These strategies are shown in figure a. 1. Each of the generic strategies involves a fundamentally different route to competitive advantage. The cost leadership and differentiation strategies seek competitive advantage in a broad range of industry segments, while focus strategies aim at cost advantage (cost focus) or differentiation (differentiation focus) in a narrow segment.

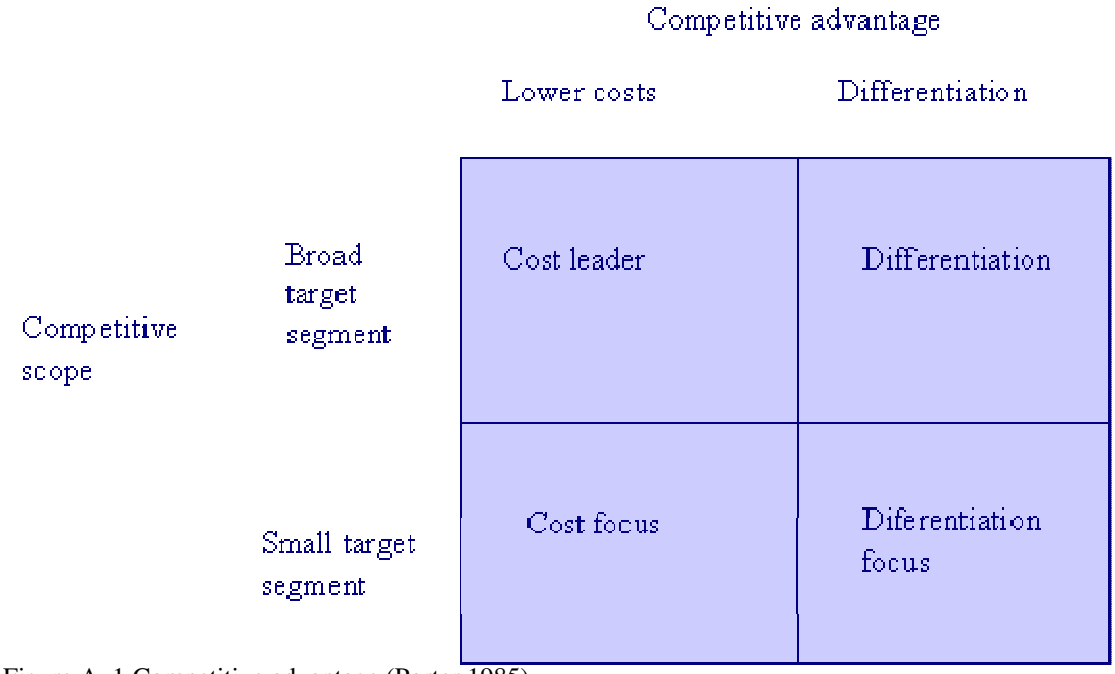


Figure A. 1 Competitive advantage (Porter,1985)

A cost leader sets out to become *the* low-cost producer in its industry. The firm has a broad scope and serves many industry segments, and may even operate in related industries. Low-cost producers typically sell a standard product and place considerable emphasis on achieving scale or cost advantages from all sources.

In a differentiation strategy, a firm seeks to be unique in its industry along some dimensions that are widely valued by buyers. It selects one or more attributes that many buyers in an industry perceive as important, and uniquely positions itself to meet those needs. It is rewarded for its uniqueness or perceived uniqueness with a premium price. A differentiator must always seek ways of differentiating that lead to a price premium

greater than the cost of differentiating. A firm must differentiate itself by choosing attributions that are different from its rivals'.

The focuser selects a segment of group of segments in the industry and set its strategy to serving them and excludes other segments. By optimizing its strategy for the target segments, the focuser seeks to achieve a competitive advantage in its target segments even though it does not possess a competitive advantage overall. In cost focus a firm seeks a cost advantage in its target segment, while in differentiation focus a firm seeks differentiation in its target segment.

Appendix 5 Organization chart PMS Purchasing department (March 2007)

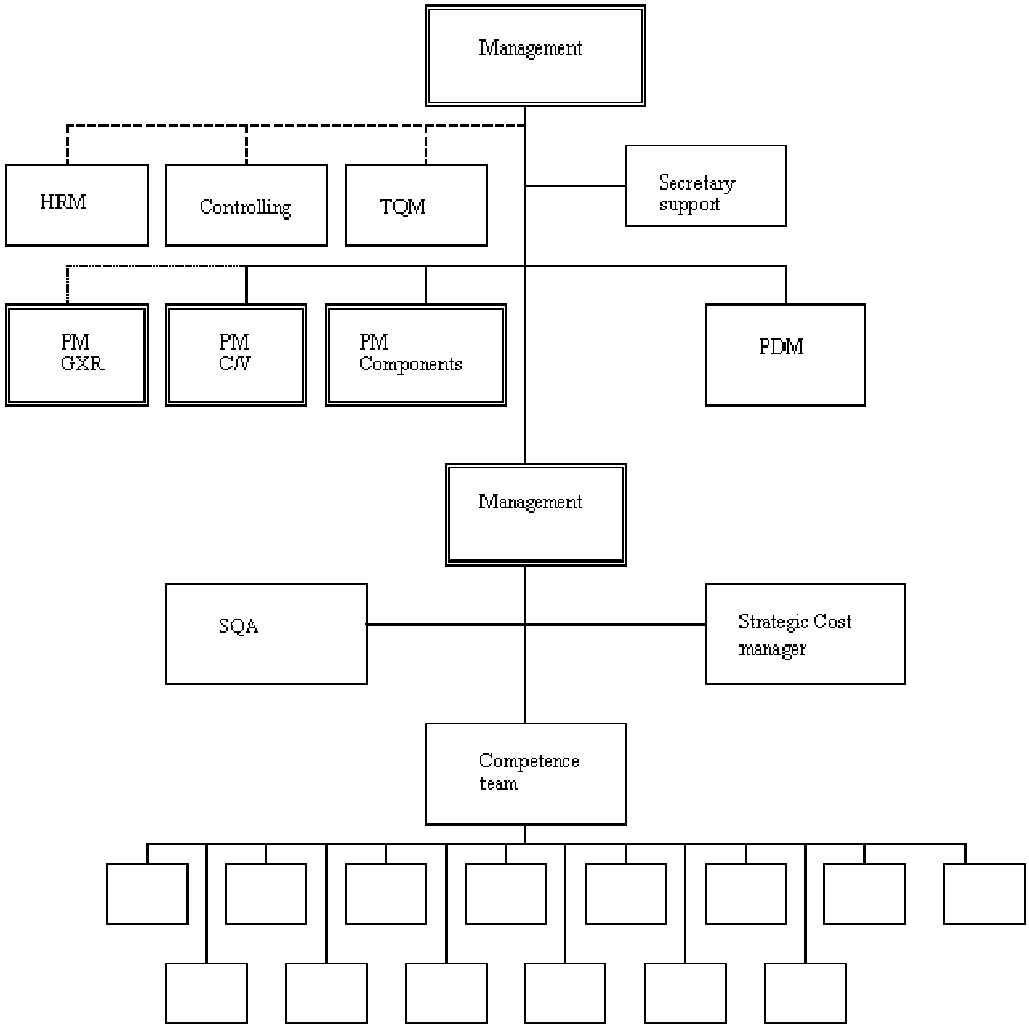


Figure A. 2 Organization chart

HRM: Human Resource Management
TQM: Total Quality Management
PM: Purchasing Manager
PDM: Product Development Management
SQA: Supplier Quality and Assurance

Appendix 6 Levels of outsourcing

Levels of outsourcing

1. Rationalization & negotiation: Simple components and products are outsourced. The buyer-supplier relation is an arm's-length relation and therefore possible to negotiate to achieve the lowest price.
2. Cost reduction: Buyer and supplier aim to achieve cost reduction by improving in for instance the process, logistics, or product.
3. Joint product creation (ESI): Buyer and supplier together design and develop the product. Early supplier involvement (ESI) is important in this level.
4. Outsourcing – functional specifications: The buyer only provides the functional specifications and the supplier develops an application which meets these requirements.
5. Joint road mapping: Buyer and supplier together form a plan for the future. The companies' goals are compared and a consensus is reached for the joint direction. Solutions can be proposed for mutual benefit.
6. Strategic Outsourcing and competence allocation: The buyer uses the suppliers' competences for the development of a technology and product. The buyer wants to have for instance a chair of glass and the supplier will research the possibilities to produce a chair of glass. The supplier proposes total solutions.
7. Joint business creation: This is a joint partnership in which both buyer and supplier put in resources. The buyer contributes for instance by put in money and assets and the supplier puts in knowledge. An example of a joint business creation is a joint venture.

Appendix 7 Kraljic portfolio

Kraljic (1983) developed a product portfolio model to be used in purchasing as a basis for classifying purchases and setting a purchasing strategy. The Kraljic's product portfolio is used within Philips to categorize the products or commodities based on two variables. The first variable is the supply risk that is measured against specific criteria. The second variable is the companies' spend. This results in an matrix with four quadrants: bottleneck, strategic, routine and leverage. In figure a. 3 the positioning of several commodities of PMS is given in the product portfolio. Depending on the product segment of the portfolio, the supply strategy should differ.

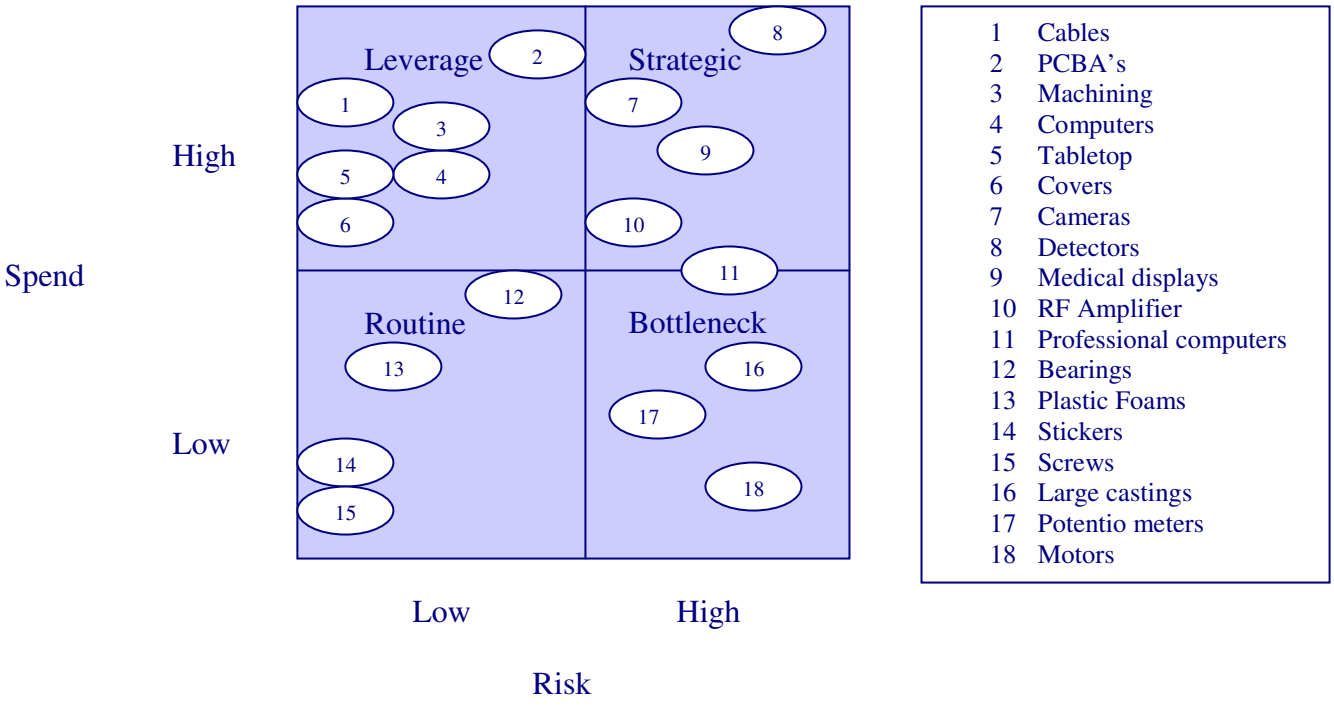


Figure A. 3 Product Portfolio (Commodity differentiation)

Appendix 8 Buyer's assessment from supplier's view

Buyer's assessment from supplier's view

- Nuisance: In the nuisance quadrant is the supplier indifferent to the organization as a customer and gives low attention to that business.
- Exploitable: In the exploitable quadrant, the supplier is interested, but on its own terms, with little room for negotiation.
- Development: In the development quadrant the supplier sees an opportunity for development. The company is not a key customer, but does see significant value in the relation with the organization.
- Strategic: In the strategic quadrant, the supplier identifies the organization as a key customer and will work very hard to build a good relationship and to keep the business. It is important to have the priority from your supplier. Then the company has power and has a better position for negotiations.

Appendix 9 Monzcka model

The model is called the MSU- model or Purchasing Excellence model and developed in the early nineties. World-class can be defined as excellence recognized by the customer as better than competitors. This approach is based on:

1. Eight strategic processes aimed at long-lasting improvements; structured, documented and reviewed with a 3 year focus (figure a. 4).The organization has to take these strategic processes into account with purchasing management.
2. Six enabling processes – mid- / long-term focus areas that provide the essential preconditions for the key strategic processes (figure a. 5). The six enabling processes mainly are to simplify the strategic processes.

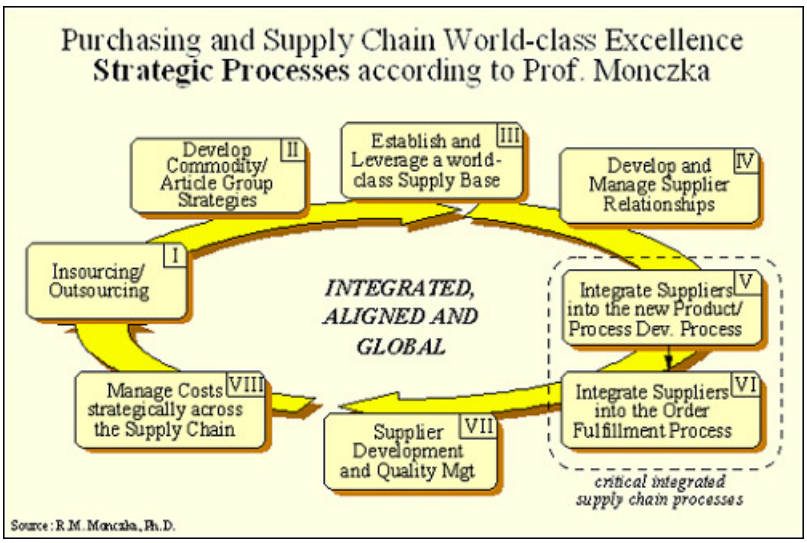


Figure A. 4 Purchasing and supply chain world-class Excellence Strategic Processes (Source: http://pww.supplymanagement.philips.com).

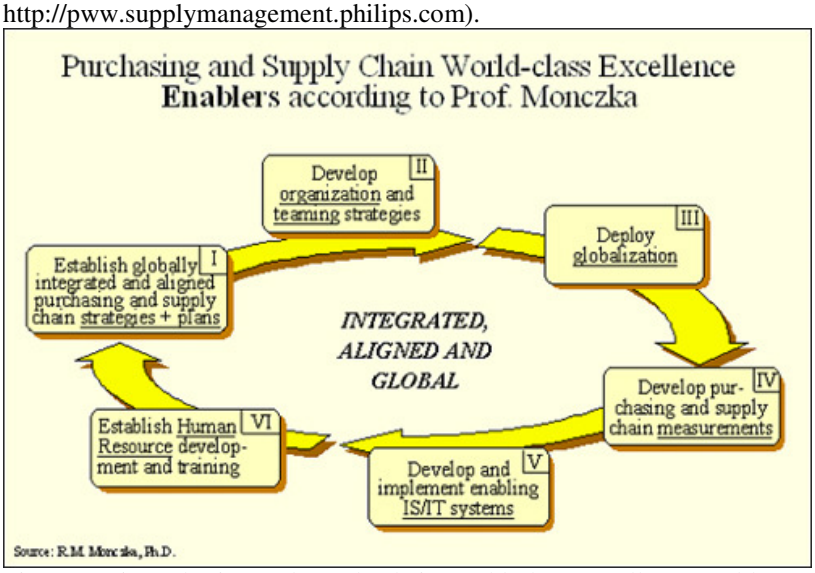


Figure A. 5 Purchasing and supply chain world-class Excellence enablers (Source: http://pww.supplymanagement.philips.com).

The Purchasing Excellence model is based on a benchmark between several multinationals to be able to compare their purchasing and supply processes and to learn from experiences of other companies. Also Philips joined this benchmarking initiative in 1992. Philips uses this model as a tool for the planning of improvements in supply management, identifying the current level of maturity of the purchasing process, and to stimulate the sharing of best practice.

In Best, every quarter a self-assessment is performed by a multi-disciplinary team to compare the score with World-Class performance. Once a year a representative of Philips Corporate Purchasing performs the external audit. All the eight strategic processes and the six enablers are scored on a ten point scale. Scoring guidelines are given for each point. If the score is 10, then the World-class position for that strategy or enabler is reached. In 2005, Philips' average score on the basis of self-assessment was 6.3. The score of the external audit was 6.2 and the target for 2006 was 6.9. For 2007 the target will be 7.1, so Philips follows an upward tendency to world-class excellence.

Appendix 10 Interviewees cases

Case	Number of interviewees
Case 1	4 (project leader with e-auction experience, initial buyer, logistic and operational buyer)
Case 2	4 (strategic cost manager, marketing manager, Initial buyer Project manager and senior engineer)
Case 3	5 (initial buyers, Supplier account manager, project leader comparable project, project leader, strategic cost manager)

Table A. 3 Interviewees cases

Interview protocol

- What is your function in this project?
- What are characteristics of this product (volume, spend, position in Kraljic portfolio, position in PLC)?
- Where on the physical good – service continuum can the product be placed?
- What is the process flow in this project?
- What is the time span?
- How is supplier competition applied?
- What are conditions to apply supplier competition?
- What were direct consequences of using supplier competition?
- What were direct consequences of using the supplier competition method?
- How are supplier selected that join the supplier selection process?
- Is the standard supplier selection process used?
- What method of supplier competition is used?
- On which factors is the eventual supplier selection decision made?
- Were there any noticeable moments when you could see that the supplier competition put pressure on the supplier?
- What is the relation with the supplier before and after the application of supplier competition?
- How do the suppliers assess PMS?
- What were the results of this project?

Appendix 11 Within case analysis

This analysis in the appendix consists of a general project description followed by the analysis of the application of supplier competition. Then, the consequences of the use of supplier competition in this project and the consequences of the use of the method are described. Conditions of using supplier competition are given for these cases. The relation with the suppliers after the application of supplier competition is explained followed by the results of the project.

****** for confidentiality reasons the content of the cases has been removed ******

Appendix 12 Cross-case analysis

***Tactic 1*:**
Per dimension the different cases are compared and the influence of the dimension for the level of supplier competition is described. The level of outsourcing, position in the Kraljic portfolio, the buyer's assessment from supplier's view and the stage in the PLC are the dependences mentioned to apply supplier competition. The buyer-supplier relationship, supplier integration, supply market and the organization's involvement are the factors linked with the supplier's contribution. Comparing these factors, a better insight into the level of supplier competition is obtained. It is possible to apply supplier competition for these cases. Due to the difference in characteristics, different forms of supplier competition are used. Conclusions are drawn from the comparison of the different dimensions.

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***Tactic 2*:**

The comparison with the different cases is performed on the basis of different factors mentioned in the within case analysis.

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Appendix 13 Supplier capability matrix

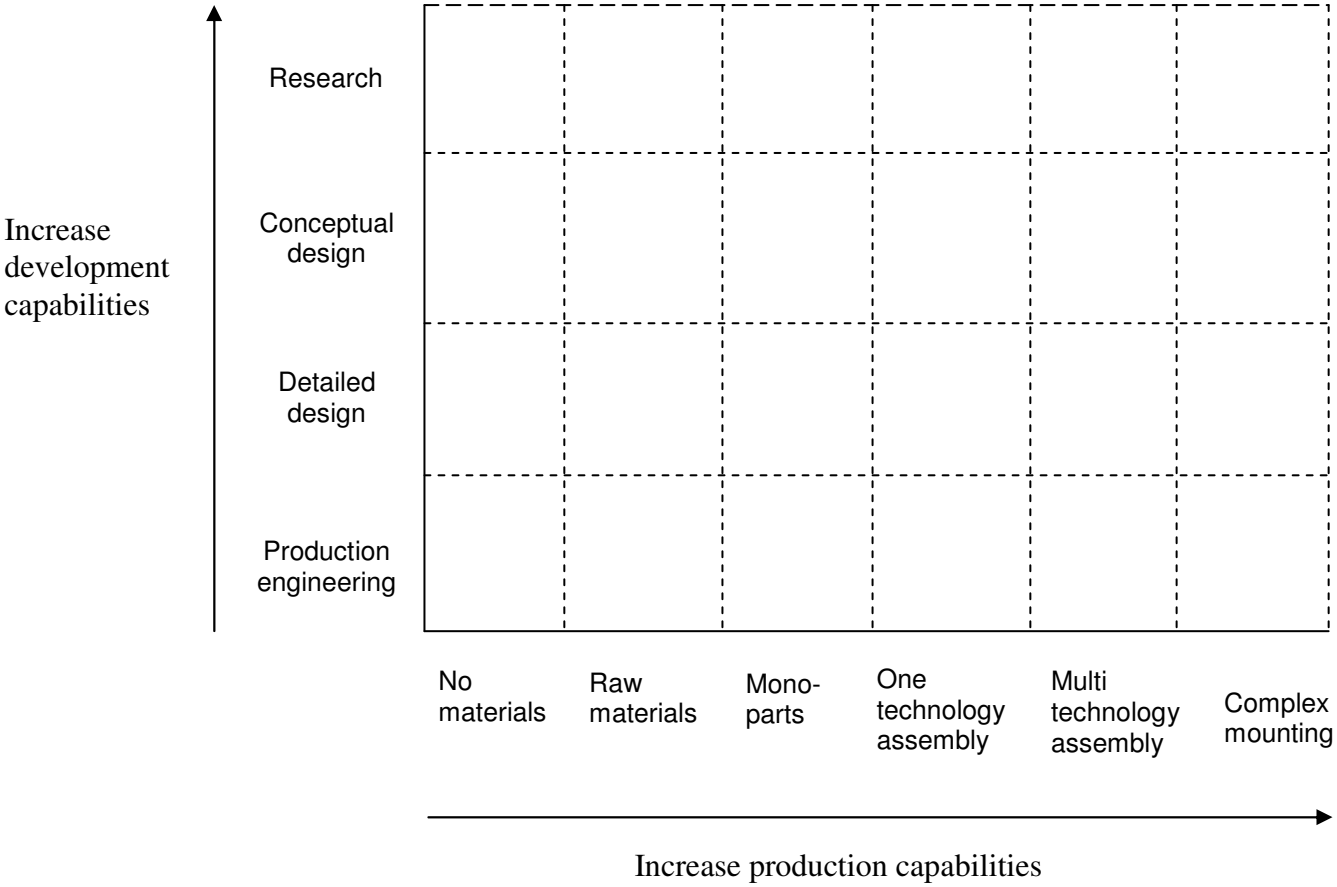

Figure A. 6 Supplier capability matrix (Source: Supplier capability positioning description)

Figure A. 6 describes the supplier capabilities and is explained below. The figure and the explanation is based on the supplier capability positioning description of Albert de Jong (2004).

Increase development capabilities (y-axis)

Production Engineering

Production Engineering is the translation of product requirements in clear low level specifications that are describing how a product should be made, mounted, tested etc. In this phase the Technical Product Documentation is translated in working instructions and a production flow. Keywords for these types of companies are: Translating not defining, one level of in house technology, added value in own production facilities and not in engineering, etcetera.

Detailed design (Engineering)

The detailed design engineering is a translation from a conceptual design to product/ module/ building block specifications that are describing in detail the parts. The possible

detailed designs will be weighed against relevant criteria like costs, specification, produce ability, risks, timing, logistics, flexibility, serviceability, etcetera.

Conceptual Design (Development)
Conceptual design knowledge is the capability to translate the requirement functionality into design solutions. At the end a concept choice based on the weighing of relevant aspects, like development throughput time, development costs, product costs, risks, produce ability, etcetera, is made. The concept choice is documented and handed over to the engineers who translate the concept to detailed product specifications.

Research
Research is the investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws.

Description of the level of maturity in the Production area (x axis)
Raw materials
Companies that deal with raw materials are transferring these materials into basic materials like aluminum bars, sheet metal plates, plastics etc. The main expertise is producing these basic materials as cheap as possible. The (world) market often dictates the prices of these raw materials and basic materials.

Mono parts
Mono parts suppliers are transferring basic materials into products. The purchasing of these materials is mostly done by the production preparation department and needs hardly any attention. The logistic process within the company and towards customers is simple. The main focus with the nowadays highly automated companies, where labor more and more is secondary to machine costs, lies in optimizing machine capacity and reducing machine costs.

One Technology Assembly
One technology assembly companies are companies that extended their expertise from mono parts machining to simple mounting capabilities. The mounting is in the own technology area. Logistics and purchasing is getting more important.

Multi Technology Assembly
Multi technology assembly companies are companies that extend their mounting expertise from a simple one technology based mounting to more complex mounting capabilities with other technology areas.

Complex Assembly
The same as multi technology mounting, but with extending demands on the capabilities of the control- and mounting people. Keywords are: dependant control loops, dependency in constructions, complex adjustments, special mounting facilities like clean room and gluing, specialized (often own developed) high sophisticated test equipment. The difference with multi technology mounting is failure detecting instead of adjusting.

Appendix 14 Supplier competition process diagram and process description

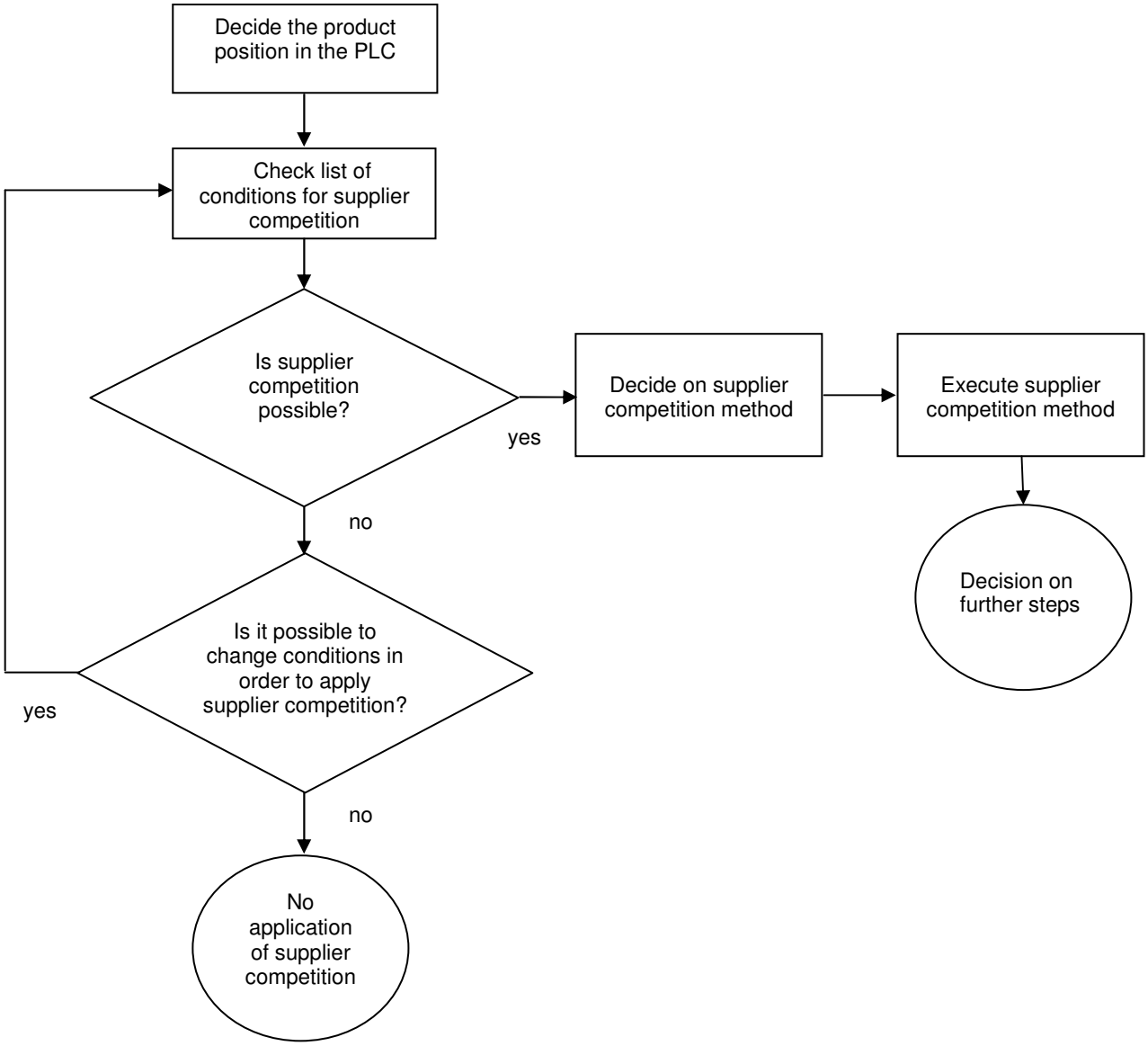

Figure A. 7 Supplier competition process flow diagram

Process description

1. To start the supplier competition process, the initial buyer has to select a product on which supplier competition might be applied. Due to the fact that the application of supplier competition differs per stage of the PLC, the current stage of the product has to be indicated. The choice between the development stage, introduction stage, growth stage, maturity stage, and the decline stage has to be made.

2. Per stage of the PLC a list of conditions have to be checked to make a well-considered choice to apply supplier competition or not. The list of conditions is described in paragraph 5.3.6. The list of conditions can be adjusted with new conditions if it is found in practice. This list is divided into conditions that can be influenced by the project team (operational conditions), and conditions that cannot be influenced by the project team (strategic conditions). It is important to notice the different conditions to take the risks into account. It is not said that if one condition cannot be met, the supplier competition cannot be applied. The risks of not meeting the condition have to be taken into consideration.
3. The choice of application of supplier competition is made. 'Yes' means that supplier competition is applied and possible risks are taken into consideration. 'No' means that supplier competition cannot be applied, because either important conditions cannot be met at all and the process ends, or with some adjustments in the project team, the conditions can be met. In the latter case, after the adjustments of the conditions, a new check on the list of conditions for supplier competition can be done.
4. If the decision is made to apply supplier competition, the choice for the application method has to be made. Four methods of application of supplier competition are RFx, e-auction, design-in workshop, and threat.
5. The next step in the process flow is the execution of the supplier competition method.
6. After the execution of the supplier competition method the decision on further steps have to be made.