Diploma Thesis

Outsourcing Body and Trim Engineering Activities

Analysis and Improvement of the Process

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Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

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Abstract

Outsourcing is becoming more and more popular. Outsourced activities continue to climb up the value chain. Even the outsourcing of engineering activities has become a common practice. However, literature, which proposes frameworks for outsourcing engineering activities, is still limited. Outsourcing can offer myriad opportunities for firms. Even so, if not well thought through outsourcing can cause considerable damage. Organisations expend a great deal of effort to optimise their production process. Administrative processes however, are often not analysed in detail.

At the Body & Trim department at MAGNA STEYR Fahrzeugtechnik (MSF) there are no process maps outlining the process for outsourcing engineering activities. Process participants have only limited knowledge about tasks outside of their area. Within this thesis flowcharts are used to display the as-is situation and identify frustration and problem areas. Several unnecessary and avoidable process steps are detected. Measures to improve the process are stated and a to-be process is created. In order to generate this to-be process, the as-is process is restructured in an effective and efficient way. Furthermore, tools that assist in the process are proposed. Input, output and responsibilities are clearly set for the to-be process

This thesis helps MSF to understand the current situation and provides a good base for starting improvement initiatives. Thanks to lower cycle times, the proposed process allows the firm to act more flexibly. Further, it offers high cost saving potential. The findings and suggested changes can help MSF to prevent the failure of engineering outsourcing initiatives.

Acknowledgement

I would like to take this opportunity to thank those people who supported me throughout the writing of my thesis. This thesis would not have been possible had Mr. Ing. Roberto Krenn and Mr. Dipl.-Ing. Christian Vogl, from MAGNA STEYR Fahrzeugtechnik (MSF), not given me the opportunity to write it. I am truly indebted and thankful to my supervisor at MSF, Mr. Ing. Ralf Masser. He not only provided me with the free hand I needed for my work, but assisted me in every possible way when needed. I could not have wished for a better supervisor. It is a great pleasure to also thank everyone else at MSF who provided me with information and helped me to write my thesis successfully. Furthermore, I would like to show my gratitude to my mentors form Graz University of Technology, i.e. Ms. Dipl.-Ing. Verena Manninger and Ms. Dipl.-Ing. Elisabeth Plankenauer. They guided me safely through this new experience. Their constructional and critical comments throughout the thesis contributed considerably to the success of this thesis.

My studies and my year abroad made me what I am today. I owe sincere and earnest gratitude to my parents, Aloisia and Franz, for affording me the opportunity. Last, but not least, I would like to thank my girlfriend, Isabella. She has always motivated me and supported me with all her heart.

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1 Introduction

A modern automobile consists of over 12,000 parts. It is nearly impossible for an original equipment manufacturer (OEM) to produce and develop everything in house. Parts are sourced from suppliers in a number of countries. (Contractor, Vikas, Sumit, & Pedersen, 2011, p. 5) In recent years, outsourcing of engineering activities has become more and more popular. The reasons for this are manifold, on-going globalisation, new information and communication technologies, lower wages in emerging countries as well as access to a large pool of talent. (Bardhan & Jaffee, 2011, p. 48) Many companies sell their products worldwide nowadays. Products must be aimed at the local markets in order to meet the tastes of the customer. Hence, engineers with varied cultural backgrounds are required. The complexity of products has increased and the development process involves specialists from numerous fields. It is not feasible for organisations to build skills in all of these areas. Outsourcing offers an effective way to gain know-how from outside one's own business. (Bardhan & Jaffee, 2011, pp. 50-51) The automotive industry has experienced a shift in the value creation process. More and more of the value creating activities are being moved to suppliers. (Schneider, 2011, p. 40) The value chains have changed from their traditional pyramid-like form to that of an interweaved value web (Kurr, 2004, p. 2). As a result, suppliers that are able to offer complete vehicle production as well as development have emerged. There are only very few such vendors, e.g. MAGNA Steyr Fahrzeugtechnik, Willhelm Karmann GmbH, Bertone und Pininfarina. OEMs transfer the responsibilities for the development of an automobile completely to these suppliers. Consequently, suppliers must be able to play a more active role. In addition to having technical competence they must be able to steer and manage sub suppliers. (Schneider, 2011, pp. 48-51) Due to the major development scopes these complete vehicle suppliers handle, they are not always able to perform requisite tasks on their own and are therefore confronted with the outsourcing of engineering activities.

This thesis is performed in cooperation with MAGNA STEYR Fahrzeugtechnik (MSF). It was conducted at the functional department Body & Trim and was initiated by the Project Management department.

1.1 About MAGNA STEYR Fahrzeugtechnik

MSF is one of the seven members of the Magna Group (see Figure 1.1) (MAGNA STEYR Fahrzeugtechnik [MSF], 2012, p. 2). Magna designs, develops and manufactures the entire spectrum, from individual components to complete vehicles. This makes Magna the most diversified global automotive supplier in the world. (Magna International, n.d., p. 1 of 1) Magna operates in 26 different countries and employs over 107,000 people (Allmer, 2012, p. 1).

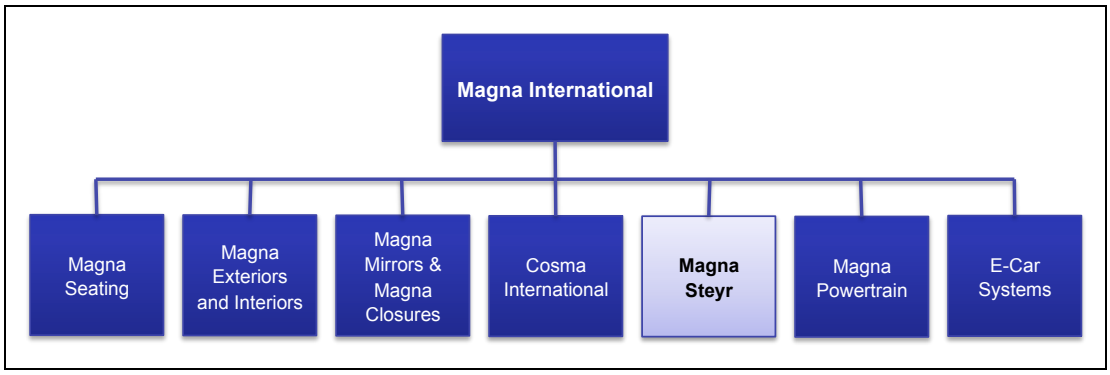


Figure 1.1: Overview Magna International (MSF, 2012)

MSF has built more than 2.5 million vehicles and possesses over 100 years of experience in the automotive industry. (MSF, 2012, pp. 5-6) MSF (n.d.) states that it is "*the worldwide leading, brand-independent engineering and manufacturing partner for OEMs*". (p. 1 of 1)

MSF offers the following services (MSF, 2012, pp. 7-17):

- Engineering: Conventional and virtual engineering, from modules and subprojects to complete vehicles.
- Vehicle Contract Manufacturing: Flexible production of customer-specific solutions while maintaining maximum quality standards. MSF handles niche as well as high volume production.
- Fuel Systems: It supplies everything from individual tank components to complete fuel systems.
- Roof Systems: Production of all kinds of different roof types using state-of-the-art materials and manufacturing methods.

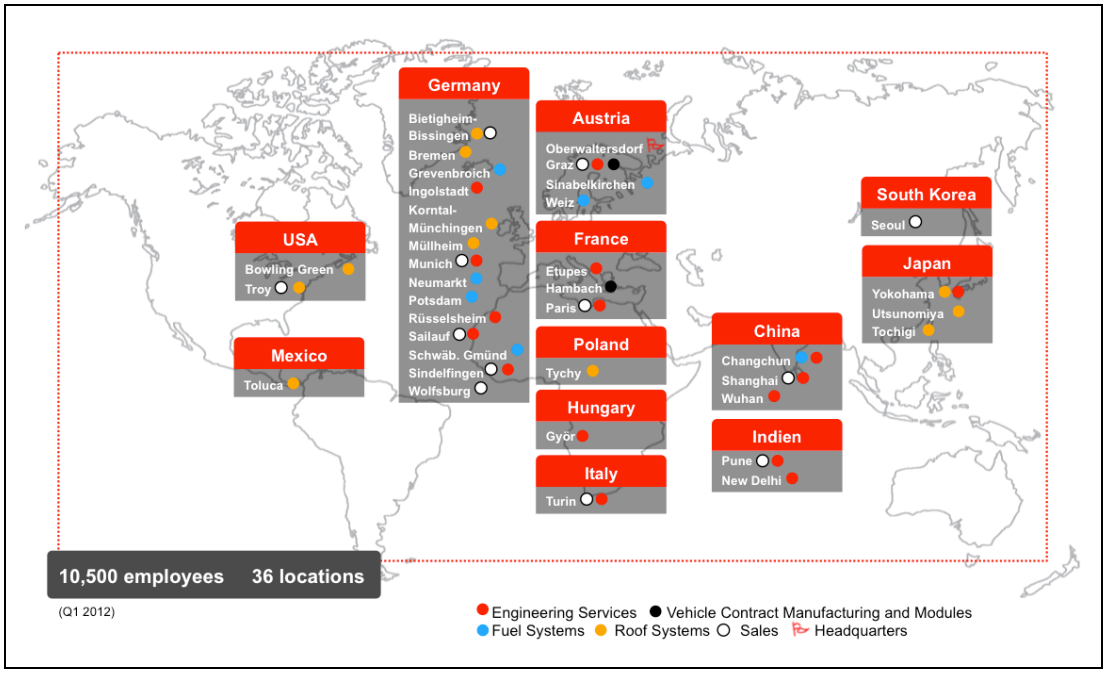


Figure 1.2: Worldwide Presence of MSF (MSF, 2012, p. 6)

Figure 1.2 gives an overview of all MSF locations worldwide. 10,500 employees work at the 36 different branches. The headquarters are located in Oberwaltersdorf. (MSF, 2012, p. 6)

1.2 Problem Definition and Objectives

MSF outsources engineering activities to internal as well as external suppliers. The way in which this is done is only documented in a very limited way. There are no process maps or descriptions available. Process participants are not very knowledgeable about what happens outside of their own area of responsibility. MSF has experienced an increase of outsourcing activities in recent years. The Body & Trim department is not completely satisfied with how things are done at the moment. It is suspected that the various Body & Trim departments use different approaches for outsourcing engineering activities. These departments do not have the same level of experience in this field.

The objective of this thesis is to provide an outsider's perspective for the outsourcing process of engineering activities. The as-is situation of these processes for the Body & Trim departments, i.e. Body in White, Exterior, Interior as well as Doors & Closures, needs to be documented. The aim is to

detect problem areas within the process. Measures to improve identified frustration areas should be noted. One of the goals is to combine the knowledge of the four Body & Trim departments and create a standard process. This to-be process must apply to all four Body & Trim departments.

1.3 Approach

This thesis is split into three main phases (see Figure 1.3), i.e. documentation and analysis of the as-is, development of the to-be and final documentation.

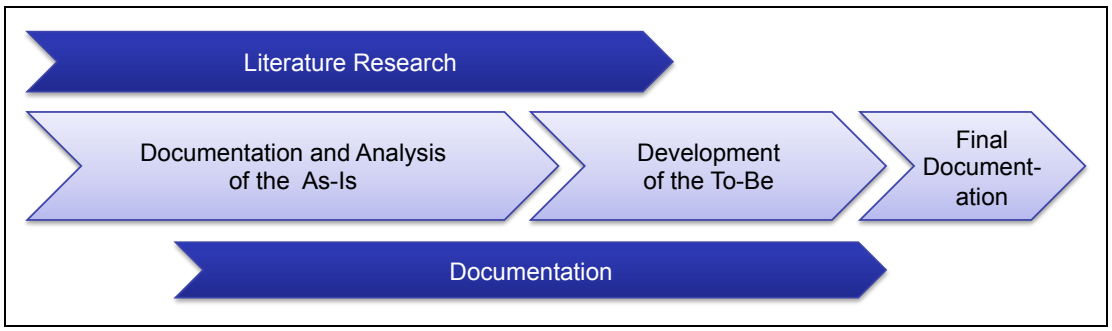


Figure 1.3: Approach (Own Illustration)

Parallel to these three stages, literature research is performed and the thesis is documented.

Documentation and Analysis of the As-Is

During this phase, several interviews with the process participants are conducted. General information about outsourcing of engineering activities at MSF is gathered. Documents regarding the topic are identified and analysed. A rough process model is created using this information. This model is then used for further interviews and is enhanced in an iterative process. The complete process map acts as input for the process analysis in which problem areas are detected.

Literature Research

Books as well as papers for processes and outsourcing are consulted. The sources used are mainly university libraries, amazon.com, Google books,

Google scholar as well as scopus.com. To do so, several key words are set (see Table 1.1).

Outsourcing	Processes
Outsourcing development	Mapping processes
Outsourcing engineering	Process analysis
Outsourcing automotive	Process flow
New product development	Process improvement
Engineering service provider	Process management
Offshore Development Centre	

Table 1.1: Key Words for Literature Search

These terms, as well as different combinations of them, are used for the search. Outsourcing findings related to IT are not relevant for thesis.

Documentation

During this phase, findings from the practical part as well as the literature research are documented.

Development of the To-Be

Based on the findings of the as-is analysis, suggestions for improvement are developed. The process is restructured in such a way as to function in an effective and efficient manner. Tools that assist process participants are proposed. By considering all these measures, a to-be process is mapped. For this process input, output as well as responsibilities for each process step are stated.

Final Documentation

Final changes within the written thesis are made. The results of the thesis are presented at the company as well as the university.

2 Outsourcing

The pressure on automobile manufacturers has increased over the last two decades due to globalisation and changing customer requirements (Lamming, 1994, pp. 36-37). Furthermore, the automotive industry is confronted with a saturation of what is known as the triad markets, i.e. Western Europe, North America and Japan (Ebel, Hofer, & Al-Sibai, 2004, p. 3). The automotive OEMs are trying to compensate for this by entering new markets in Latin America and Asia. (Schneider, 2011, p. 34) All this has resulted in increased outsourcing of production as well as development. This section will have a look at outsourcing in general, the opportunities and risks of outsourcing, external vs. internal outsourcing, outsourcing of engineering activities as well as frameworks for outsourcing engineering.

2.1 Definition of Outsourcing

The term outsourcing has its origin in American management practice. The word is a synthesis of the words outside, resource and using. In that sense, outsourcing simply means the use of external resources. (Hermes & Schwarz, 2005, p. 15) For a long time, the term outsourcing was only used when activities were performed internally and then sourced somewhere else. This is no longer the case for modern definitions of outsourcing. (Zahn, Ströder, & Unsöld, 2007, p. 4) Power et al. define outsourcing as *"transferring the work to an external party"* (Power, Desouza, & Bonifazi, 2006, p. 3). The literature surveyed does not agree on what the "outside" in the term outsourcing means, due to the fact that the boundaries between organisations and the environment are becoming more and more blurred. Some authors claim that there must be strict separation (i.e. legal and financial) between the outsourcing entity and the vendor. Others also use the term outsourcing when activities are transferred between independent internal organisational units. (Barth, 2003, pp. 8-10) In this thesis the latter, wider definition will be used.

Nowadays, outsourcing is used as a synonym for sourcing and hence as an umbrella term for numerous concepts (Jouanne-Diedrich, 2004, p. 127). As a result, the term outsourcing is used in several different contexts and the meaning in a particular case is, therefore, often unclear (Zahn et al., 2007,

p. 4). Jouanne-Diedrich has proposed five different dimensions, which allow the distinguishability of the common outsourcing variants (see Figure 2.1).

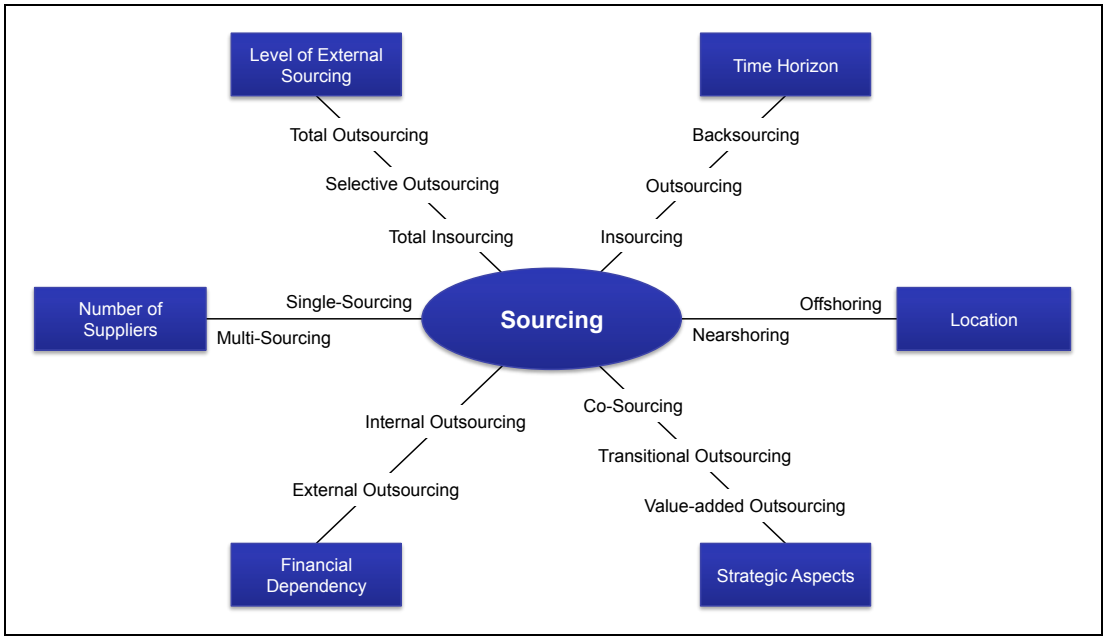


Figure 2.1: The Different Forms of Sourcing (Jouanne-Diedrich, 2004, p. 127)

These dimensions are explained in more detail in the following paragraphs.

Level of External Suppliers

This dimension describes the proportion of outsourcing in relation to the whole budget of an organisational function. Insourcing means that an activity is sourced internally and outsourcing means that it is sourced externally. Selective sourcing is a hybrid of these two and means that 20 to 80 per cent is sourced externally. (Zahn et al., 2007, p. 5) Insourcing should be used for activities with high strategic importance as management would then have 100% control over the activity. (Lang, 2007, p. 15)

Time Horizon

Generally, an activity starts out performed in house (i.e. insourcing) and can later be outsourced. Backsourcing takes place after the completion of the collaboration as well as when outsourcing fails. (Schneider, 2011, p. 19) This means activities, which were performed externally, are re-insourced (Lang, 2007, p. 13).

Location

Nearshoring (also domestic shoring) is used when activities are sourced within the organisation's own country or region. Offshoring, on the other hand, indicates that activities are sourced in foreign countries. (Zahn et al., 2007, p. 5)

Strategic Aspects

The aim of co-sourcing is to reach economies of scale. Similar activities from different organisations are pooled together so as to gain an advantage (Lang, 2007, p. 14). Transitional outsourcing is especially useful in technology intensive markets. In this case, old technologies are outsourced in order to be able to concentrate on new ones. The risk of know-how loss is thereby very low. (Zahn et al., 2007, p. 5) With value-added outsourcing there is collaboration between the outsourcing organisation and the vendor. The goal is to combine their competences and satisfy the external market. (Lang, 2007, p. 14) With this form of outsourcing the revenue and risk is shared between the partners. (Zahn et al., 2007, p. 5)

Financial Dependency

Internal outsourcing involves the transfer of activities to companies whose equity is linked to the outsourcing organisation, e.g. profit centres and subsidiaries. If the vendor is legally and financially independent from the outsourcing organisation the term external outsourcing is used. (Schneider, 2011, p. 19)

Number of suppliers

Single-sourcing indicates that an activity is sourced from only one vendor. With this kind of sourcing the number of interfaces is quite low and overhead is reduced. In the case of at least two vendors the form of sourcing is known as multi-sourcing. (Lang, 2007, p. 15) The advantage of multi-sourcing is that there is competition between the vendors, which can positively affect performance (Zahn et al., 2007, p. 5).

2.2 Opportunities and Risks of Outsourcing

Outsourcing, as a strategy, can generate plenty of benefits for an organisation. Often, companies do not realise the full potential of outsourcing. However, outsourcing is also accompanied by considerable risk. (Power et al., 2006, p. 19) Lang analysed the importance of the opportunities and risks of outsourcing (see Table 2.1). He compared eleven different sources and divided the opportunities as well as the risks into three categories, according to how often they were mentioned in the referenced literature (Lang, 2007, pp. 25-26):

- A: very often mentioned
- B: often mentioned
- C: seldom mentioned

	Opportunities	Risks
A	Cost reduction in general (economies of scale/scope) Transforming of fixed into variable costs Higher transparency of costs Access to external resources (know-how, technology, infrastructure) Higher flexibility	Increase of transaction costs Loss of know-how Dependency on partners (backsourcing very difficult) Cultural uncertainty (resistance of employees)
B	Focus on core competences Higher rate of innovation Optimising (speed up) internal processes Reduction of skilled personnel shortages Lower/shared risk Grow potential / new business areas Higher product / service quality	Absence of expected cost reductions Loss of competitive advantage Planning and quality risks Bankruptcy of the vendor Additional burden for the management (geographical distance, areas of conflict…) Loss of power Conflicting goals of organisation and supplier
C	Labour cost reduction Other savings (taxes, fees) Faster process of change	Lower ability to plan long-term costs Other additional costs Image loss

Table 2.1: Opportunities and Risks According to the Literature (Lang, 2007, p. 26, p. 31)

In order to guarantee fruitful effects, outsourcing has to be well planned, as well as efficiently implemented and managed. Organisations seldom have the commitment and discipline to do this. This results in the failure of outsourcing initiatives and backsourcing. In some cases it is even worse, as activities are outsourced to another vendor and the same errors are made again. Due to these reasons, it is necessary to carefully evaluate the opportunities and risks of outsourcing. (Power et al., 2006, p. 19) This section will give an overview of the most common ones.

2.2.1 Opportunities of Outsourcing

Outsourcing enables the splitting of activities between different organisations and can offer several advantages. The most important opportunities provided by outsourcing can be grouped into three categories: Benefits in terms of cost, focus on core competences and increase of performance. (Barth, 2003, p. 13)

Benefits in Terms of Costs

Decreasing costs is perhaps the most commonly cited objective for outsourcing within the literature. Vendors are usually able to perform certain activities at lower costs than the outsourcing organisation. (Barth, 2003, p. 16) One of the reasons for this effect is that the suppliers are able to use economies of scale. These companies specialise in the products and services they provide and therefore produce them in much higher quantities. This enables them to use their resources more efficiently and to benefit from continuously increasing experience. Specialised vendors often have lower labour costs because they have optimised personnel structures and higher productivity. In addition, they have to vie with competitors and are regulated by the market. (Hermes & Schwarz, 2005, p. 20) Outsourcing enables organisations to turn fixed costs into variable costs. When companies perform activities on their own, a portion of the costs is always fixed. If an organisation outsources activities, costs only occur when services are rendered and are thus categorised as variable costs. Internal costs are, in most cases, hard to allocate to certain products or processes. Outsourcing costs, on the other hand, are tied to certain contracts and are paid periodically. This allows for a precise allocation of the costs as well as higher cost transparency and easier cost planning. (Bruch, 1998, p. 32)

Furthermore, there are no initial investments for an infrastructure and no idle time costs caused by unused capacity. As a result, lower investments are needed and some assets can be sold, which increases the liquidity of an organisation. (Hermes & Schwarz, 2005, p. 20)

Focus on Core Competences

One of the main motives for outsourcing is that it can help organisations to focus on their core competences (Barth, 2003, p. 13). Core competences are special abilities which enable an organisation to perform certain activities of the value chain better than its competitors. They contribute in an above average way to the value perceived by the customer. For competitors it is quite hard to reach the same performance for such competences. Core competences can also be used to create new products and services. (Hermes & Schwarz, 2005, p. 21) With outsourcing it is possible to concentrate on what the market demands and on what the company is able to do best (Zahn et al., 2007, p. 10). By focusing on these activities limited resources are not consumed in less important areas. This enables an organisation to use the available resources in strategically relevant areas. By doing so, their flexibility increases and their complexity decreases. (Barth, 2003, p. 13) Non-core competences rarely contribute to an increase of the completive edge, but can cause considerable problems. Through outsourcing of these activities the buyer can lower his risks. The vendor, which provides the services, must fulfil the contract and is responsible for any problems, e.g. delays, quality problems and increases of cost. (Hermes & Schwarz, 2005, p. 21)

Increase of Performance

Performing activities requires certain know-how. (Hermes & Schwarz, 2005, p. 21). In order to be competitive, this know-how has to be acquired as quickly and economically as possible. However, building competences takes time and requires substantial effort. Outsourcing can offer a solution for this problem. Vendors possess a specialised knowledge base in their area of expertise. This knowledge enables them to perform activities, often more effectively and efficiently, which results in higher quality at the same or even lower costs. It is difficult for companies to keep pace with technical progress in all areas, especially in technology intensive markets. Through outsourcing, firms can profit from the know-how of suppliers. (Barth, 2003, p. 15)

In addition, it is possible to agree upon certain service levels with a supplier. This guarantees consistent availability, reaction time and quality. Internally it is much harder to realise this, because internal suppliers are not as focused on their customers as external ones are. (Hermes & Schwarz, 2005, p. 22)

2.2.2 Risks of Outsourcing

The opportunities described in the previous section are also accompanied by several risks. Some of these risks can be prevented or minimised by capable management and foresight in planning the outsourcing partnership. Other risks, however, cannot be avoided and must be accounted for. (Beer, 1998, p. 126) If risks are not considered, it can lower the potential for success considerably and can even result in a failure of an outsourcing initiative. The most important risks are dependency on the outsourcing provider, increase of costs, performance and quality issues as well as loss of know-how. (Hermes & Schwarz, 2005, pp. 22-25)

Dependency on the Outsourcing Provider

Outsourcing of processes is normally irreversible in the medium term. One reason for this is that outsourcing contracts are usually binding for several years. This can result in a dependency of the outsourcing organisation on the vendor. (Hermes & Schwarz, 2005, p. 23) That is especially true for complex products and services. For simple activities however, which can easily be copied, the risk of dependency on the supplier is quite low. In such cases there is often considerable competition on the supplier market. (Zahn et al., 2007, p. 12) Due to the fact that the know-how of outsourced activities is often no longer available within the organisation, the risks associated with dependency are increased. The more specialised an activity is the higher the bargaining power of the outsourcing provider is. (Hermes & Schwarz, 2005, p. 23) In such cases, the outsourcing company has limited options for intervening in the event the quality is insufficient, delivery problems occur or the vendor wants to increase prices. (Zahn et al., 2007, p. 12) Furthermore, the outsourcing company can face severe problems if the supplier goes bankrupt (Hermes & Schwarz, 2005, p. 23). Mutual dependency between the outsourcing organisation and the vendor is difficult to avoid. As a result, the possible risks due to dependencies have to be carefully evaluated. (Zahn et al., 2007, p. 13)

Increase of Costs

In the previous section the reduction of costs was mentioned as probably the most cited benefit of outsourcing in the literature. However, poor realisation of an outsourcing initiative can cause an increase in costs. In addition to the costs for the provided services, firms must account for transaction costs. Such costs are often underestimated by organisations. (Hermes & Schwarz, 2005, p. 24) Transaction costs are incurred by the following: negotiation, set-up, contract incompleteness, delay, monitoring, as well as coordination costs. It does not matter how long and detailed a contract is, it will never cover all contingencies. Costs which arise due to this reason are called contract incompleteness cost. (Contractor et al., 2011, p. 29-30) Transaction costs should not be underestimated, particularly due to the complexity of contracts. Furthermore, monitoring is necessary to guarantee compliance with the contract. It is difficult to determine transaction costs accurately, so only a rough estimation is possible. Another type of costs the buyer has to take into consideration is switching costs. They arise as a result of one-time organisational or technical changes, which are needed in order to enable outsourcing, e.g. for setting-up control mechanisms. (Barth, 2003, p. 18)

The reduction of direct costs was mentioned as a benefit of outsourcing. However, this should be critically analysed. The costs for in-house production of a product or services are often overestimated. Organisations often still use full cost accounting and it is therefore difficult to correctly allocate overhead costs. (Barth, 2003, pp. 18-19) If the calculation shows that in-house production is much higher than external procurement, this can also mean that the organisation’s own processes are inefficient. Under these circumstances it is better to improve the processes rather than to outsource. (Hermes & Schwarz, 2005, p. 25) Fixed costs are not reduced automatically in the outsourcing company. To do so, firms have to sell or relocate assets and reorganise their workforce. In some cases this is not possible in the short run and organisations have to cover these fixed costs as well as the costs for the outsourcing provider. (Barth, 2003, pp. 19)

Performance and Quality Issues

Products and services, which are provided by the vendor, have to be precisely and comprehensively defined within the outsourcing contract. Everything that is not mentioned in the contract costs extra. (Hermes &

Schwarz, 2005, p. 24) In order to reach economies of scale, outsourcing providers tend to standardise products and services. This results in less exclusive products and services that the buyer can only influence in a limited way. (Barth, 2003, pp. 20) Poor communication or lack of communication can cause performance and quality problems. The risk is especially high if there is a major geographical distance between the outsourcing company and vendor or if there is internal resistance against outsourcing. When activities are offshored, organisations also have to account for language and cultural barriers. Performance and quality issues on the vendor's side can have far-reaching consequences. They can result in deficiencies of the end product as well as schedule and payment delays. (Hermes & Schwarz, 2005, p. 24)

Loss of Know-How

A critical risk factor, which should not be forgotten, is the loss of valuable know-how. This can occur when firms outsource the wrong activities. The outsourcing of core competences often results in a negative development of the organisation. (Zahn et al., 2007, p. 13) The vendor may also offer the outsourced products and services to his other customers. This would cause a loss of competitive advantage. (Barth, 2003, p. 20)

2.3 External vs. Internal Outsourcing

In section 2.1 it was shown that one can distinguish between internal and external outsourcing based on the degree of financial dependency. This is necessary because organisations have become very complex and often consist of a network of independent companies (Hermes & Schwarz, 2005, p. 27). Figure 2.2 shows an overview of internal and external outsourcing.

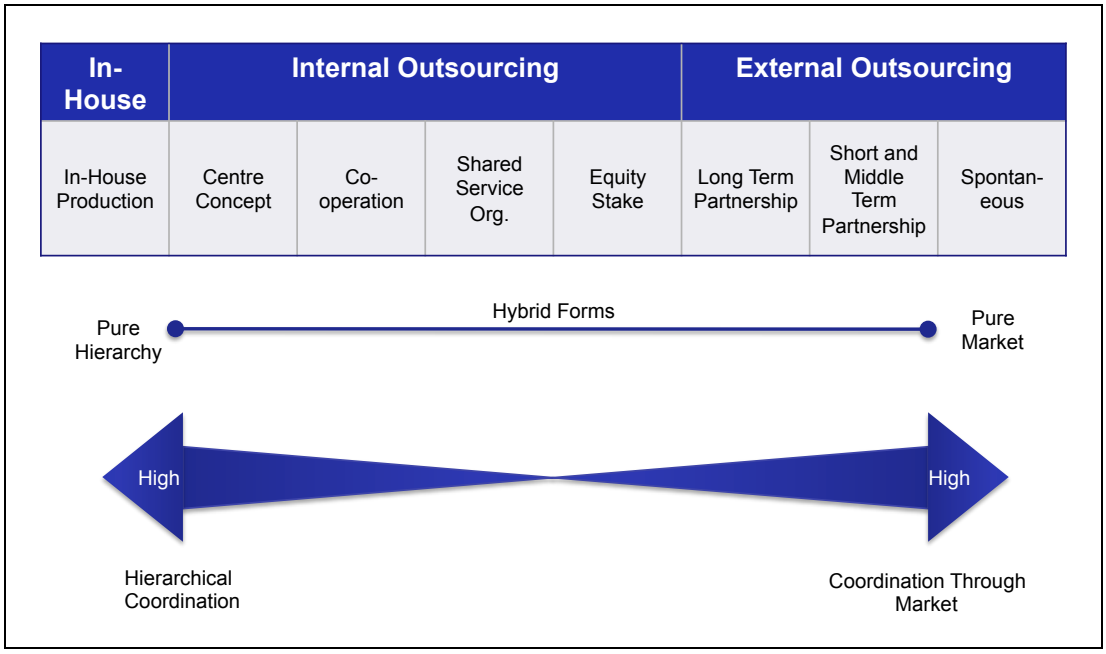


Figure 2.2: Internal and External Outsourcing (Zahn, Barth, & Hertweck, 1998, p. 118)

Since MSF uses internal as well as external outsourcing providers this thesis provides a further explanation of the two.

2.3.1 External Outsourcing

External outsourcing means that the product or service is procured from outside the organisation. The market regulates the relationship between the partners. As a result, the outsourcing contract has a very high relevance for this type of outsourcing. It represents the only possibility for the buyer to influence price, quality and performance. In a limited way it is also possible to affect the business policy of the vendor. (Barth, 2003, p. 28) External outsourcing has a high potential for increasing efficiency, since the outsourcing provider is driven by the competition on the market. In the set-up and negotiation phase, the demand on management is extensive. After the contract is signed the responsibility for the product or service is passed to the supplier. (Bechtolsheim, 1994, p. 18) From this moment on, the outsourcing organisation has no way to directly influence the vendor (Bliesener, 1994, p. 279).

2.3.2 Internal Outsourcing

Internal outsourcing is the relocation of activities to parts of an organisation, which are still within its area of influence (Bliesener, 1994, p. 279). Thus, a vendor, whose equity is linked to the outsourcing organisations, provides the outsourced products or services. In such cases the organisation retains influence over the outsourced activities. (Bruch, 1998, p. 56) This offers several benefits. There is no risk for loss of know-how and no dependency on the supplier. Internal outsourcing should be chosen for activities which cannot be clearly defined at the time of the conclusion of the contract. (Hermes & Schwarz, 2005, p. 28) Another advantage is that internal vendors already know how the organisation works and there are already interfaces in place. Furthermore, there is no risk of an organisational culture clash. Negotiation with the supplier is easier and does not require as much effort. Contracts are not as detailed as those with external vendors. The reason for this is that the organisation can influence an internal supplier. All in all, this minimises transaction costs as well as the risk. (Power et al., 2006, p. 81)

Many organisations err in not considering in-house bidding on work. When there are areas of an organisation which can offer a comparable service level they should, at least, be considered. However, insourcing should not be used for cutting costs. Internal outsourcing can only be successful if executives put the overall good of the company above their own initiatives. By shifting activities from one part of the firm to another, one manager will lose power while another will gain more. When mangers do not focus on the overall good of the organisation, internal outsourcing can result in power struggles which cause disruption. In such cases, an external supplier should be favoured. (Power et al., 2006, p. 81) In general, there are four different forms of internal outsourcing (see Figure 2.2).

Centre Concepts

Outsourcing in the form of centres has, aside from in-house production, the strongest ties to the vendor. Centre concepts offer higher cost transparency and make it easier to allocate costs. Nevertheless, they demand substantial initial investments. This type is especially suited for areas that have a high know-how potential. (Barth, 2003, p. 30)

Profit Centres are an organisational area for which the accounting period balance is determined separately. This balance is used to evaluate profit centres as well as to steer them. The head of a profit centre acts as in a similar way to an independent contractor. (Profitcenter, 2012) Profit centres offer their services not only to internal customers but also to the entire market with profits in mind (Bruch, 1998, p. 59).

Offshore Development Centres (ODC) are used by organisations to access the large and cheap labour pools of offshore countries like India and China. They help to retain proprietary knowledge and patents. (Balaji, Chand, & David, 2012, p. 295) Usually 20% to 30% of the work is done at the onsite location of an organisation, e.g. gathering information for requirements, planning, early design, ensuring that the time schedule is met. The rest is performed at the ODC. The difference to normal offshoring is that the customer handpicks the offshore team. This offshore team then directly reports to the firm's onsite manager. The onsite team manages the offshore team and functions as a communication layer between the offshore team and the customer. (Faiz, Qadri, & Ayyubi, 2007, pp. 2-3)

Cooperation

In outsourcing in the form of cooperation, a few companies work together with the aim of gaining a competitive advantage (Lang, 2007, p. 11). This form is suitable for organisations which do not have the know-how or capacity to produce certain products or services on their own (Bruch, 1998, p. 58).

Sheared Service Organisation

With this type of internal outsourcing several outsourcing partners contribute resources as well as know-how to build a common organisation, i.e. joint-venture. The partners profit from shared competences as well as synergy effects. (Barth, 2003, p. 29)

Equity Stake

The buyer owns some shares of the vendor company. The level of influence on the supplier depends on how many shares he owns. He profits from the success of the vendor. (Barth, 2003, p. 29)

2.4 Outsourcing of Engineering Activities

Globalisation has resulted in increasingly fierce competition for organisations. In addition, customer requirements have become more and more demanding and products have diversified. Organisations have realised the importance of short development cycles, which enable them to win market share. In order to do so, they must be able to develop products quickly and at low cost while also guaranteeing quality. (Wang, Wang, & Liu, 2010, pp. 1794-1795) This has resulted in a change of the product development process. Nowadays, companies leverage their own internal capabilities as well as those of external suppliers. Outsourcing of development has become increasingly common. (Gottfredson, Puryear, & Phillips, 2005, p. 132)

The motivation for companies to outsource is not only a quest to minimise costs anymore. The opportunity to access know-how, ideas and human capital from outside the company is becoming more and more interesting. Today's organisations split up their design activities and distribute them all over the world. One cause for this is the need of international firms to source talent and know-how from people all over the world. Companies in the USA, Europe and Japan point out that their main reason for outsourcing engineering is not to lower costs, but to gain access to talent (Contractor et al., 2011, pp 11-12) Farrell compared the importance of low-cost labour and access to highly skilled labour for different activities. (see Figure 2.3) (Farrell, 2003, p. 6).

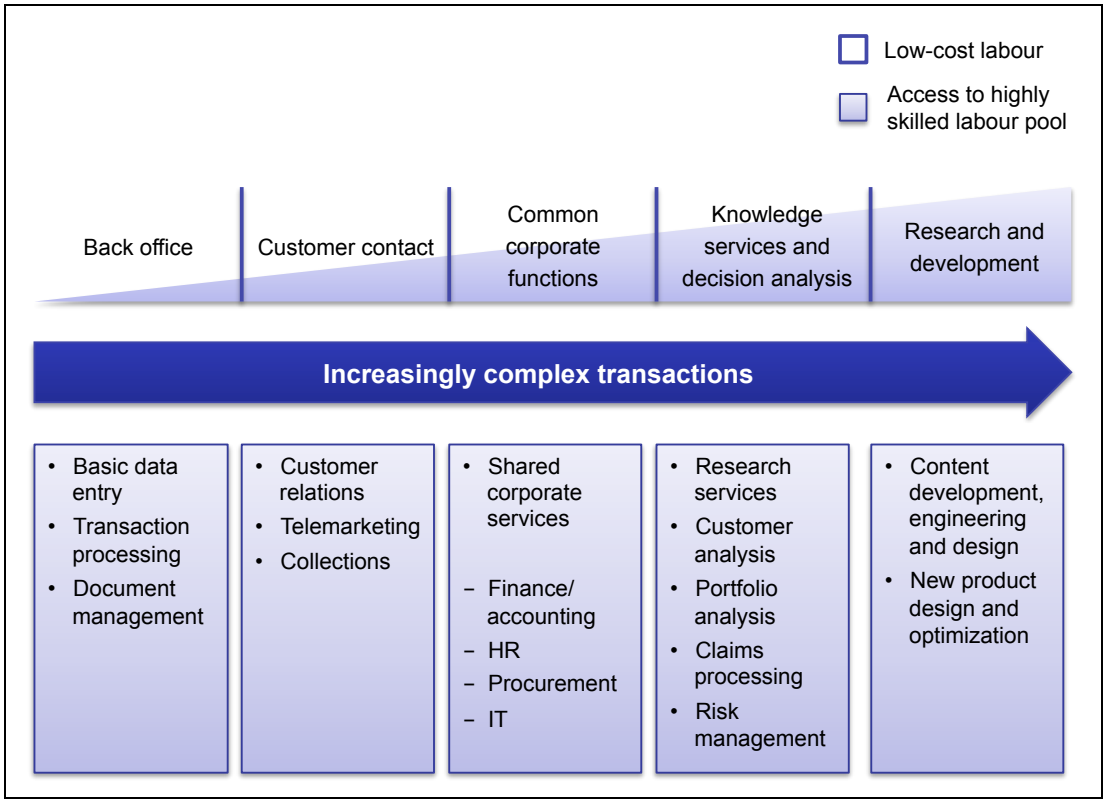


Figure 2.3: Outsourcing Drivers Regarding Personnel (Farrell, 2003)

Manning et al. claim that global sourcing of talent is the next generation of global sourcing. (Manning, Massini, & Lewin, 2008, p. 40) Nowadays, large organisations sell their products all over the world. These products have to be aimed at the local tastes and cultures. Consequently, skilled personnel from different cultural backgrounds is required. In addition, product complexity is increasing steadily and specialists from multiple sectors have to be involved in new product development process. Since it is not feasible to hire all these experts long term, outsourced activities continue to move up the value chain (Bardhan & Jaffee, 2011, p. 49-51). However, the general rule for outsourcing, to never outsource core competences, remains valid. Design activities should be split between critical and non-critical tasks. The latter can be outsourced to external providers without losing the competitive edge. The number of activities that organisations consider to be core competences is getting lower. (Contractor et al., 2011, p 13)

2.4.1 Empirical Findings Within the Literature

This section states the results of research about outsourcing development in the area of mechanical engineering. The research investigated the motives for outsourcing engineering and how these engineering services are procured. Furthermore, the findings of a case study about outsourcing development in the automotive industry are pointed out. This case study analyses an automobile OEM which failed with outsourcing engineering and was forced to backsource. The study identifies pitfalls as well as limits for outsourcing engineering.

Gangl (2008) analysed outsourcing of research and development (R&D) activities in the area of mechanical engineering. To do so, he created a questionnaire, which was aimed at two groups, i.e. R&D providers and R&D customers. R&D providers offer R&D services for third parties, whereby R&D customers carry out R&D for their own products. The questionnaire was answered by 21 R&D providers and 49 R&D customers within Austria. (Gangl, 2008, p. 197, p. 204)

Gangl's research showed that 85% of all R&D providers and 80% of all R&D customers procure R&D services from external organisations. He asked the organisation how important certain motivations were for outsourcing R&D. The result is displayed in Figure 2.4. Better distribution of resources and lack of know-how were identified as the main drivers for R&D outsourcing. However, tax advantages, the option of sharing risks as well as the rapidly changing market seem to have just minor roles. The organisations interviewed seem to keep pace with technology changes or even set the pace themselves. The comparison of providers and customers shows that the issues of strategy and sharing risk are of higher importance to customers. The most vital motives against R&D outsourcing were identified as keeping the R&D lead and higher costs of procuring R&D than doing it in-house. (Gangl, 2008, pp. 213-217)

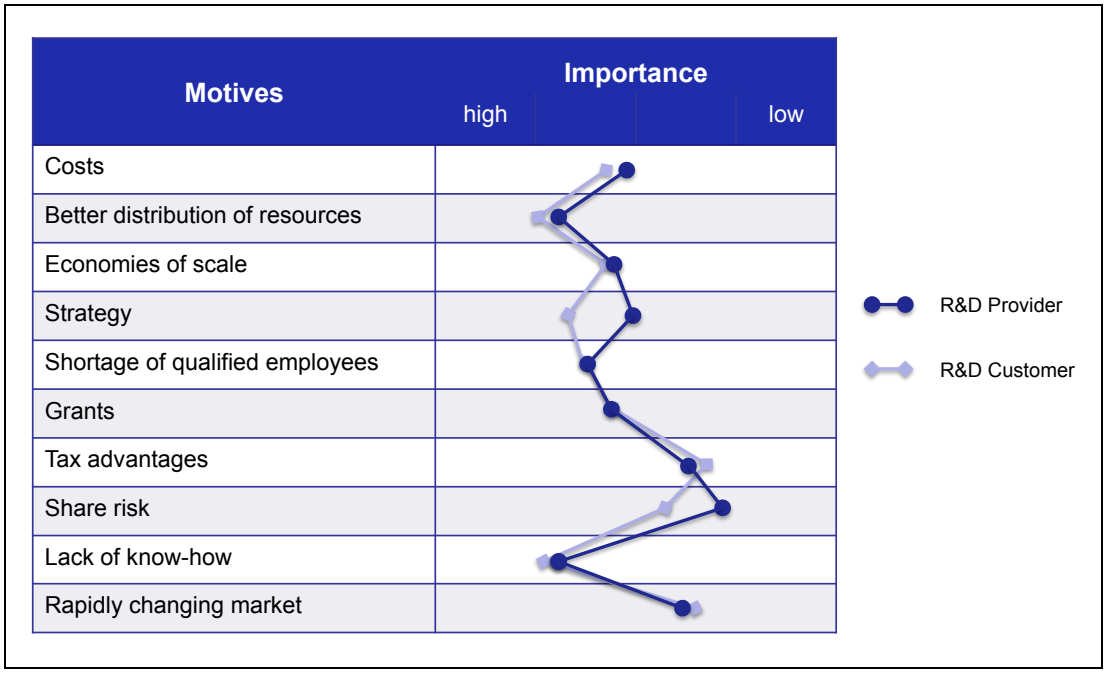


Figure 2.4: Criteria for Outsourcing R&D (Gangl, 2008, pp. 215-216)

Lang (2007) conducted a research study of empirical outsourcing motives within the literature. If Lang's result is compared to Figure 2.4, one can see that costs seem to have lower importance for R&D outsourcing. However, a shortage of qualified employees, as well as lack of know-how, seems to have a much higher significance for R&D outsourcing. (Lang, 2007, p. 44) Quélin's and Duhamel's findings confirm this. They analysed the motives for different business functions. (Quélin & Duhamel, 2003, p. 656) Manning's et al. survey shows that the number one motivating factor for outsourcing, in general, is still costs. However, their survey also indicates the increasing importance of access to qualified personnel. An increase in the growth of engineering offshoring fosters this development. (Manning et al., 2008, pp. 35-36)

Gangl also looked into how organisations procure these R&D services. His research showed that roughly 40% was outsourced in the form of contract development and another 40% in the form of cooperation. The other forms of outsourcing played only minor roles. (Gangl, 2008, p. 219) Outsourcing in the form of contracts means that the activity is sourced externally. The vendor performs the activities according to a contact. (Brockhoff, 1992, p. 47)

Gangl's investigations showed that approximately 60% of the R&D services were sourced from vendors within Austria, 30% in neighbour countries and 10% in the rest of the world. In addition, he found out that organisations

usually do not source out whole projects. Only 2.6% of the surveyed organisations stated that they source out whole projects. Gangl explains this with the fact that the risk of know-how spill over is lower when only parts of an R&D project are outsourced. Another interesting finding is displayed in Table 2.2.(Gangl, 2008, pp. 223-228)

Location	R&D Provider		R&D Customer	
	Amount [#]	Per Cent [%]	Amount [#]	Per Cent [%]
Vendor's site	12	66.7	16	41
Outsourcing organisation's site	1	5.6	0	0
At both sites	5	27.8	23	59

Table 2.2: Location of Value Creation for R&D Services (Gangl, 2008, p. 228)

The table shows that, in general, the majority of the outsourced R&D activities are performed at the vendor's site. However R&D customers seem to prefer that R&D services are carried out at both sites. Gangl notes the need to use specific and expensive resources as a possible reason for this result. (Gangl, 2008, p. 228)

Zirploi and Becker conducted a case study within the automotive industry. The focal point of their study was a multi brand auto manufacturer, which they named Alpha. Alpha covers all market segments and offers the whole product range from passenger and luxury cars to trucks and even Formula 1 racing cars. This company experienced enormous changes with its supply chain of engineering and design activities over the years. It was fully vertically integrated before it performed a rather radical shift towards an extreme outsourcer. After some time, the company steered back and began to backsource activities. Zirpoli and Becker's research gives insight into what happened within this time span of 10-15 years. They used multiple sources of data, i.e. industry publications, archival data and company documents as well as interviews with Alpha and eight of its first-tier suppliers. (Zirpoli & Becker, 2011, p. 24)

As mentioned in the previous paragraph, Alpha performed most of its new product development (NPD) activities on its own at the beginning. 3,450 of

3,500 technical drawings, needed for engineering a car, were made by their own engineers. During this period (1987-1993) Alpha built a local supplier base, which was competitive in terms of cost and quality. Then the period of extreme design outsourcing started (1993-2001). A re-engineering of the NPD process took place in 1996, which sped up the outsourcing of design activities. Alpha began to outsource engineering tasks to strategic partners. It used two types of suppliers, i.e. system and module suppliers. Within this period the firm outsourced as much as 85% of its engineering activities and hence, became one of the companies with the highest degree of engineering outsourcing in the entire automotive industry. In phase three, from 2002-2006, a great deal of engineering activities where moved back in-house. Nowadays, Alpha has changed back to a natural rate of outsourcing design tasks within the automotive industry, i.e. 50%. (Zirpoli & Becker, 2011, pp. 28-29)

Zirpoli and Becker where especially interested in the reasons for backsourcing large parts of the NPD process. They found out that Alpha had lost large parts of its design competences, i.e. the ability to engineer dashboards, suspension- and passenger safety systems. The Chief Technology Officer stated that at the end of phase two, business units were completely out of touch and that outsourcing destroyed Alpha's technical competences in core areas. One of Alpha's cars reached the maximum score at the EuroNCAP test. So, Alpha decided to arrange a lessons learned meeting with the passenger safety system supplier. Despite the meeting, neither the supplier nor Alpha was able to identify the reasons for the success. This made the firm realise that it was no longer able to understand the interactions of the different components. Due to years of outsourcing engineering activities, people were no longer capable of understanding the overall performance of systems anymore. The interviewed managers claimed that it is nearly impossible to integrate systems without having detailed knowledge of each individual system. (Zirpoli & Becker, 2011, pp. 29-31)

Takeishi's study of the automotive industry in Japan also showed that for successful outsourcing of engineering, it is necessary to understand how individual components work together. He calls the ability needed to do so architectural knowledge. An automobile manufacturer needs a high level of architectural as well as component-specific knowledge in order to be able to keep up with innovation. (Takeishi, 2001, pp. 415-416) Alpha's Innovation

and Methodologies Manger explained it in the following way, Alpha set up the interfaces for the individual components and then handed everything over to five system suppliers. These suppliers were supposed to develop the best components for Alpha, but in reality they did what was best for them and Alpha did not have the competence to look inside. (Zirpoli & Becker, 2011, p. 32) Monitoring and coordination mechanisms are vital to prevent opportunistic behaviour of the supplier. The vendor is particularly motivated to act opportunistically when the outsourcing organisation has imperfect knowledge. (Harmancioglu, 2009, p. 401)

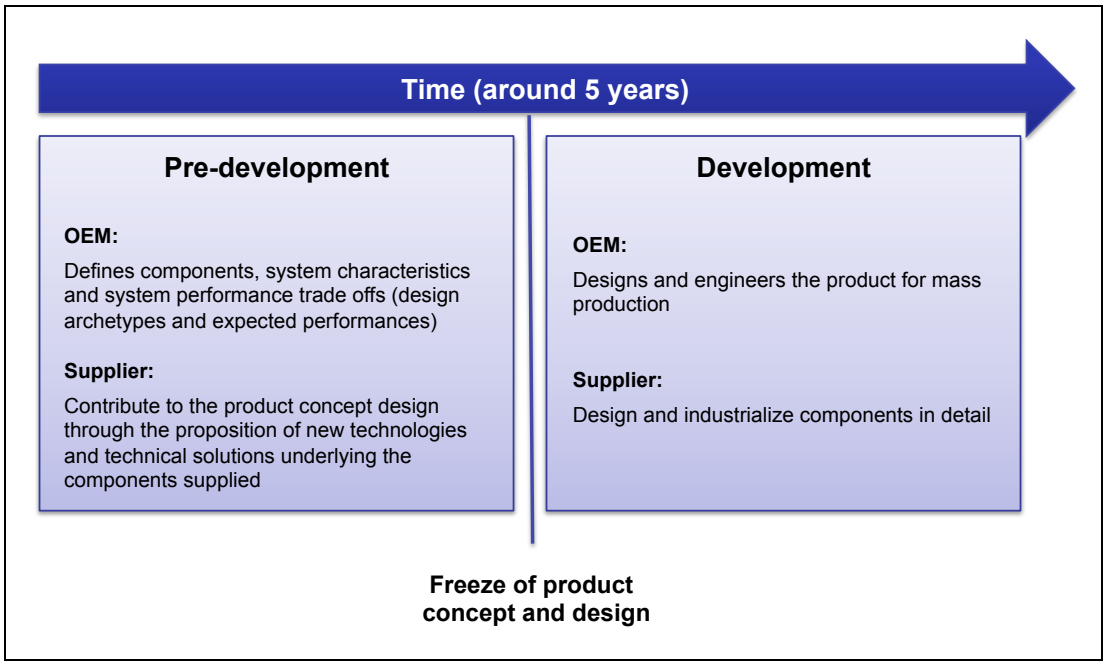


Figure 2.5: Pre-Development and Development Phases (Zirpoli & Becker, 2011, p. 31)

To win back its abilities, Alpha tried to learn from its suppliers. As a result only engineering providers that were willing to share their knowledge were selected (Zirpoli & Becker, 2011, p. 29). Alpha specifically tried to intensify the engineering activities during the pre-development phase (see Figure 2.5) and abandoned its black box sourcing strategy (Zirpoli & Becker, 2011, p. 32). Black box sourcing (see Figure 2.6) means that the vendor engineers parts according to in depth specifications (e.g. Exterior shape, costs and interface details) provided by the buyer. It is also often referred to as an arm's length supplier relationship. With black box sourcing the organisation's own product development can be split from that of the vendor. Hence, it is

possible to maintain control of the central design, while utilising the suppliers' design competences. (Clark & Fujimoto, 1991, pp. 141-142)

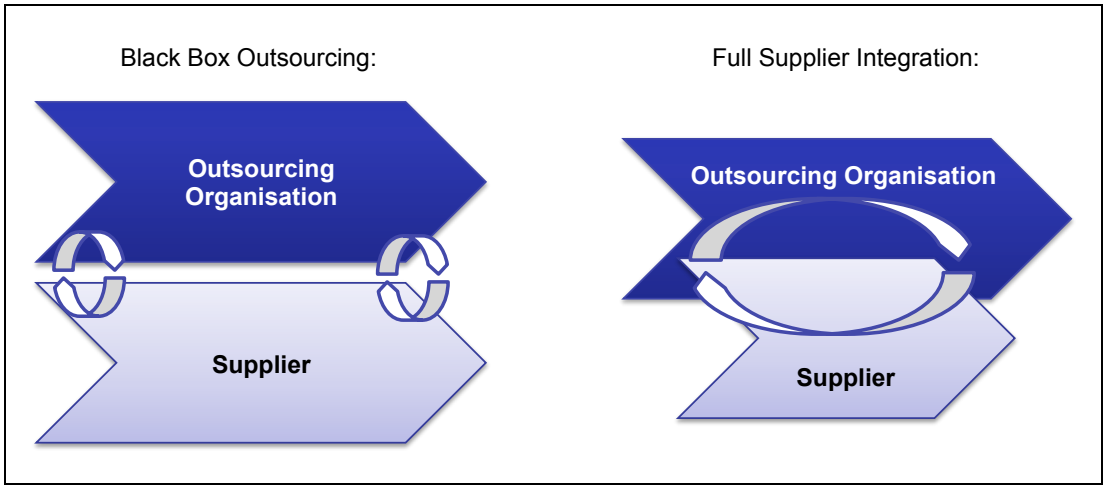


Figure 2.6: Black Box Outsourcing and Full Supplier Integration (Tang, 2007, p. 883)

Luo et al. researched collaborative product development across six countries (i.e. USA, Japan, Korea, Germany and Sweden, Finland) in three industries (i.e. electronics, automotive and machinery) (Luo, Mallick, & Schroeder, 2010, p. 253). They state that the negative impact of increased outsourcing can be lowered by supplier involvement. (Luo et al., 2010, p. 260) This supports Alpha's move against black box sourcing.

Zirpoli and Becker note that during the pre-development phase a lot of trade-off decisions must be made. If suppliers make these decisions, they are focusing on their parts and not the overall system. This will probably result in a lot of problems in the development phase. (Zirpoli & Becker, 2011, p. 32) Takeishi found evidence that outsourcing of development needs extensive internal effort as well as internal coordination abilities. Both parties must be involved in the pre-development phase. (Takeishi, 2001, p. 419) The findings of Luo et al. also indicate that internal coordination capability is important for the ability to outsource engineering activities. It helps to integrate external parties into the projects. (Luo et al., 2010, p. 259) Both, Takeishi and Luo et al., found evidence for the importance of an early, integrated problem solving process with the supplier. It helps the outsourcing organisation to minimise problems with component design, coordination as well as costs. (Luo et al., 2010, p. 416; Takeishi, 2001 p. 259) However, in order to be able to make early design decisions, specific knowledge as well as a particular level of

understanding is required. This level can only be gained by learning by doing. Hence, outsourcing engineering, beyond a certain degree, at which component specific knowledge is lost, represents a limit. (Zirpoli & Becker, 2011, p. 35)

The research of Oh and Rhee pointed out that increasing technology uncertainty makes outsourcing of engineering more difficult unless there is a high level of trust. (Oh & Rhee, 2010, p. 768) In one of their previous studies they found evidence that technology uncertainty hinders collaborative problem solving (Oh & Rhee, 2008, p. 509). Takeishi's research indicates that for new technologies component-specific knowledge is vital. (Takeishi, 2001, p. 420)

2.4.2 The Impact of Modularization on Outsourcing Development

Within the literature two contradicting views regarding the impact of modularization on supplier relationships exist. On one hand, it is suggested that modularisation leads to higher collaboration between buyer and supplier as well as reduced interface constraints. On the other hand, modularization can lead to black box sourcing (see 2.4.1). (Howard & Squire, 2007, p. 1193) Modularization generates standard interfaces that help to decouple components and enable outsourcing of engineering as well as manufacturing (see Figure 2.7). (Howard & Squire, 2007, p. 1198) Schilling describes modularity as *"a continuum describing the degree to which a system's components can be separated and recombined and the extent to which the system architecture enable the mixing and matching of components"* (Schilling, 2000, p. 312) Modular product architecture, reduces the risk of knowledge spillovers, functional mismatches, external dependence and lowers transaction costs. (Harmancioglu, 2009, p. 400; Peng & Li, 2011, p. 155)

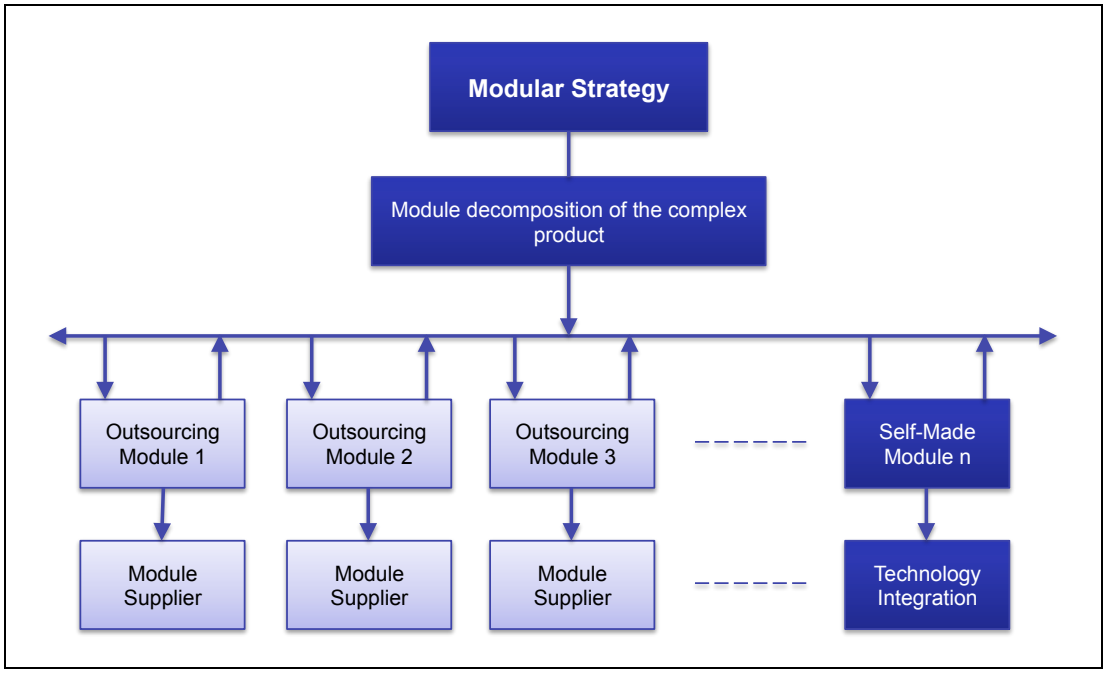


Figure 2.7: Modular Strategy and Outsourcing (Peng & Li, 2011, p. 155)

Howard and Squire surveyed 104 manufacturing companies in the UK. Their results indicate that product modularization can lead to a higher degree of collaboration between outsourcing parties. However, relationship specific assets and sharing of information is necessary. Hence, a higher degree of collaboration is more likely under partnership conditions. Howard and Squire further highlight the need for information systems to enable collaborative planning and forecasting. (Howard & Squire, 2007, p. 1204) Griffith et al. remarked that a higher degree of modularity increases the number of suppliers and decreases the amount to which the supplier influences the buyer's product design. Modular design fosters higher vendor involvement. As reasons, they suggest the need to work more closely with the outsourcing provider to ensure compatibility. Furthermore, Griffith et al. mention the ability of modular structure to protect against knowledge leakage. (Griffith, Harmancioglu, & Droge, 2009, p. 222)

Oh and Rhee conducted a survey in which 92 Korean first-tier automotive suppliers participated. The result indicated that the vendors engineering capabilities, flexibility and modularization positively correlate to outsourcing. (Oh & Rhee, 2010, p. 762) Modular product architecture helps to simplify the cars' assembly process and makes outsourcing of modules possible. As a result, it enables shorter development cycles. (Oh & Rhee, 2010, p. 767)

The research of Lau et al. (2007) within Hong Kong's manufacturing industry also confirms the positive impact of modular product design on product co-development. They further highlight that considerable coordination effort is needed. (Lau, Yam, & Tang, 2007, pp. 1051-1052)

To sum up, it can be said that a modular product design enables buyers and suppliers to perform engineering tasks separately. Whether it leads to higher collaboration or not dependents on the way the outsourcing company manages its relationship to the vendor.

2.5 Frameworks for Outsourcing Engineering

The previous chapter states that outsourcing of engineering is not without risk. The literature proposes several models, which help mangers to avoid pitfalls and establish successful outsourcing (Schneider, 2011, p. 135). However, there are very view frameworks for outsourcing engineering. This section will explain two frameworks suggested by the literature. Schneider states that there is no existing model within the literature that assists with the outsourcing decision for complex outsourcing projects (Schneider, 2011, p. 5).

2.5.1 Conceptual Framework for Outsourcing Prototyping

Liao et al. (2010) developed a conceptual framework for outsourcing of prototyping. In order to do so, they conducted a detailed case study in a US firm as well as an in-depth literature research. The result is displayed in Figure 2.8. The complete process consists of three stages. (Liao, Liao, & Hutchinson, 2010, p. 128) Since prototyping is an important part of the product development process (Liao et al., 2010, p. 124), the framework for outsourcing prototyping should be, in general, similar to that of one for outsourcing engineering.

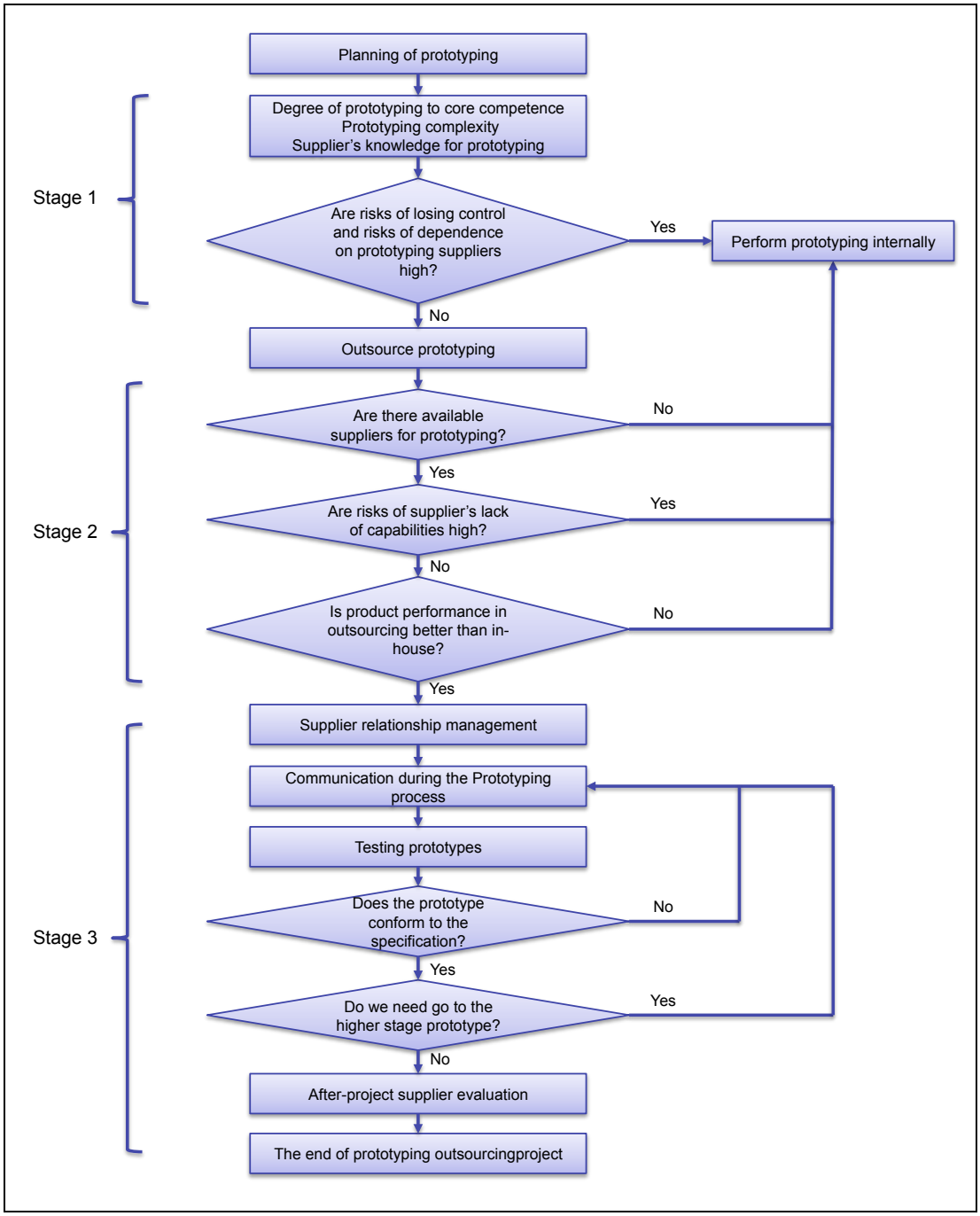


Figure 2.8: Conceptual Framework for Outsourcing Prototyping (Liao et al., 2010, p. 129)

The following paragraphs describe the three stages in more detail.

Stage 1 – Determine Whether to Outsource

In this stage, a decision is made as to whether the prototyping is outsourced or performed in-house. To avoid possible pitfalls due to outsourcing, a

detailed analysis of the prototyping activity is required. Furthermore, the risk of outsourcing this activity must be assessed. There are basically two types of risk that should be considered, i.e. the risk of losing control over the supplier and the risk of dependence on the supplier. The former refers to opportunistic behaviour of the vendor. Sensitive information is transferred when outsourcing for prototyping. There is a chance of know-how leakage. The supplier could use the knowledge gained for competitors' products as well as its own. Liao et al. also mention the risk of losing competence which can result in being at the mercy of the suppliers. (Liao et al., 2010, pp. 128-130) This is in conformance with Zirploi and Becker's study (see section 2.4.1) (Zirpoli & Becker, 2011, pp. 29-32). Prototyping has a strong influence on the product development process. As a result, time delays and quality issues will result in considerable problems. When the buyer is dependent on the supplier, he will have only very limited bargaining power (see also section 2.2.2). Prototyping should only be outsourced if both of these risks are believed to be minor. (Liao et al., 2010, p. 130)

Stage 2 – Supplier Selection

The task of stage 2 is to select an appropriate supplier. Liao et al. split this stage into three sub processes, i.e. pre-selection, supplier evaluation and product performance assessment. For the *pre-selection* they cite price, quality, time, delivery reliability and project failure as possible criteria. They claim that time is the most important factor for prototyping, since time to market is very important for the competitive advantage of a firm. In addition, they suggest that the previous performance of the vendors should be analysed. This step is particularly vital when the buyer does not have the know-how to evaluate the supplier's capabilities. In the *supplier evaluation* process the compatibility of the organisational cultures, trust between the supplier and the buyer, the priority of the project for the supplier as well as the level of top management support of the supplier is assessed. For innovative activities, trust and compatible cultures are essential in order to enable knowledge sharing between the firms. The *product performance assessment* ensures that the supplier has the capabilities to handle the prototyping and is able to adapt to market turbulences. If the in-house performance is considered superior to that of the vendor, the activity can still be kept in-house. (Liao et al., 2010, pp. 130-131)

Stage 3 – Outsourcing Process Management and After-Project Supplier Evaluation

Research shows that outsourcing often yields less than satisfying results. One of the reasons for these findings is that successful managing of outsourcing is very demanding, e.g. handling the relationship and communication between the two companies. (Lonsdale, 2005, p. 177) Outsourcing of prototyping is difficult to forecast and so the possibility of changes occurring is quite high. It creates a certain level of interdependence between the supplier and the buyer according to the complexity and strategic importance of the product. Liao et al. suggest a strategic *relationship* with a somewhat small number of suppliers for prototyping. (Liao et al., 2010, pp. 131-132) This is in accordance with the view of Lau and Hurley (1997), who point out that for outsourcing strategic competences a partnership with the supplier should be built. However, for non-core activities an arm-length relationship is more suitable. (Lau & Hurley, 1997, pp. 6-7) Partnership enables the sharing of risk, which can boost the outsourcing performance. *Communication* is one of the most vital factors when outsourcing prototyping. It requires effective two-way communication as well as willingness to share design information. Communication is also important for negotiations, as changes might have to be made. The commitment of the supplier to jointly find solutions has crucial influence on the performance of prototyping. After the outsourced activity is completed a review should be made. (Liao et al., 2010, pp. 133-133)

Comparison to Outsourcing Engineering

The framework proposed by Liao et al. is, to a large degree, consistent with the model for outsourcing services suggested by Barth (2003). He differentiates between four types of services. Engineering is ranked among knowledge intensive services. (Barth, 2003, pp. 169-212) The outsourcing of prototyping is very similar to outsourcing design. For both, sensitive information needs to be transferred, changes while outsourcing are common and both usually have a high degree of core competence.

2.5.2 Model for Outsourcing the Development of a Complete Vehicle

Schneider (2011) conducted three case studies within the automobile industry. In these case studies, an automotive OEM outsourced the complete vehicle development as well as production. (Schneider, 2011, p. 89) With the insights she gained and the input from the literature she developed a model that should assist OEMs with outsourcing complete vehicle development and production. (Schneider, 2011, p. 5) It consists of three phases, i.e. business strategy, cooperate planning and conception of the outsourcing model (see Figure 2.9) (Schneider, 2011, p. 144).

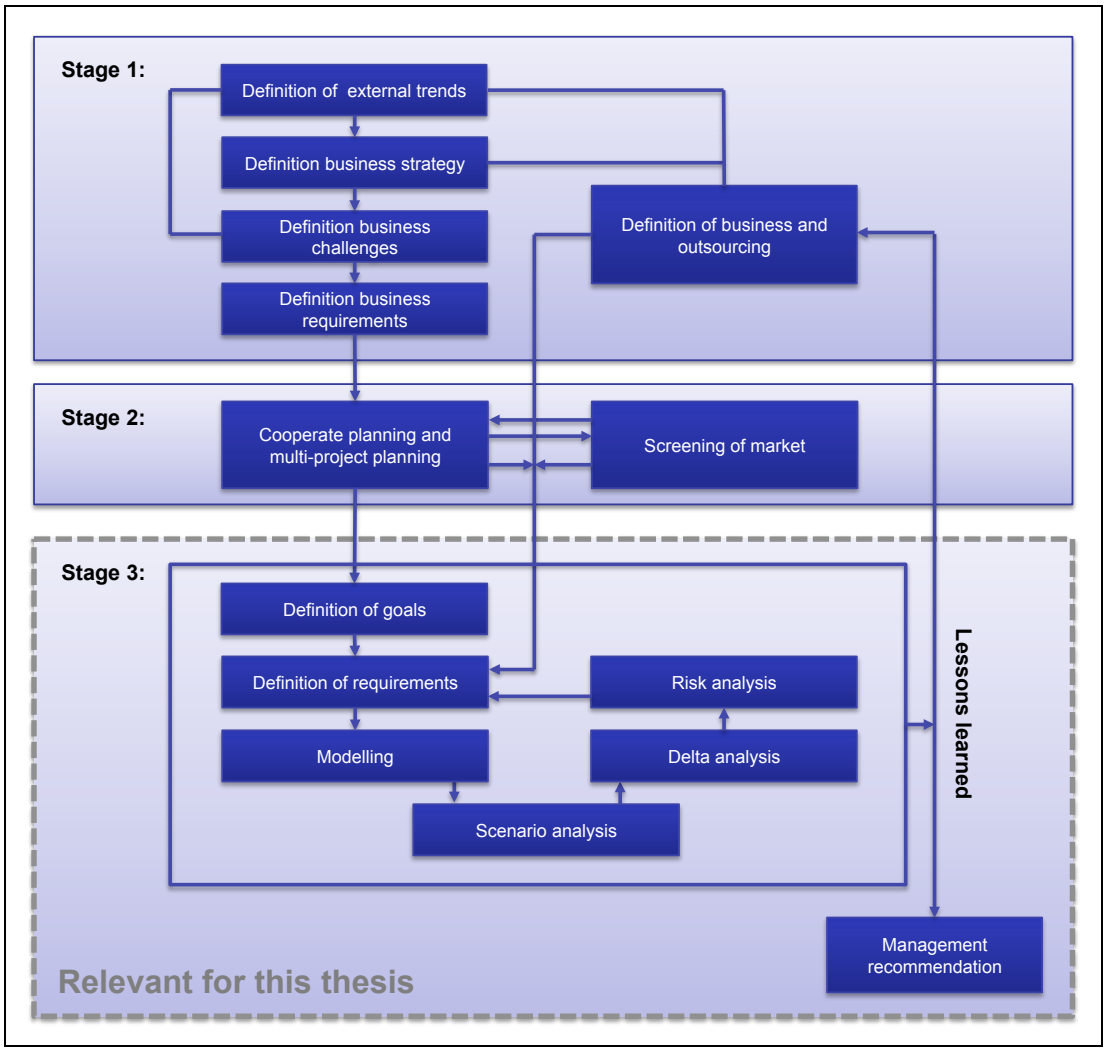


Figure 2.9: Model for Outsourcing Complete Vehicles (Schneider, 2011, p. 144)

Since the scope of this thesis begins after the decision to outsource is made, only stage three of the framework, conception of the outsourcing model, is of importance for this thesis. Hence, only this stage will be explained further.

Definition of Goals

The main task of this step is to define what the organisation wants to achieve by outsourcing and how it can communicate these goals to the supplier. Such goals must be consistent with the company's strategy and its overall aims. For each goal a performance number should be designated. This allows a performance measurement of the outsourcing initiative at regular intervals. (Schneider, 2011, pp. 161-162)

Definition of Requirements

Schneider differentiates between performance/responsibility, process, IT and general requirements. General requirements consist of requirements, which cannot be allocated to one of the other groups, e.g. internal capacity needs and financial requirements. (Schneider, 2011, pp. 163-164) Table 2.3 shows an overview of the other groups.

Requirements		
Performance / Responsibility	**Process**	**IT**
• Scope of outsourced activities • Who is responsible for which activity • Place where activities are performed • How the preformed services are documented	• Process definition and execution • Process integrity • Process complexity • Process documentation • Level of detail • Transformation of processes	• Information • Application • Infrastructure

Table 2.3: Categorisation of Requirements (Schneider, 2011, pp. 165-167)

The requirements are often interdependent. Thus, requirements of one category will probably result in requirements in the others. The consistency and the comprehensibility have to be kept in mind. (Schneider, 2011, p. 163)

Therefore, requirements should fulfil the following points:

- they are not contradictory
- they have to support the goals
- they are consistent with surrounding conditions

(Schneider, 2011, p. 164)

Modelling

In order to be able to analyse, communicate, document and integrate the requirements of different stakeholders, it is necessary to visualise the value-generation network as well as the three levels, i.e. performance/responsibility, process and IT. The value-generating network can be displayed with the aid of organisational charts. It gives an overview of all suppliers and diverse other parties (e.g. research institutes) that perform activities. Interface agreements allow for the detailed visualisation of both the performance and responsibility model. They show who is responsible for an activity and who has to be informed about the progress and result of the activity. (Schneider, 2011, pp. 167-170) Table 2.4 shows an abstract of the interface agreement that Schneider used in her case study.

Interface Agreement					
Interfaces		**Responsibility**			
		OEM		**Supplier**	
Date		**Info**	**Execution Responsibility**	**Info**	**Execution Responsibility**
	Engineering	**x**			**x**
	Designing components	**x**			**x**
	Configuration and change management	**x**			**x**
	Validation		**x**	**x**	
	Release management	**x**			**x**

Table 2.4: Interface Agreement (Schneider, 2011, p. 170)

Both models, process and IT, are created based on the performance and responsibility model. The former gives an overview of the involved processes as well as who is responsible for them. The IT model shows how IT assists the process model and which IT solutions are used. (Schneider, 2011, pp. 170-172)

Scenario Analysis

The scenario analysis is a tool to evaluate different future outsourcing scenarios. To do so, the previously defined outsourcing requirements are rated for each of the suitable suppliers. (Schneider, 2011, pp. 172-173) The scheme for the scenario analysis proposed by Schneider can be found in Appendix A.

Delta Analysis

After the scenario analysis a delta analysis is performed. The current situation of the outsourcing requirements is compared with the target situation. Afterwards, measures for eliminating this gap are formulised (see Appendix A). (Schneider, 2011, p. 174)

Risk Analysis

Schneider differentiates between exogenous and endogenous risks. The former refer to macro-economic risks, which influence all firms on the market. Endogenous risks are related to a single organisation. In order to account for possible risks, a risk analysis should be performed. Schneider proposes a model in which possible risks have to be evaluated according to the probability of their occurrence and the amount of damage they can cause. (Schneider, 2011, pp. 175-177) Her model is displayed in Appendix A.

Enquiry and Negotiation Process

Schneider suggests that the outsourcing organisation should define criteria ahead of time, which cause an immediate disqualification of a supplier in the event of non-compliance. The enquiry documents will change dynamically at the beginning. Consequently, it must be ensured that they are consistent. Suppliers have to reply by a certain due date and have to follow the rules for quotes set by the supplier. Otherwise, the comparability of the quotes is not ensured. The quotes are evaluated according to past experience or by comparing standardised services. In order to prevent discrepancies, suppliers should be able to send questions to the outsourcing organisation. These are accepted until a certain date and then all questions are answered by the functional departments at the same time. During the negotiation phase, the scenario, delta and risk analyses are adopted. Because of the iterative nature of the negotiation process, all steps for the configuration of

the outsourcing model are performed more than once. (Schneider, 2011, pp. 178-179)

Management Recommendation

The management makes the final decision for outsourcing and selects the provider. Therefore, it is necessary to prepare a final overview of the different outsourcing scenarios. Schneider suggests the inclusion of a SWOT-analysis in this overview (see Appendix A). If none of the scenarios is suitable for outsourcing, the goals, requirements or the outsourcing model need to be questioned. (Schneider, 2011, pp. 180-181)

2.5.3 Comparison of the Frameworks

Schneider's framework is very detailed, since it was developed to outsource the engineering of complete vehicles. As a result, this framework requires more effort than the one proposed by Liao et al. Schneider's model ensures that the goals and requirements for outsourcing are clear. This is an important step to enable the success of outsourcing. Liao et al., however, do not mention this point. Both frameworks stress the importance of analysing the risk of outsourcing and carefully selecting the supplier. Liao et al. states that after the completion of outsourcing, the supplier should be evaluated. This provides a very helpful input for future outsourcing initiatives. For outsourcing smaller scopes, like the ones looked at in this thesis, Schneider's framework is too complex. However, some of the measures proposed by Schneider can be very helpful when outsourcing engineering activities.

2.6 Conclusion

Outsourcing of engineering activities has become common practice in the industry. It can offer several advantages, but is not without risk. To minimise the probability of failure outsourcing initiatives need to be well thought out. There are limits on to what extent development can be outsourced. If a company sources out too much, it will lose the ability to understand its own products. Frameworks for outsourcing engineering activities proposed in the literature are still limited. Such frameworks need to be adapted to the outsourcing scope and have a balanced effort-benefit ratio.

3 Process Analysis and Improvement

Quality is only ensured when processes run without any problems, under controlled conditions in all involved departments and areas of the organisation. As a result, management of processes is of utmost importance for managing firms. This is especially true, because companies have to deal with increasingly complex structures, operations and products. (Füermann & Dammasch, 2008, p. 5) Thanks to modern transport and communication technologies, companies act globally in today's market (Schmelzer & Sesselmann, 2006, p. 1). In addition, customer requirements are constantly on the rise. Process management helps to keep an overview despite the increasing complexity. Processes are identified and aligned with customer requirements. In this way, customer satisfaction, as well as profit, can be increased. (Füermann & Dammasch, 2008, pp. 5-6) Since it is the main task of this thesis to map, analyse and improve processes, this chapter provides input from the process literature.

3.1 The Processes

Each day, every one of us is confronted with processes, but often we are not aware of it. Such processes are, for example, attending a meeting, preparing a meal, going for a run or cleaning a car. One starts to become aware of processes when something does not go as planned. Processes are especially important for organisations, as most organisational problems have their roots in processes. By considering the process view, they are able to perform activities much more effectively and efficiently. They can use process analyses to investigate problems. (Madison, 2005, p. 1)

Thinking in terms of processes dates back to the differentiation between organisational and operational structure, which was introduced by Nordsieck (1934) and Henning (1975) (as cited in Atzert, 2011, p. 11). The organisational structure is concerned with the infrastructure of a company (Kosiol, 1976, p. 32). It divides firms into organisational units (e.g. departments, divisions) and assigns tasks for which they are responsible (Lehmann, 1974, column. 290). The operational structure on the other hand is the dynamic component (Erich, 2000, p. 7). It is displayed in the form of processes and deals with the execution of tasks (Gaitanides, 1992, p. 1).

The operational structure coordinates the timing aspects, as well as everything else that is relevant for the implementation of tasks (e.g. who, what, how and with what) (Esswein, 1993, p. 551; Schweitzer, 1974, column. 1). Nowadays, the operational structure is often also known as process organisation (Schmidt, 2000, p. 366).

3.1.1 Definition of Processes

There are a vast number of definitions for processes in the literature. (Atzert, 2011, p. 14). Some authors use the term process and others the term business process. In general, literature does not differentiate between these two terms. They are often even used as a synonym for each other. (Becker & Schütte, 2004, p. 107) Freud and Ebers remark that they use process as a synonym for business processes, since it is shorter (Freud & Ebers, 2008, p. 5).

The following definitions can be found in the Literature:

Harrington describes a process as "*any activity or group of activities that takes an input, adds value to it, and provides an output to an internal or external customer."* (Harrington, 1991, p. 9)

Davenport defines a process as *"a structured, measured set of activities designed to produce a specified output for a particular customer or market. (…) A process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs."* (Davenport, 1993, p. 5)

Hammer and Champy characterise a process as *"a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer."* (Hammer & Champy, 1993, p. 35)

Common to all these definitions is that they describe processes as a set of activities, which convert a certain input into a desired output for a customer (see Figure 3.1). Harrington (1991) highlights that these customers can be internal or external.

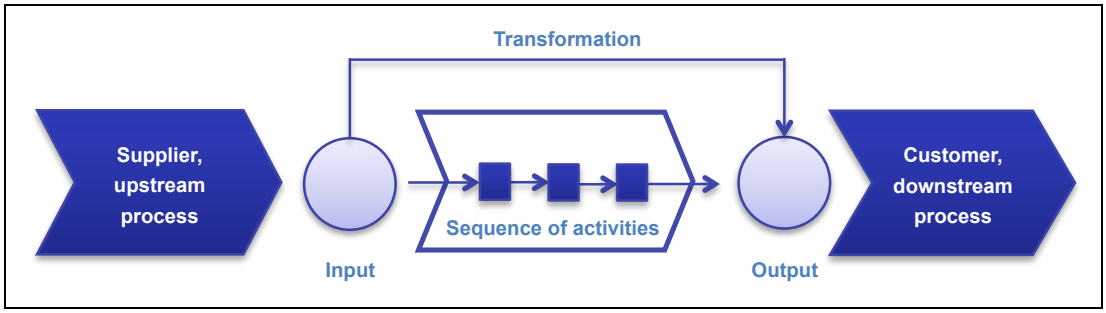


Figure 3.1: Nature and Structure of a Process (Atzert, 2011, p. 16)

Both tangible and intangible factors, such as manpower, material, machines and information, serve as input for a process. They are provided by a supplier and are transformed by the activities within the process to a certain desired result – the output. Products or services intended for the customer are the output of processes. Processes are often also referred to as Input/Output-Relation. (Schmelzer & Sesselmann, 2006, p. 59) Every process has at least one supplier and one customer, as well as a measurable input and output. Suppliers and customers are organisational units that receive and forward services. They can be processes, external organisations or individuals within or outside the organisation. (Füermann & Dammasch, 2008, p. 12)

Schmelzer and Sesselmann differentiate between processes and business processes. They state that the term process does not indicate anything about the boundaries, scope, content, structure or the receiver of the output. Even a few linked activities can be seen as a process. This means that hundreds or even thousands of processes exist within a company. A business process, on the other hand, consists of function- and organisation overlapping, value creating activities. The important thing though, is that the process creates value. The generated value must be of importance for the customer and reach the process goals derived from of the business strategy. Business processes have a request/result relationship rather than an input/output relationship. The results of a business process are contributors to turnover and profit. (Schmelzer & Sesselmann, 2006, pp. 60-62)

Becker and Schütte (2004) remark that a business process is a special kind of process. They argue that this is already indicated by the name. For them, a business process results from the business objectives of the company.

It has interfaces to external parties, such as suppliers and customers. (Becker & Schütte, 2004, p. 108)

3.1.2 Classification of Processes

Business processes differ in their influence on the value for the customer and on the business success. Some create value for external customers, while others have more of a supporting function. Hence, the literature distinguishes between two process levels, i.e. primary and supporting processes (see Figure 3.2). (Schmelzer & Sesselmann, 2006, pp. 73-74) The terms used for these process levels vary in the literature and, in addition to primary processes, the expressions core processes, key processes or strategic processes are used. (Meise, 2001, p. 169) Support processes are also referred to as secondary processes (Schmelzer & Sesselmann, 2006, p. 74).

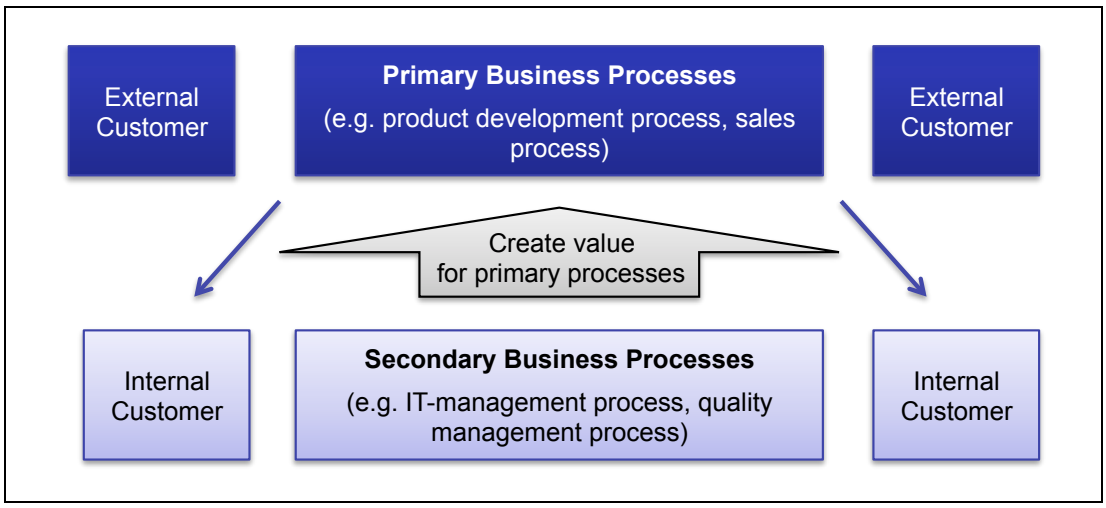


Figure 3.2: Primary and Secondary Business Processes (Schmelzer & Sesselmann, 2006, p. 74)

Porter (1991) introduced the differentiation between primary and supporting processes within his value chain model. Primary processes are concerned with direct creation of value, i.e. the production and commercialisation of products as well as services for external customers. Thus, they directly contribute to the revenue of the organisation. (Porter, 1991, p. 65) In order to be efficient, these processes need assistance, which is provided by the support processes. They generate value for internal customers such as primary processes. Usually, the services provided by support processes are

not visible to external customers. (Schmelzer & Sesselmann, 2006, pp. 74-75) However, the realisation of value adding activities is not possible without their aid. There is a smooth transition between primary and supporting processes. It is possible that the same process is a primary, as well as a support process, under different circumstances. (Becker & Kahn, 2011, p. 6)

Examples for primary business processes (Schmelzer & Sesselmann, 2006, p. 75):

- Innovation process: Generating and checking new product ideas
- Product planning process: Define requirements for new products
- Product development process: Development of new products
- Sales process: Acquire new customers and orders
- Order handling process: Produce, deliver and install the products
- Service process: Handle complaints and solve product problems

Examples for support business processes (Schmelzer & Sesselmann, 2006, p. 75):

- Strategy planning process: Planning, adopting and checking of business areas, core competencies, success factors, competitive strategies and goals of the organisation
- Human resource management process: Planning, acquisition, qualification, deployment and support of employees
- Finance management process: Planning, acquisition, deployment and checking of funds
- Resource management process: Planning, acquisition, deployment maintenance and checking of technical resources
- IT-management process: Planning, acquisition, deployment maintenance and checking of IT resources
- Quality management process: Planning, introduction, adopting and evaluating of the quality management system
- Managerial accounting process: Planning and checking of the operative business goals

3.1.3 Levels of Abstraction

There are different levels of abstraction for processes. Leistert (2008) suggests the following classifications, macro processes, sub processes and activities (see Figure 3.3) (Leistert, 2006, p. 37). A macro process starts with the requirements of the customers and ends with the delivery of the service or product to the customer (Schmelzer & Sesselmann, 2006, p. 108). Macro processes usually involve several functional areas within the organisation. Their purpose is to create value for the customer. A macro process can consist of several sub processes, whereby a sub process can again contain several sub processes (Leistert, 2006, p. 37).

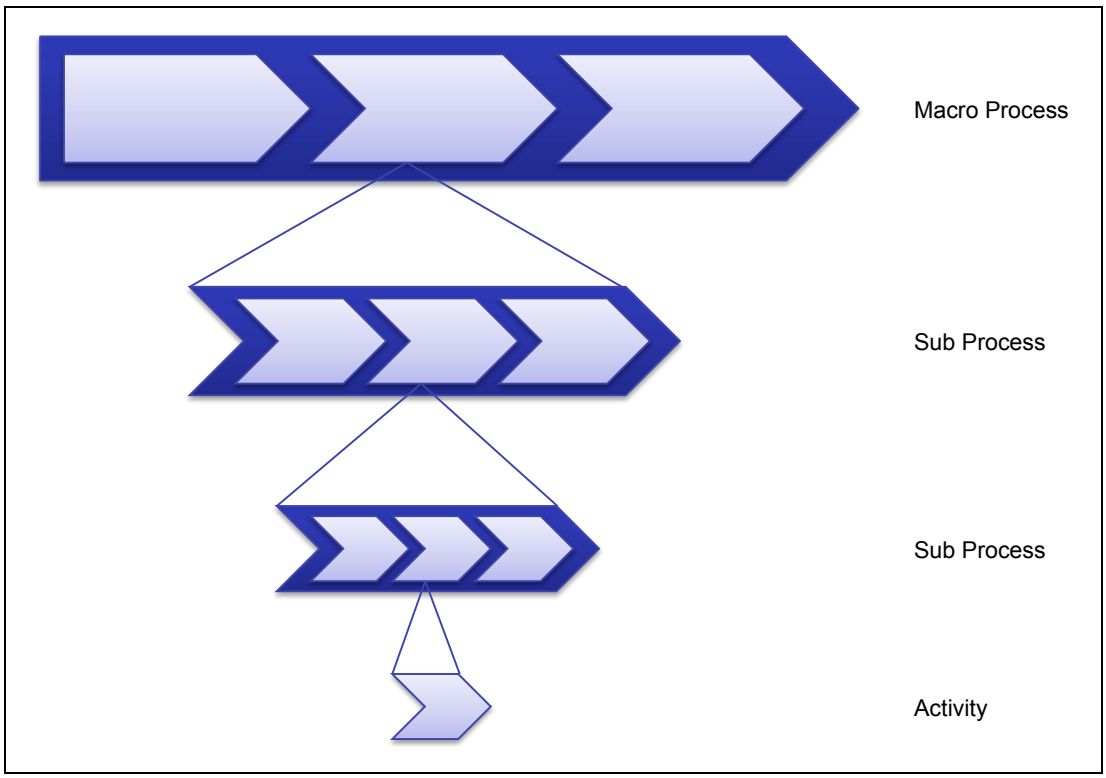


Figure 3.3: Level of Abstraction (Atzert, 2011, p. 18)

Generally, sub processes involve only parts of the value creating system, like production steps. The lowest level of abstraction is represented by activities. Every process consists of multiple activities. (Atzert, 2011, p. 18) An organisation usually has five to twenty macro processes and over a hundred sub processes. They are connected to each other through the exchange of material and information. (Füermann & Dammasch, 2008, p. 9)

3.2 Process Management

Growing market transparency has resulted in higher competition and competitive pressure. Market participants can easily obtain information about markets, customer requirements as well as competitive products. These days, it is not the size of a company, but rather the flexibility and ability to change which quickly determine a company's success. (Schmelzer & Sesselmann, 2006, pp. 1-2) Process management makes it possible for organisations to respond faster to changes and adapt by altering the processes (Hammer, 2010, p. 7).

The process management we know nowadays was founded in the 1990s as a third management dimension, alongside line management and project management. There are diverse motive forces for process management. In practice, a process management initiative is often started when there is some kind of problem. Depending on the type of problem, the motivations and expectations differ. Motivation factors are things such as costs, a desire to increase effectiveness and efficiency, organisational learning or earning an ISO-certificate. On one hand, one-dimensional initiatives are often doomed to fail, but on the other hand, initiatives that are too complex are also not likely to succeed. (Hiller, Minar-Hödel, & Zahradnik, 2010, pp. 16-17)

Process management includes planning and organisational- as well as controlling measures for a goal-oriented management of the company's value chain. It focuses on quality, time, costs and customer satisfaction (Gaitanides, Scholz, & Vrohlings, 1994, p. 3). Schmelzer and Sesselmann state that, in addition to customer needs, the requirements of other stakeholders must also be considered. Such stakeholders are, for example, employees, investors, owners, supplier and partners. (Schmelzer & Sesselmann, 2006, pp. 1-2) Process management is concerned with enabling a goal-oriented and structured communication within processes. It is an enabler, but no solution for a problem. (Hiller et al., 2010, p. 18)

The main aim of business process management is to increase the efficiency and effectiveness of a company by optimising business processes. It ensures a strategy and customer oriented approach, which enables the aligning of requirements for customer and stakeholder. Management, organisation and controlling build the cornerstones for a steady improvement of process performance and the achievement of targets. Information and communication

technology has a vital impact on business processes and their efficiency. (Schmelzer & Sesselmann, 2006, pp. 6-8) Figure 3.4 visualises the business process management.

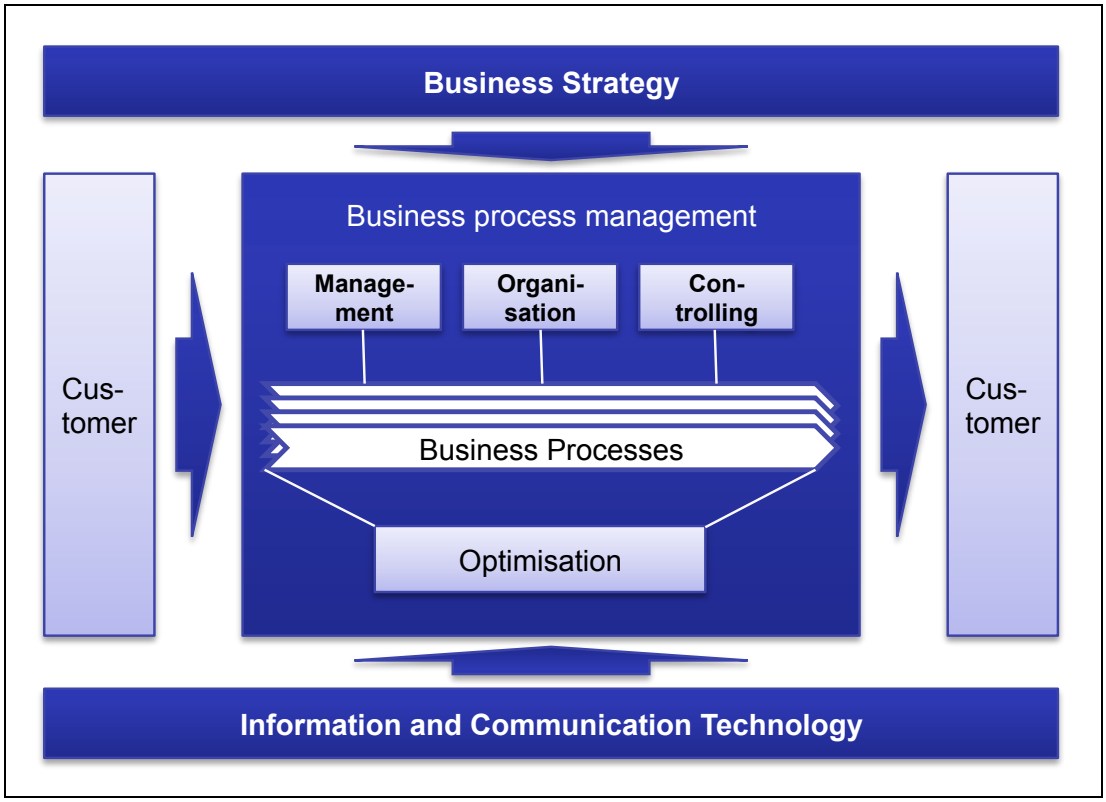


Figure 3.4: The Business Process Management System (Schmelzer & Sesselmann, 2006, p. 7)

Process management is often associated with the evaluation and analysis of the current processes as well as the development of target process. In practice, process management ends right there in many cases. Often, there is just a sporadic review of the processes instead of any real process management. The biggest operational gain is continuous improvement and this is not possible without constant assessment of the processes. (Hiller et al., 2010, pp. 19-20)

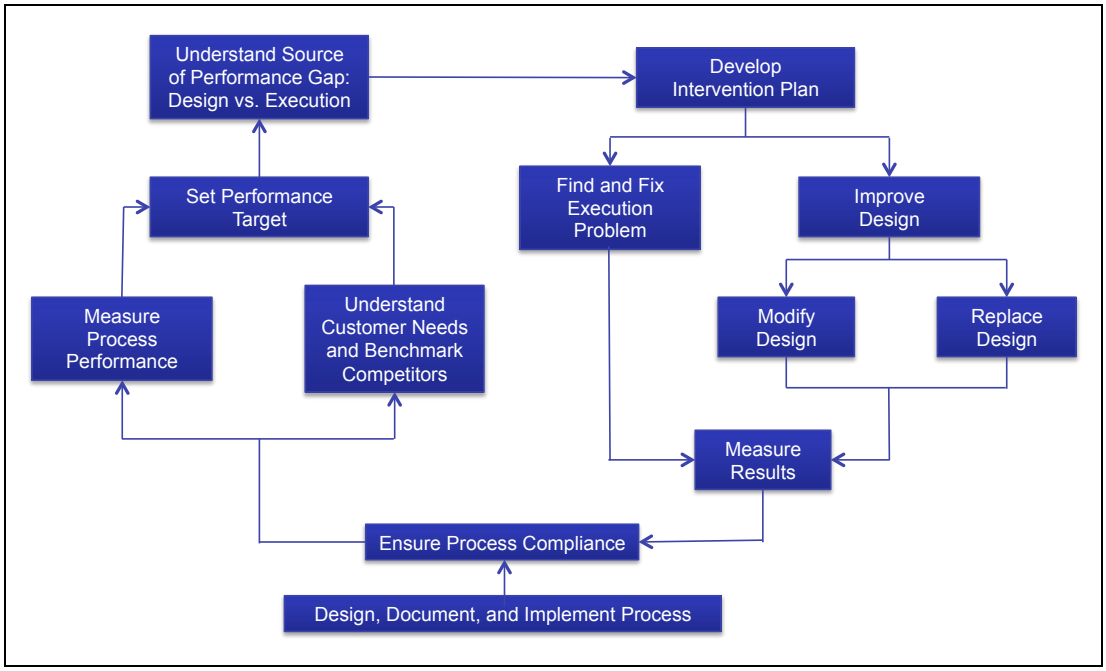


Figure 3.5: The Process Management Cycle (Hammer, 2010, p. 5)

Hammer (2010) describes process management as a cycle (see Figure 3.5). In this cycle, designing and implementing a process is just the first step. After that, the process has to be managed and reviewed continuously. Its performance in key areas is measured und compared to target values. If there is a gap between these two, corrective actions have to be taken. There are two possible reasons for such a gap, faulty execution and faulty design. On-going shortcomings in performance usually indicate design weaknesses. They are, in most cases, easy to identify, but it is challenging to find a solution. The reverse is true for problems with the execution. They are hard to identify, but once they are discovered it is quite simple to come up with a better way. (Hammer, 2010, pp. 5-6)

3.3 Roles Within Process Management and Processes

In order to run smoothly, the responsibilities and competences within a process must be well defined. The main principle of process management is that there has to be one person responsible for each process. (Füermann & Dammasch, 2008, p. 31) In the literature, different roles within processes and process management are defined.

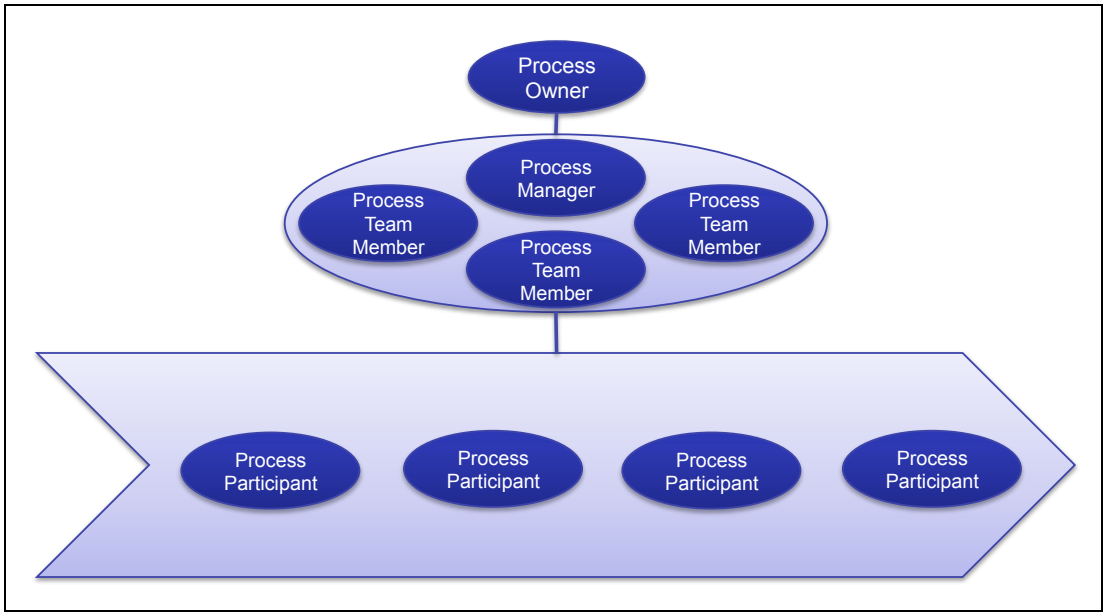


Figure 3.6: Roles Within Process Management and Processes (Hiller et al., 2010, p. 52)

In this thesis a distinction is made between the process owner, process manager, process team member and process participant as displayed in Figure 3.6. See also Schmelzer and Sesselmann for alternative classification of roles (Schmelzer & Sesselmann, 2006, pp. 129-142).

3.3.1 Process Owner

The process owner makes the final decision regarding the process goals, process management and the modification of processes. He represents the link to the steering committee and, therefore, to the multi process level. Together with the person responsible for the process he sets the boundaries for the process and the extent of change. (Hiller et al., 2010, pp. 52-53)

The process owner has multiple duties such as the following (Hiller et al., 2010, pp. 52-53):

- Designate a process manager as well as assistance with selecting a process team.
- Set up of process goals in cooperation with the process manager as well as the process team
- Ensure that the process is aligned with the strategy
- Define key values

- Conduct steering sessions together with the process manager
- Ensure continuous improvement and optimization of the process

A process owner needs strategic-, social- and communication skills. In addition, he has to be able to notice changes in the environment. These skills are especially vital when a process covers several functional departments of an organisation. The process owner must ensure that the various areas work together. It is important that the process is optimised as a whole and not by each department on its own. It is easy to appoint a process owner, when the process covers just one department. Here, the department head is automatically the process owner. However, for cross-functional processes it is trickier. A good choice in such cases is a person that is responsible for a major part of the process and stands to gain the most from a smooth process flow. This person should have a broad knowledge of the overall process and must be able to bring together different functional areas. (Füermann & Dammasch, 2008, pp. 31-33) The appointment of a process owner is one of the most important decisions in process management. Because he has great power, his selection often causes difficulties. (Schmelzer & Sesselmann, 2006, p. 112) He is usually in top management (Neumann, Probst, & Wernsmann, 2011, p. 276) and needs the authority to make cross-functional design and steering decisions for the process (Hiller et al., 2010, p. 53).

The literature often takes no notice of the process owner or even uses it as a synonym for the person responsible for the process. Nevertheless, for a total process model, in which business processes are split up into several sub processes, there should be a process owner as well as a person responsible for the process. (Neumann et al., 2011, p. 275)

3.3.2 Process Manager

The process manager is, in practice, also often referred to as the person responsible for the process. His competences depend on the organisational structure. (Hiller et al., 2010, p. 53) The ones responsible for a process must ensure that it is carried out in an effective and efficient way, from the beginning until the end. Furthermore, they are responsible for the fulfilment of the process goals as well as process improvement. (Schwarzer & Krcmar, 1995, p. 45)

The process manager may have, for example, the following tasks (Hiller et al., 2010, pp. 54-55):

- Establish process team
- Lead and coordinate the process team
- Organise regular process team meetings
- Continuous improvement of the process
- Regular collection of process key values and evaluating the status of a process together with the process team
- Reporting to the process owner

3.3.3 Process Team Member

For complex processes a process team, which supports the process manager, is sometimes necessary. It is not the sum of all process participants, but a group of process experts (5±2 persons). These experts contribute specific knowledge and generate process improvement suggestions. (Hiller et al., 2010, p. 56) Furthermore, they discuss problems and create process flow diagrams. Process team members are the centre of continuous improvement and have a close relationship to process customers. The participation in the process team is voluntary. If multiple departments are involved in a process, the team should have a member of each department. (Füermann & Dammasch, 2008, pp. 34-35)

3.3.4 Process Participant

One very important role within a business process is the process participant. The process participants perform the tasks at an operative level. They can be part of the process team. It is important to involve employees that carry out the activities in the design of business processes. To enable this, it is necessary that each one of them has access to the process information. (Schmelzer & Sesselmann, 2006, pp. 141-142)

3.4 Process Modelling

There are different ways to illustrate processes in practice, such as textual, tabular and graphical process descriptions (Bergsmann & Grabek, 2005, p. 54). Popular ways to visualise processes are the *event-driven process chain* (EPC), the *Business Process Modelling Notation* (BPMN) as well as *flowcharts*. In addition to these three, there are other models like value creation chain diagrams, technical term models and Petri-networks. (Hiller et al., 2010, pp. 239-251; Rosemann, Schwegmann, & Delfmann, 2011, pp. 54-65) Each model type uses a number of objects which are represented by defined symbols. They are used to model the process. Depending on the model type used, the same object can have different symbols. (Rosemann et al., 2011, pp. 54-55)

3.4.1 Event-Driven Process Chain

The EPC is an often-used model for visualising processes. The main EPC elements are displayed in Figure 3.7. Functions represent activities and transfer input into output. They consume time and costs. Events describe a flow-relevant status. (Rosemann et al., 2011, pp. 57-58) After each function an event follows. They are connected via the control flow. Logical operators, i.e. and, or, XOR are used to spread and bring back together the control flow. Organisation units represent roles that bear responsibility and are assigned by straight lines. Information and materials are connected to function by the information flow. (Hiller et al., 2010, p. 247)

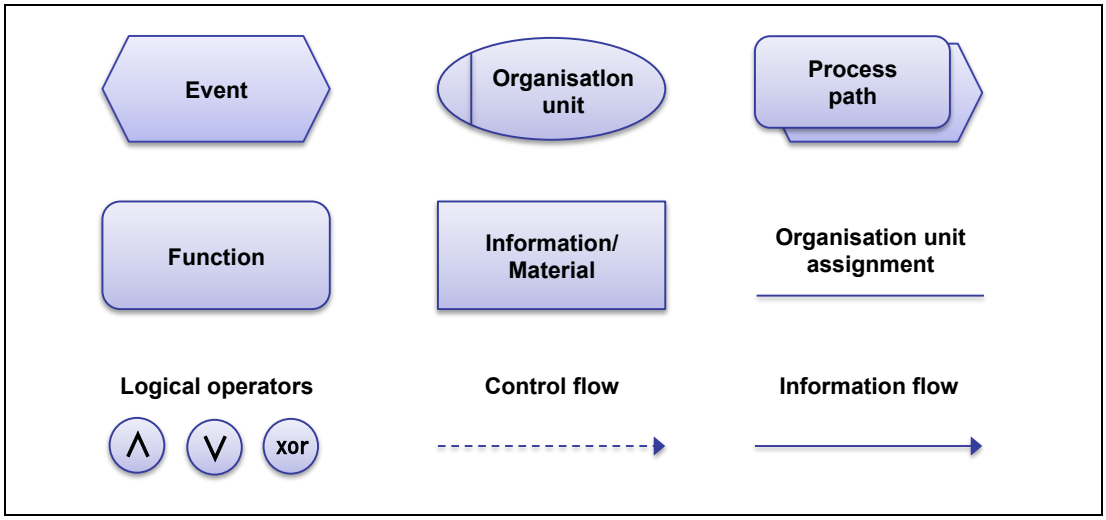


Figure 3.7: Basic EPC Elements (Hiller et al., 2010, p. 247)

With EPC there has to be an event after each function. However, in practice, this is often omitted, because otherwise process models would become complex and very long. Every process model has to start and end with an event. This ensures that the conditions at the beginning and the end of the process are defined. Logical operators can only appear after functions. (Rosemann et al., 2011, pp. 58-59) Figure 3.8 shows an example of an EPC process.

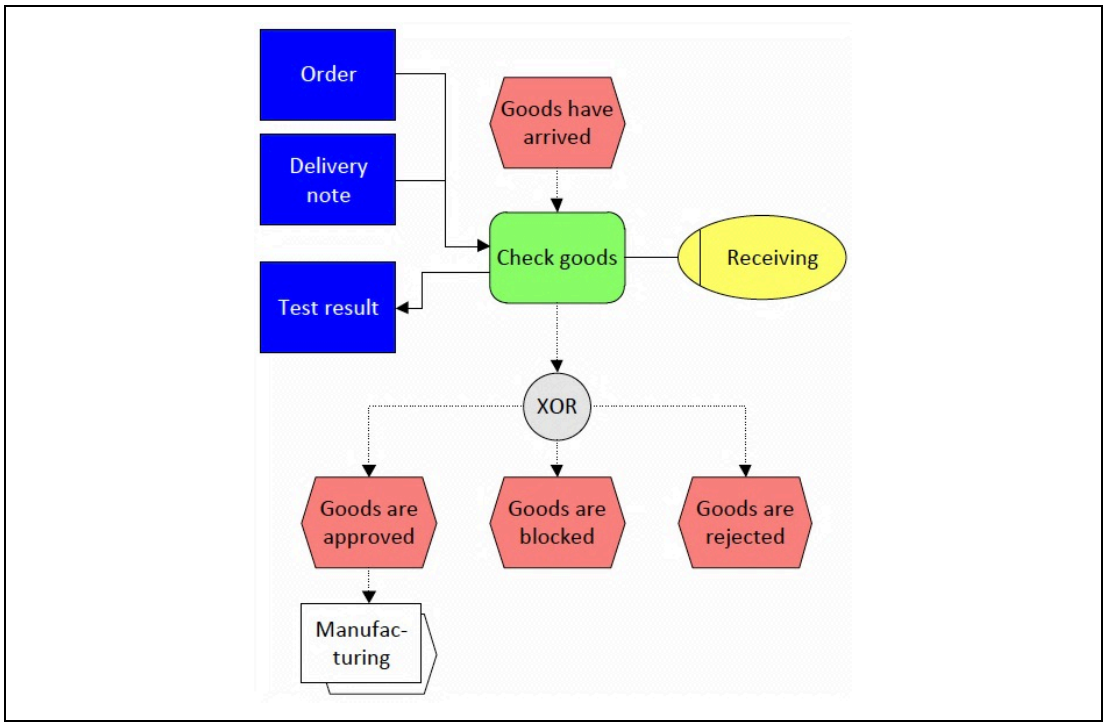


Figure 3.8: Example for EPC Process (Vössner, 2011, p. 25)

3.4.2 Business Process Modelling Notation

BPMN is a flow chart based standard, first presented in 2004, for mapping business processes. The standard is designed in such a way that it is understandable for both, humans and machines. One of the main goals for the development of BPMN was to build a bridge between the technical models and execution languages. Historically, technical models had to be translated. This was necessary so that the systems that were designed to implement and execute these processes could understand them. BPMN consists of a set of core elements and an extended element set. The core set is usually sufficient to map most business processes (see Table 3.1). (Aagesen & Krogstie, 2010, pp. 215-216)

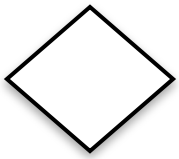
Element	Description	Notation
Event	Events are either start, intermediate or end events. They usually have a cause or an impact.	
Activity	An activity represents work that is performed within a process.	
Gateway	Gateways are used to visualise branching, forking, merging, and joining of paths. Internal markers are used to display their behaviour.	
Sequence Flow	It defines the order in which activities of a process are executed.	
Message Flow	It indicates the direction of messages, which flow between the participants.	

Table 3.1: Some Core Elements of BPMN (Object Management Group, 2011, p. 29)

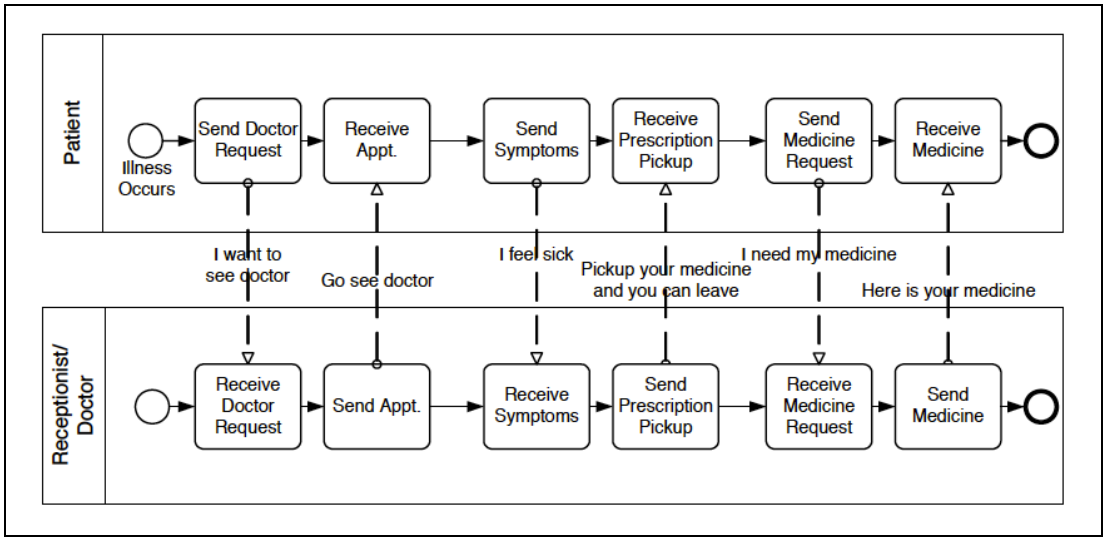


Figure 3.9: Example for BPMN Process (Object Management Group, 2011, p. 25)

Figure 3.9 shows an example of a BPMN process.

3.4.3 Flow Chart

A flow chart is a classic way to display as-is processes as well as to-be processes. It shows the course of events for the single process steps in either horizontal or vertical form. (Hiller et al., 2010, p. 245) In the vertical form, the process starts at the top and flows to the bottom. For horizontal charts, the process begins at the left and moves to the right. (Madison, 2005, p. 25) Flow charts support process oriented thinking and enable a clear illustration of processes. After creating the flow chart, the process team members are often seeing the process, in its entirety, for the first time. This helps in understanding the purpose of the process as well as in recognising the interfaces within the process. Flow charts support the training of new employees. They help them to understand the basic things about the process. It is an important tool for analysing and improving processes. Initially, flow charts should not be too detailed. It is better to start with relatively rough processes and narrow them down step by step. In any event, process flow charts should not be overly detailed in order to keep the charts clear. (Füermann & Dammasch, 2008, pp. 40-41)

There are rules for creating an easy to interpret chart (Füermann & Dammasch, 2008, p. 40). Within these rules the symbols used for flow charts are standardised (Hiller et al., 2010, p. 245). In order to be able to

understand flow charts, it is necessary to know the symbols and what they stand for. Software programs like Microsoft Visio enable the creation of flowcharts by drag and drop of such symbols. (Madison, 2005, p. 19)

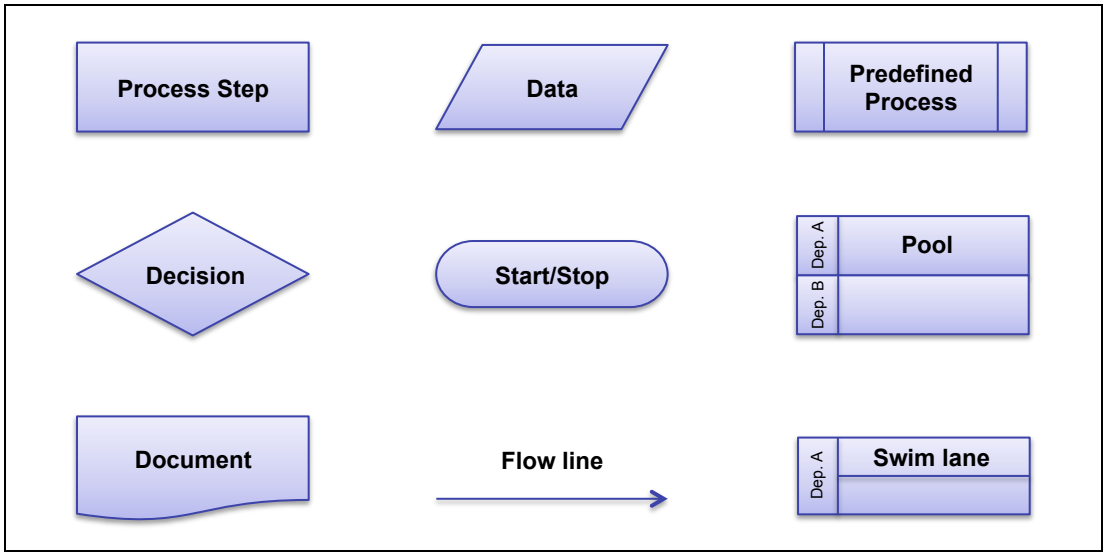


Figure 3.10: Common Flow Chart Elements (Aagesen & Krogstie, 2010, p. 217; Füermann & Dammasch, 2008, p. 42; Hiller et al., 2010 p. 245)

The most commonly used symbols are displayed in Figure 3.10. Process steps and activities are represented by rectangles (Hiller et al., 2010, p. 245). The diamond is used for reviews, inspections and decisions. Reviews and inspection usually have two possible answers, i.e. yes and no. (Madison, 2005, p. 19). Diamonds have one incoming and up to three outgoing routes. Inside the diamond there is a question which sets the conditions for the intersection. Input and output can occur in the form of data or documents. Every process has a beginning and an end. They are visualised by ovals and labelled with start or end. (Hiller et al., 2010, pp. 245-246) The process flow, as well as transport of material and information, is indicated with arrows (Madison, 2005, p. 20). They connect the different symbols with each other (Hiller et al., 2010, pp. 246). For processes that involve several departments, pools and swim lanes are used. Pools are used to represent the responsible departments and divisions and swim lanes divide a pool into several sub areas. With the aid of these two elements it is possible to group process steps. They are also used for the BPMN. (Aagesen & Krogstie, 2010, p. 217) Pools and swim lanes help to keep an overview of the interfaces between the organisational units. Pools can also be used to visualise external

stakeholders like suppliers or customers. (Hiller et al., 2010, p. 250) Figure 3.11 shows an example of a flowchart.

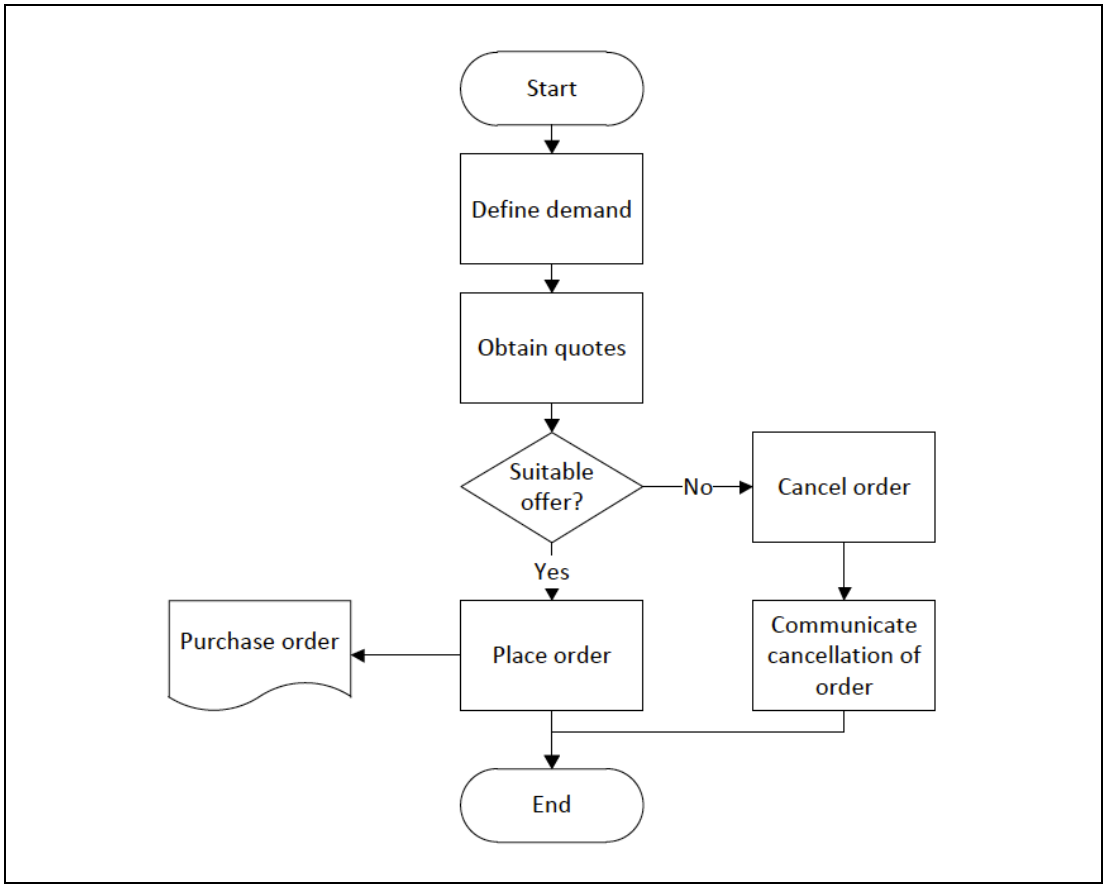


Figure 3.11: Example for a Flowchart (Hiller et al., 2010, p. 245)

Flow charts are especially suitable for visualising the sequence of process steps and are, therefore, very useful for analysing processes. Flowcharts are easy to read thanks to the standardised symbols. (Hiller et al., 2010, p. 246) They can be used to calculate process times, cycle times and process costs. Flowcharts help to find problems and quality issues. (Madison, 2005, p. 25) In order to keep a flow chart readable, text should be kept to a minimum. The process flow has to be self-explanatory by the order of the symbols. (Füermann & Dammasch, 2008, p. 44)

3.4.1 Responsibility Charts

Every process step must have a person who is responsible for it. Responsibility charts, as well as function diagrams, are used to assign responsibility, approval, support and information (who gets information) for each process step. In practice, this is often not done. (Hiller et al., 2010, pp. 50-51)

Roles / Process Steps	Role 1	Role 2	Role 3	Role 4	Role 5
Process step A		R	S		
Process step B	R	S		I	
Process step C		R		S	A
Process step D			R		
Process step E	R			S	
Process step F		I		R	A

R ... Responsible
A ... Approval
S ... Support
I ... Information

Figure 3.12: Function Diagram (Hiller et al., 2010, p. 51)

Figure 3.12 shows a function diagram which states who is responsible for each process step.

3.5 As-Is Situation

The first step to detect weaknesses and possible areas to improve, within a process, is to capture its current status. This often involves considerable effort. (Schwegmann & Laske, 2011, p. 133) After mapping the as-is situation the process can be analysed regarding several objectives (Schwegmann & Laske, 2011, p. 147), e.g. frustration, cost, time and quality (Madison, 2005, pp. 85-128)

3.5.1 Preparation of As-Is Modelling

The first step for as-is modelling is to define the scope of the process concerning the time, substance, regional and social dimensions (see Figure 3.13). In practice this phase is often skipped. Firms model the process right away. They focus on weak points and problem areas. This is done in order to save time, but in many cases it results in a much higher effort all in all. (Hiller et al., 2010, p. 98)

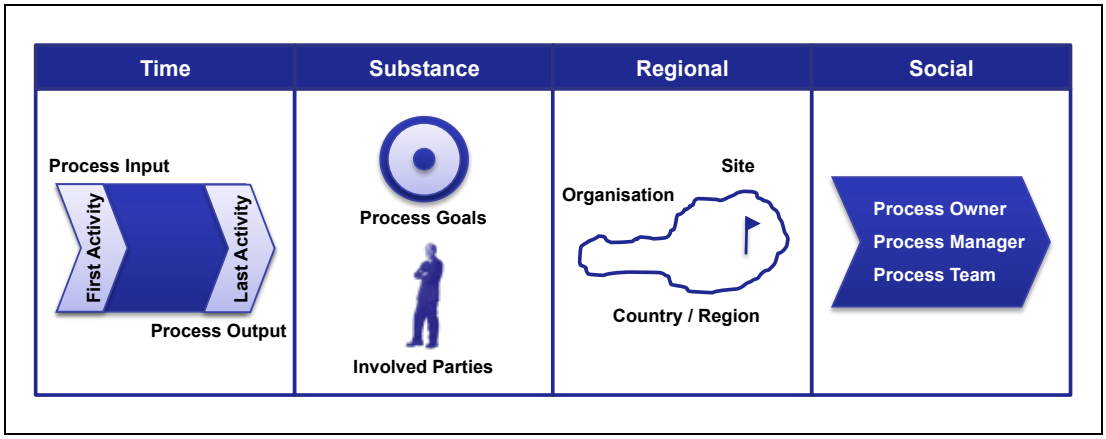


Figure 3.13: Dimensions for Defining the Scope of a Process (Hiller et al., 2010, p. 98)

In the following paragraphs the dimensions are explained in more detail.

Time Dimension

The central question of this dimension is: Where does the process begin and where does it end? Therefore, the activity or decision that initiates the process must be identified. (Madison, 2005, p. 24) It provides input for the process and is followed by the first activity of the process. The process ends, when the last activity of the process is performed and a new process starts. It is important to define the desired output. (Hiller et al., 2010, p. 100)

Substance Dimension

In this dimension the goal of the process is determined. Questions to find the process aim are, for example, “What is the purpose of the process from a customer’s view?” or “What would be missing, if the processes did not exist?”. A good way to quantify the process goals is to appoint key figures,

e.g. costs or cycle time. Furthermore, the parties involved in the process are defined. (Hiller et al., 2010, p. 99)

Regional Dimension

Regional dimension is concerned with the location in which the process takes place. There are variables involved in whether a process involves only one site or several sites on multiple continents. (Hiller et al., 2010, p. 101) All organisational units involved in the process must be identified. (Best & Weth, 2010, p. 68)

Social Dimension

The last step for defining the scope of a process is to define the process organisation, i.e. appoint a process owner, process manager and process team. (Hiller et al., 2010, p. 101)

3.5.2 Gathering Information

After the scope of the process is defined a start can be made to gather detailed information about the process (Wiegand, 2005, p. 402). This requires a careful approach, because people often fear negative consequences of a process analysis. (Hiller et al., 2010, p. 103) There are two main methods for gathering the required information, i.e. analysis of documents and interviews (see Figure 3.14). For both, cooperation of the employees is crucial. For that reason, it is important to involve employees from the very beginning and inform them about the goals of the process analysis. (Freud & Ebers, 2008, p. 37)

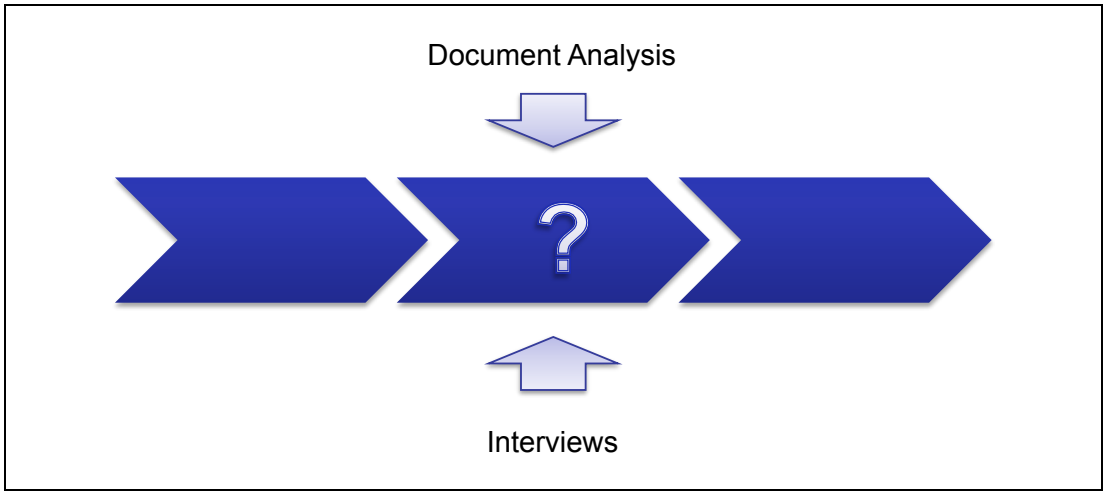


Figure 3.14: Main Methods for Gathering Information About the Process (Hiller et al., 2010, p. 104)

Organisational manuals, reports, files, statistics and surveys are collected and evaluated for the document analysis. In addition to documentation about the process, business documents, like customer orders and receipts, can provide useful input for mapping processes. The ease with which these documents are located and collected, as well as how well they match the process, indicates a lot about the process. (Hiller et al., 2010, p. 104) All of the documents must be reviewed and evaluated in terms of their significance and quality (Schwegmann & Laske, 2011, p. 135). This is done to get a picture of the process and the required process steps. Documents are an important source of input for creating a process model. (Freud & Ebers, 2008, p. 38). Unfortunately, they are often not up to date and do not reflect the current status. (Schwegmann & Laske, 2011, p. 135)

Interviews offer the opportunity of getting to know the people involved in the processes. They can be asked specific questions about the process and any problems. The process participants can describe the process from their point of view and get the chance to identify weaknesses of the process. In addition, they can make suggestions as well as express wants, expectations and fears. (Wiegand, 2005, p. 403) Interviews can be classified by how well they are structured. They range from open and unstructured to strictly structured interviews. For the former, only a minimum of guidelines is defined. The latter has standardised questions, as well as a defined sequence. This enables a higher objectivity and reliability. The downside is that one only gets answers to the standardised questions and no additional information. (Diekmann,

2002, pp. 337-338) It can be beneficial to use written surveys for a large number of process participants. The advantage here is that it is possible to get input from a great number of people relatively quickly. (Hiller et al., 2010, p. 104) Face-to-face interviews take a lot of time, but they also have their advantages. With this type of interview the opportunities of mutual understanding are much higher. This is the case because visual aids can be used (e.g. show documents) and reactions and body language can be observed. (Wiegand, 2005, p. 405) The interviewer has to ensure that he only records what the interviewee states. Often, the temptation is quite high for an interviewer to fill gaps with his own knowledge. This would not only distort the process, but could also prevent identification of problem areas. (Best & Weth, 2010, p. 69)

Sometimes, it makes sense to use workshops to gather information. Here, experts from different areas are invited. They work together in order to map the as-is situation. Such workshops provide a mutual understanding of the process for all workshop participants. On the other hand, it is possible that weaknesses are concealed and attention is drawn away from the real problem areas. Tension between different areas can be found more easily in interviews. (Best & Weth, 2010, p. 69)

3.5.3 As-Is Modelling

After the necessary data is collected, it is possible to start mapping the process. The approach for modelling itself is explained in section 3.4. In order to create a process flow chart the data gathered is sorted and structured. It is important that the as-is model displays the real current situation. (Freud & Ebers, 2008, p. 40) This means one has to be careful to map what is actually happening and not what should happen. A good way to ensure this is to ask the process participants to recall the last time they performed the process. At each diamond there are two to three possible ways out. In order to keep the flowchart simple and readable it is important to map only the main variations. Each process step and decision (i.e. rectangles and diamonds) should be numbered, so as to have a reference point for the as-is analysis. The numbers should be consecutive, which can be tricky with a parallel process. In any event, the most important thing is that every rectangle and diamond has a unique number. (Madison, 2005, pp. 24-25)

3.5.4 As-Is Process Analysis

The first step for an as-is analysis is to choose objectives that are important for the process and need to be improved. Then the process is analysed according to these objectives. (Madison, 2005, p. 71) The most important objectives according to Schmelzer and Sesselmann, are customer satisfaction, process time, adherence to schedules, process quality and process costs (Schmelzer & Sesselmann, 2006, pp. 141-142). They are called key indicators and are often related to each other. This means that, for example, an improvement in cost could cause a setback in terms of quality. In order to ensure successful optimising of the process, all these indicators should be analysed after each change. (Hiller et al., 2010, p. 113) However, this requires time, a process team and the implementation of process management for the process. Therefore, this thesis will focus on the four lenses of analysis suggested by Madison (Madison, 2005, pp. 85-128).

Madison states that there are four different lenses for the analysis of processes, i.e. frustration, time, cost and quality. Normally, the frustration lens is used at the beginning. This lens is then followed by one of the other lenses, depending on the process and the process improvement goals. (Madison, 2005, p. 71)

Frustration Lens

The frustration lens analyses the process from the perspective of the process participants. It concentrates on the things that frustrate people when they perform the process activities. The process participants can be asked either in the as-is modelling interviews or after the as-is process is modelled. The former is usually used for smaller processes. There is a risk that the process might become too complex and mapping could take too long. With the frustration lens, problem areas can be easily identified. The people who actually perform the process activities often have the best ideas for improvement. Therefore, it is important to ask them for their point of view about better ways to handle issues. In addition, this gives them the feeling that someone cares and often results in a boost of their motivation. (Madison, 2005, pp. 85-88)

Time Lens

The time dimension has a considerable influence on the efficiency, effectiveness, responsiveness and flexibility of an organisation. If a firm is able to provide a service or product faster than competitors, it will gain a competitive advantage and please customers. This enables it to sell more products, perhaps even at higher prices. It will also save costs due to economies of scales. (Schmelzer & Sesselmann, 2006, p. 250)

When speaking about the time dimension, one has to differentiate between process time and cycle time. The process cycle time is the entire time needed for a process, i.e. from the start of the process until the end. (Best & Weth, 2010, p. 78) If a short response time is required the cycle time is the indicator to be considered. This is the case, for example, for creating quotes and order processing. (Schmelzer & Sesselmann, 2006, p. 252) The cycle time is the sum of process time and wait time (see Formula 3.1). According to this formula, the wait time can be calculated by subtracting the processing time from the cycle time. In practice there is often a disparity between wait and processing times, i.e. the wait time can be as high as 90% of the cycle time (Best & Weth, 2010, p. 85).

$$Cycle\ Time = Processing\ Time + Wait\ Time$$

Formula 3.1: Cycle Time (Madison, 2005, p. 97)

The process time is the time a process participant actually needs to perform the process activity, not counting interruptions of any kind (Madison, 2005, p. 95). There are different ways to collect the data for the time dimension, e.g. interviewing process participant, time studies and estimating or logging the time. (Best & Weth, 2010, p. 78) Various documents, such as those known as travellers, can be used for logging time. Such documents accompany the work through all process steps. The participants note the process time as well as the cycle time for each process step on the document. (Madison, 2005, pp. 95-97)

Cost Lens

There are mainly three different reasons to use the cost lens, i.e. activity based costing, process analysis, return on investment of process improvement. Activity based costing calculates cost for each process step. This makes it possible to determine the actual cost for each product, customer or market. (Madison, 2005, p. 107) Traditional managerial accounting uses percentages to allocate the overhead costs. This usually results in overly low ones for complex products and overly high costs for simple products. This imprecise allocation of costs can lead to misjudgement. This is true especially for business processes that have a high proportion of overhead costs. (Schmelzer & Sesselmann, 2006, p. 267)

$$Process\ Step\ Costs = Processing\ Time \times Hourly\ Rate\ of\ Employee$$

Formula 3.2: Process Costs for One Process Step (Best & Weth, 2010, p. 80)

Formula 3.2 shows how to calculate costs for a process step. For activity based costing, one would also have to account for overhead, e.g. rent, insurance, depreciation (Madison, 2005, p. 107). In any case, Formula 3.2 suffices as a useful basis for process redesign in practice. If there are several employees involved in one process step there are two possible approaches. The first one is used when the hourly rates are considerably different. Here, the costs per employee or employee group (e.g. engineers and blue-collar workers) are computed separately and then totalled. If the hourly rates are in the same range, an average hourly rate can be used for the calculation. In the case of diamonds, the probability of occurrence is also needed, as there is more than one possible way. The cost for the whole process is the sum of the individual process step costs. (Best & Weth, 2010, pp. 78-81)

Quality Lens

Quality is one of the most important criteria from a customer point of view. Good quality helps an organisation gain market share and leave competitors behind. (Madison, 2005, p. 115) That's one of the reasons why quality of products is extensively measured in practice. However, this is often not the case for process quality, although this would be especially important. In order to ensure good product and service quality, a high process quality is

required. Therefore, stable processes that prevent mistakes are needed. The process quality of administration and service processes in some companies is often quite low. This means that there is a high potential for process quality improvement. (Schmelzer & Sesselmann, 2006, pp. 260-261)

Every time something is not done right the first time it causes extra costs (Madison, 2005, p. 115). Additionally, mistakes influence the satisfaction of external as well as internal customers. Disappointed customers may prefer a competitor the next time. Process quality is measured on the basis of errors. Mistakes only occur if processes do not completely fulfil the requirements of the customers and stakeholders. (Schmelzer & Sesselmann, 2006, p. 261) The quality lens can be used to identify and document quality problems within a process. Calculating the costs for quality problems at each process step is one way to do so. Other tools are, for example, the Failure Mode and Effect Analysis, fish bone diagrams, Pareto diagrams and check sheets. (Madison, 2005, p. 117-128)

The four lenses of analysis help to systematically identify problems and weakness (Madison, 2005, p. 71). Some authors also offer checklists for the identification of weaknesses. Best and Weth suggest such checklists for five different perspectives, i.e. process and organisational structure, technology, performance measurement, personnel, and organisational culture. (Best & Weth, 2010, pp. 84-92)

3.6 Process Improvement

After the as-is situation is analysed and the weaknesses of the process are identified the next step is to start to optimise the process. Suggestions for a better process design are made. (Fischermanns, 2006, p. 316) The literature offers a set of design principles which can help to improve processes. Madison suggests thirty-eight concepts for redesigning processes. He differentiates between concepts for work structure, information flow, design guides, organising people and general guidance. (Madison, 2005, pp. 152-162) Beth and Weth propose a toolbox of sixteen design aids that should make redesign easier (see Figure 3.15) (Best & Weth, 2010, pp. 136-139).

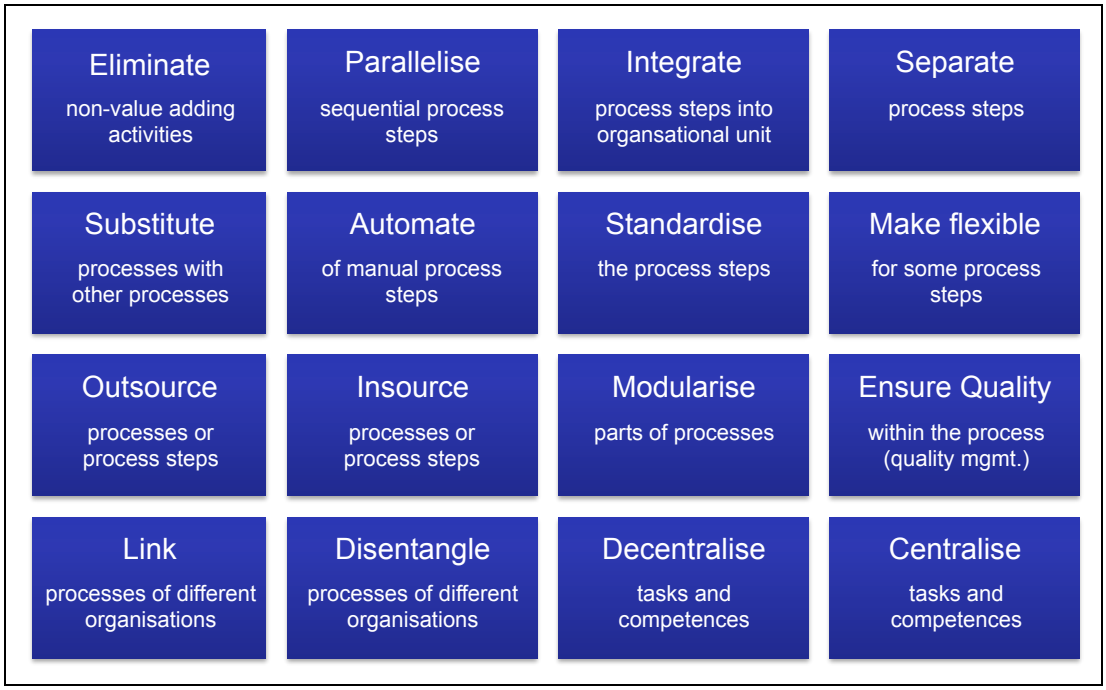


Figure 3.15: Design Aids for Process Redesign (Best & Weth, 2010, pp. 137)

3.7 Conclusion

In order to be able to improve a process, the current situation needs to be clear. Process maps help to visualise the processes and enable the analysis of the as-is situation. A smooth to-be process can only be guaranteed if the problem areas in the current process are identified. It is important that the whole process is looked at and not just single parts. After the improvement of the process, there should be regular reviews and continuous adjustments. It is essential that there is a process owner defined for the process.

4 Outsourcing Body and Trim Engineering Activities at MSF

Outsourcing of engineering activities is gaining more and more importance (see section 2.4). MSF is experiencing this trend as well. This makes it necessary to analyse the organisational tasks needed for outsourcing engineering activities in order to enable an efficient approach. The functional department known as Body & Trim outsources parts of its engineering activities to internal as well as external vendors. The number of outsourced activities has increased over the past few years and now the administration of outsourcing activities needs considerable effort. At the moment, the functional department has no model that displays the outsourcing processes. They are handled by different Body & Trim departments which do not have the same level of experience in this field. The Project Management department, which initiated this thesis, believes that the approach of the departments differs. It further suspects that the process is not working as well as it could. Before this thesis, nobody knew what the complete process looked like. In order to save time and costs, a well-structured process is necessary. Delays within the outsourcing process can interrupt the whole project and, thus, cause high costs. This chapter will show the as-is situation for the Body & Trim departments, analyse it and suggest possible improvement areas.

Most of the information for this thesis was gathered during an extensive number of interviews with the heads of the Body & Trim departments, the head of the procurement department as well as members of the project management department, the project controlling department and the Body & Trim Assistance. The detailed list of all interviews conducted is displayed in Appendix A.

4.1 The Functional Department Body & Trim

The Body & Trim department is one of four functional departments of the Engineering Center Graz. The products developed are not all produced in-house. Therefore, the Body & Trim department has to take the production and quality requirements of the customer into consideration. MSF is a brand

independent supplier to many different OEMs and manages individual and brand specific styling (Vogl, 2011, p. 4). The Body & Trim department perfectly combines development and series production. The production site in Graz handles low- as well as high volume production. The MSF Body & Trim development focuses on pre-development activities of lightweight vehicles (Mila-family) as well as lightweight modules (e.g. composite parts like front hoods). (Masser, 2012, p. 1) The Body & Trim department consists of seven departments and is structured as in the graphic below.

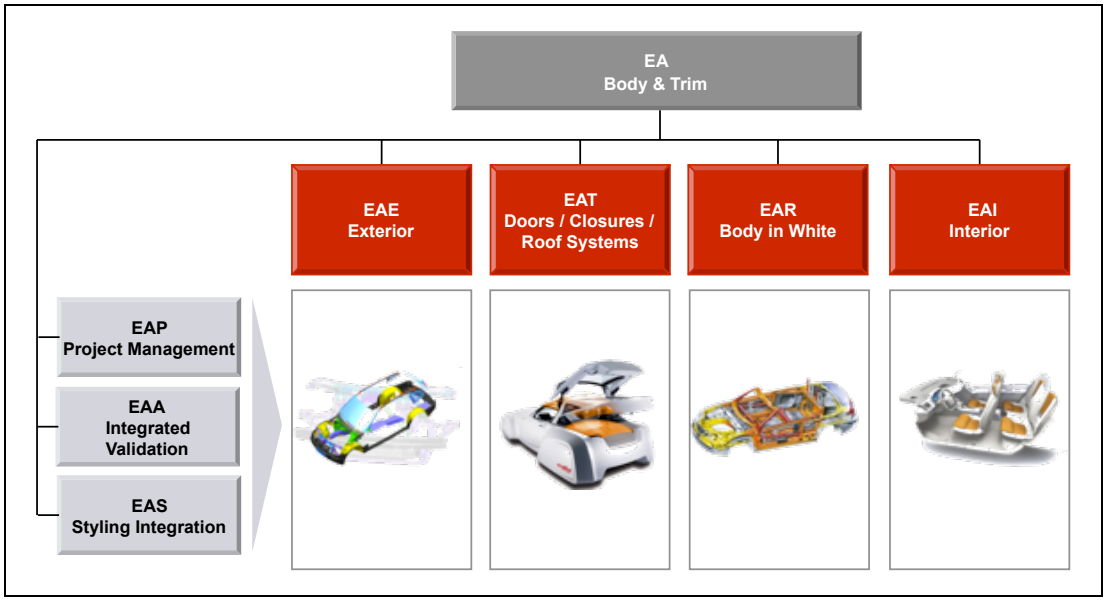


Figure 4.1: Organisation Chart Functional Department Body & Trim (Holzmann, 2012)

Within the Body & Trim department there are four design areas, Body in White (BIW), Interior, Exterior and Doors & Closures are mainly responsible for achievement of technical-, quality-, and cost-targets (e.g. design to cost). They have a wide range of competence, which is based on the experience of many previously performed development projects. They develop various vehicle types, e.g. Cabriolet, Sedan, Hatchback, Touring, SUV and lightweight Sports-Cars. The Body & Trim departments offer feasibility investigation, concept development, series development up to 3 months after Start of Production (SOP) as well as the supervision of series production till End of Production (EOP) for production projects at Magna Steyr in Graz. (Masser, 2012, p. 1)

4.1.1 The Body & Trim Departments

In order to get an idea of what the different Body & Trim departments do, a short overview is given:

- *Project Management*
  The Project Management department (EAP) is responsible for the initial client contacts and acquisition work. It creates competitive quotes for potential new projects. Hence, it ensures that the entire Body & Trim department is always working at full capacity. The EAP department has a supporting function during the project ramp up. It strives for economic success of projects and steers the other Body & Trim departments. (Masser, 2012, p. 2)
- *Exterior*
  The Exterior department develops parts such as the bumper panel, tank cover, roof rack, wheelhouse trim as well as sound and thermal insulation. (Vogl, 2011, p. 14)
- *Doors & Closures*
  The Doors & Closures department engineers doors (i.e. door structure, door window, outer and interior rear-view mirror), Closures (i.e. closure structure, hinges, gas spring, spoiler) as well as roof systems (i.e. drive unit, latching system, roof panels, glazing) (Vogl, 2011, p. 13)
- *Body in White*
  This department develops the Body in White, which consists of the weld together sheet metal components. The Body in White determines the contour of the car body.
- Interior
  The Interior department engineers cockpit parts (e.g. instrument panels, centre console, air conditioner), the interior trim (e.g. door, side and back panel trim, floor trim, luggage compartment) as well as the seating (e.g. front and back seat, airbag, seat belt). (Vogl, 2011, p. 12)

4.1.2 Functions and Roles in the Body & Trim Department

MSF has a matrix organisation structure. A group standard defines the interaction between line units and the projects. MSF also uses the term program alongside the word project. A project consists of engineering activities only. Programs, on the other hand, consist of engineering services and production. This thesis will not differentiate between project and program, in order to keep it simple.

The line has general and project specific tasks. The general tasks include the continuous development and improvement of the line units as well as the management of its staff. This allows the line to optimise the provided services. It must guarantee productive cooperation with other lines. The line is responsible for its budget and has to plan its capacity. In addition to these general tasks, it estimates the costs for projects and makes sure that the project targets are fulfilled. It supports the projects actively and assists at escalation. (Weyers, 2010, pp.1-2)

The project must execute the contractually owned project scopes and reach the project objectives previously agreed upon with the line. It is responsible for the management of the project team as well as optimising the capacity demand. The project must make timely decisions and keep customers, as well as the line, informed. (Weyers, 2010, p. 2)

Figure 4.2 shows an overview of typical line and project roles at MSF.

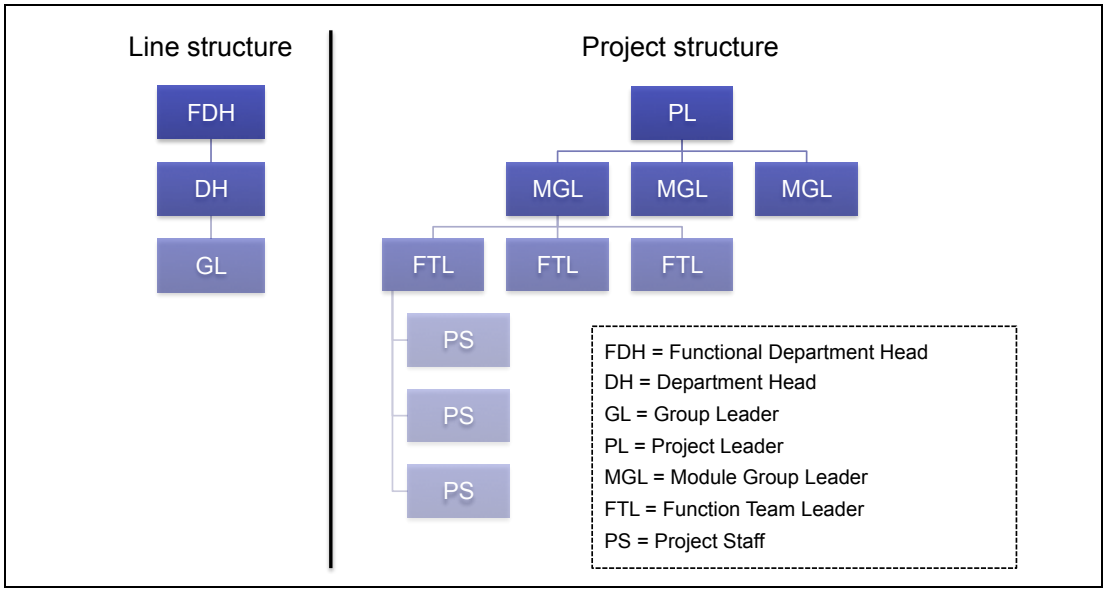


Figure 4.2: Functions and Roles in the Body & Trim (Own Illustration)

4.2 The Suppliers

MSF outsources to internal as well as external vendors. The internal ones are called Engineering Centers.

4.2.1 Engineering Centers

Engineering Centers are MSF subsidiaries that engineer complete vehicles. Each of them has competences in the areas of body&trim, engine/powertrain, chassis, electric/electronics as well as prototyping. Engineering Centers are development partners for automotive OEMs as well as other non-automotive customers. At the moment, there are sixteen in seven different countries (see Figure 4.3). This enables MSF to satisfy its customers' needs locally. Each of these centres has to be competitive in its region and should, therefore, not be dependent on the engineering headquarters in Graz. Every Engineering Center has its own general manger and is organisationally independent. They are profit centres and, therefore, responsible for their own result. There is extensive cooperation between the Engineering Centers and Graz. One of the purposes of this is to enable training and know-how exchange, so as to reach the same quality and competence in each one. (Urwanisch, 2012, p. 1)

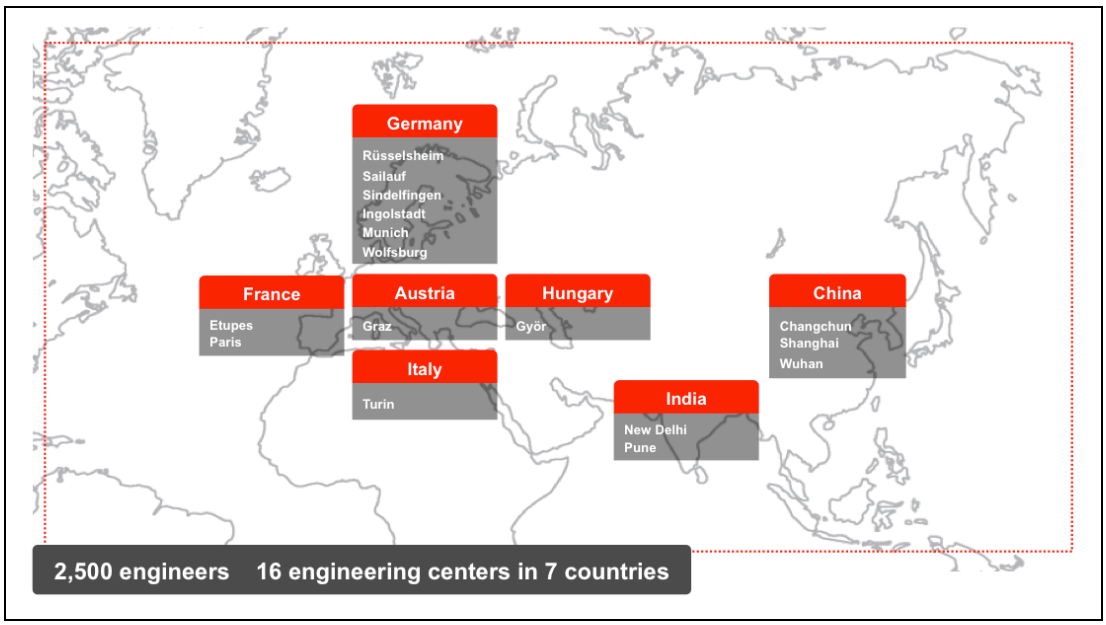


Figure 4.3: Engineering Centers Worldwide (MSF, 2012, p. 9)

4.2.2 External Suppliers

Most of the external suppliers commissioned by the Body & Trim department are strategic partners. New suppliers are used only very rarely and in special instances. The Body & Trim department has approximately 20 strategic partners. The relationship to these partners is a result of years of cooperation. There are several reasons that, for the most part, only strategic partners are used. They are all located, or have establishments, near the MSF site in Graz. One of them is even located on the premises. This makes cooperation much easier. Due to the long relationship, strategic partners are familiar with the strategic goals, the operational sequences and the systems within MSF. The Body & Trim department knows these companies, their employees and competences very well. This minimises risk and makes performance more predictable. The procurement department negotiates an hourly rate for every strategic partner annually. This allows for speedy outsourcing in the event of short notice capacity requirements.

4.3 Reason for Outsourcing

There are several reasons for outsourcing engineering activities. However, in the functional department of Body & Trim there are only a few reasons which are considered highly important: Insufficient capacity, competence, location and costs (see Figure 4.4).

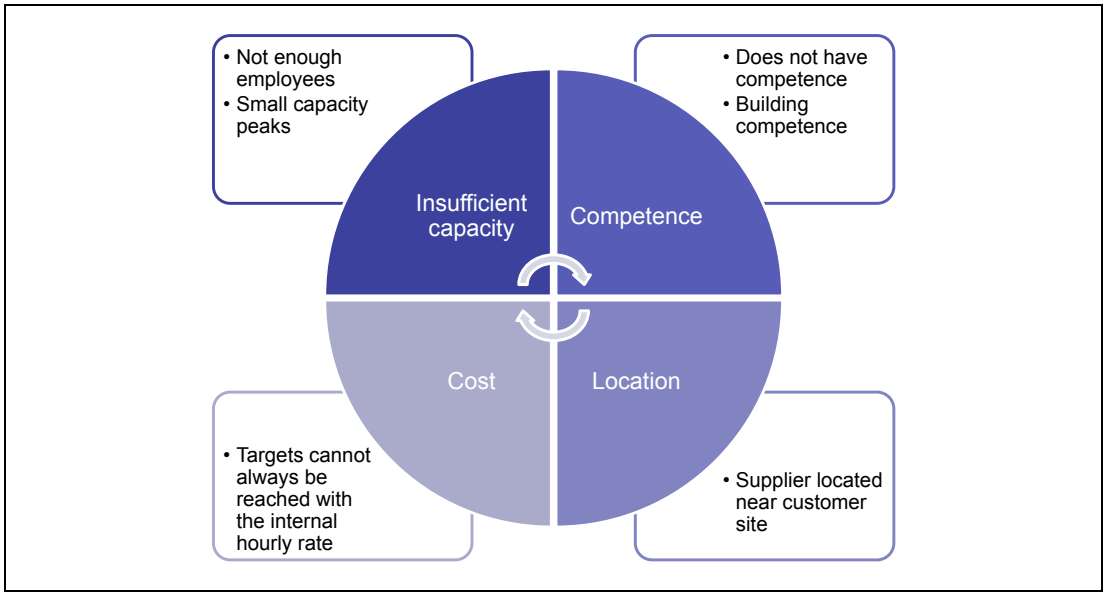


Figure 4.4: Reasons for Outsourcing (Own Illustration)

Insufficient capacity

Insufficient capacity is the main reason that the Body & Trim department outsources engineering activities. Sometimes, MSF does not have enough employees to handle an entire project. Employees are the main resource for development activities. Therefore, insufficient capacity means that there are not enough engineers in the Body & Trim department. Instead of outsourcing, hiring or contracting new personal could be an option, but there is a strategic maximum of employees set for the Engineering Center Graz and the Body & Trim department. Thus, hiring new personal is not possible when the maximum has already been reached. It would not make sense to hire new personal just for a small capacity peak. Projects in the Body & Trim department have an average duration of approximately 32 months. As a result, foresight and accurate planning is necessary.

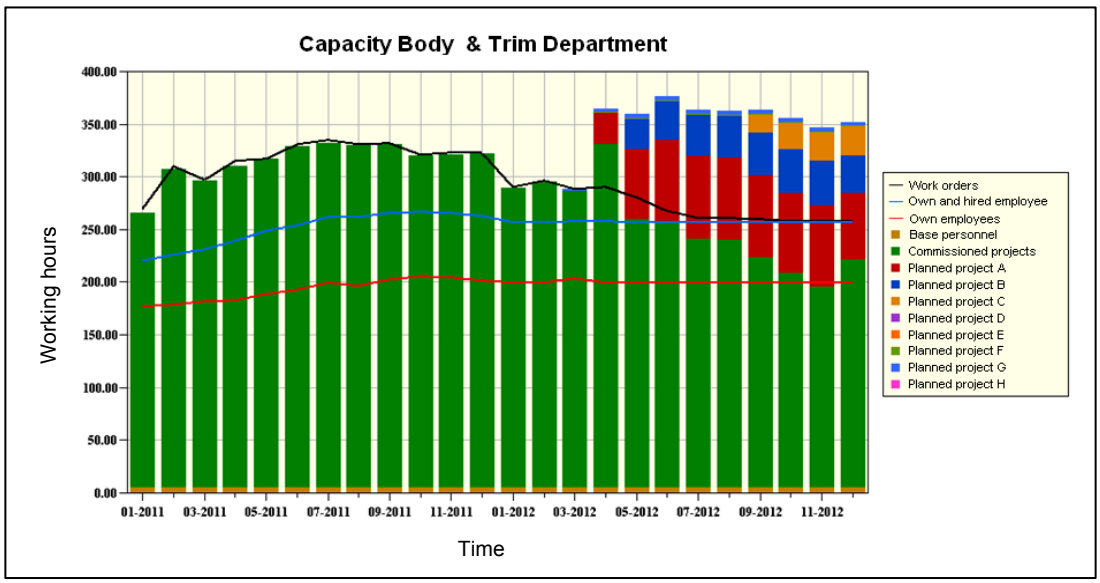


Figure 4.5: Capacity Graph of the Body & Trim Department – March 2012

The line departments plan the capacity for all projects. From this data a graph (see Figure 4.5) is created. All current and possible near future projects are shown in this chart as well as the capacity of the Body & Trim department. Everything, which exceeds the capacity of the department, has to be outsourced. There may well be sufficient capacity at a given time but projects, which are very likely to come, need to be done in house. The cause for this can be, for example, that interaction with other departments at the Graz location is needed. In this case, other projects or elements of projects

have to be outsourced in order to ensure sufficient capacity for the project which needs to be done in-house.

Competence

The Body & Trim departments do not always have all the competences needed for a project. Through outsourcing, they can take advantage of competence from outside. Even in cases in which the Body & Trim department has all the required competences, there are times when it is very busy and there is no available capacity. The alternative to outsourcing would be to build up the required competences. This is cost-intensive and not always desired, for example when the issue is outside the core business area.

Competence can also be a motive for outsourcing in respect to building competences. This is done with Engineering Centers. Elements of projects are outsourced to Engineering Centers in order for them to gain competence. So, Graz lends assistance to the Engineering Center. In that way, the Engineering Center builds up know-how and is able to handle such orders on its own after some time. The decision to build up competence is made by top management. This is done because it is something of a vicious circle. When the Engineering Center does not have the needed capabilities, it is cheaper and easier for the Body & Trim department to do it on its own or to subcontract it to someone else. However, if competences are not created, the situation will never get better.

Location

The location can also have an influence on the decision to outsource. The main customers of MSF are OEMs. For some projects it makes sense to subcontract elements of engineering to a supplier that is located next door to the OEM site. This makes the cooperation easier.

Cost

Cost is not the driving factor for outsourcing in the Body & Trim department. However, it can be a cause. Just as everyone else on the free market, MSF has to prevail against its competitors in order to get a contract from the OEM. Consequently, there is a cost pressure and the cost targets cannot always be reached with internal hourly rates. As a result, outsourcing is necessary.

4.4 Forms of Outsourcing

MSF differentiates between two basic ways of outsourcing engineering services, the work order for external services and the purchase requisition (see Appendix B). The former is used for commissioning in hours and the latter to order whole service packages. As a result, there are two main types of outsourcing after the decision to outsource has been made:

- Work order for external services (WOFES)
- Fixed price work package (FPWP)

An overview of both forms is displayed in Table 4.1. To keep it simple, WOFESs are often only referred to as work orders and FPWPs as work packages.

	Work Order	Work Package
Scope of work (size)	Small	Big
Scope of work (unit)	Hours	Monetary
Time needed for procurement	Low	High
Precision (how well defined)	Low	High
Flexibility	High	Low
Administrative effort	Low	High
Sharing risk	Difficult	Possible

Table 4.1: Difference Between the Outsourcing Types

The two forms of outsourcing engineering activities are explained in more detail in the following sections.

4.4.1 Work Order for External Services

This type of outsourcing entails commissioning the supplier for a certain amount of hours. If the supplier needs more time, for whatever reason, the hours are paid. This means that the Body & Trim department has to bear the risk. Only hours that are deemed unsatisfactory or not performed are not

paid. The hourly rates for external suppliers are negotiated once a year by the procurement department (CI). The controlling department appoints hourly rates for Engineering Centers. External suppliers are not allowed to perform any activities on the premises of MSF due to legal restrictions. For Engineering Centers, on the other hand, this is possible.

The process for work orders is fast and simple compared to that of work packages. It involves considerably lower administrative effort to procure work orders. This makes this form of outsourcing a good choice for smaller scopes and short-term capacity needs. Work orders are very flexible. As a result, it is possible to abort the outsourcing service quite easily.

4.4.2 Fixed Price Work Packages

A work package is a well-defined scope of work which is outsourced to internal Engineering Centers or external suppliers. The vendor must perform the contracted services in an agreed time at a fixed price. For that reason, the package must be well prepared and interfaces between the Body & Trim department and the supplier must be defined. The basis for this type of outsourcing is formed by contract-like enquiry documents. As a result, considerable cost and effort is required to abort outsourcing in the form of packages. The size of this effort depends on how far advanced the outsourcing initiative is.

This form of outsourcing should be used for subcontracting larger scopes. It requires substantially more administrative effort than the work order. As a result, it is time intensive and is not suitable for near-term needs. However, it has several advantages. The most important advantage is the sharing of risk. The supplier is accountable for the realization of the package content. If he miscalculates the effort for the package and his costs are higher than estimated, he must bear the consequences. It is possible to outsource whole modules via packages. This can be more effective than just outsourcing small parts of engineering, thanks to fewer interfaces. Another positive effect is that it can help to lower costs.

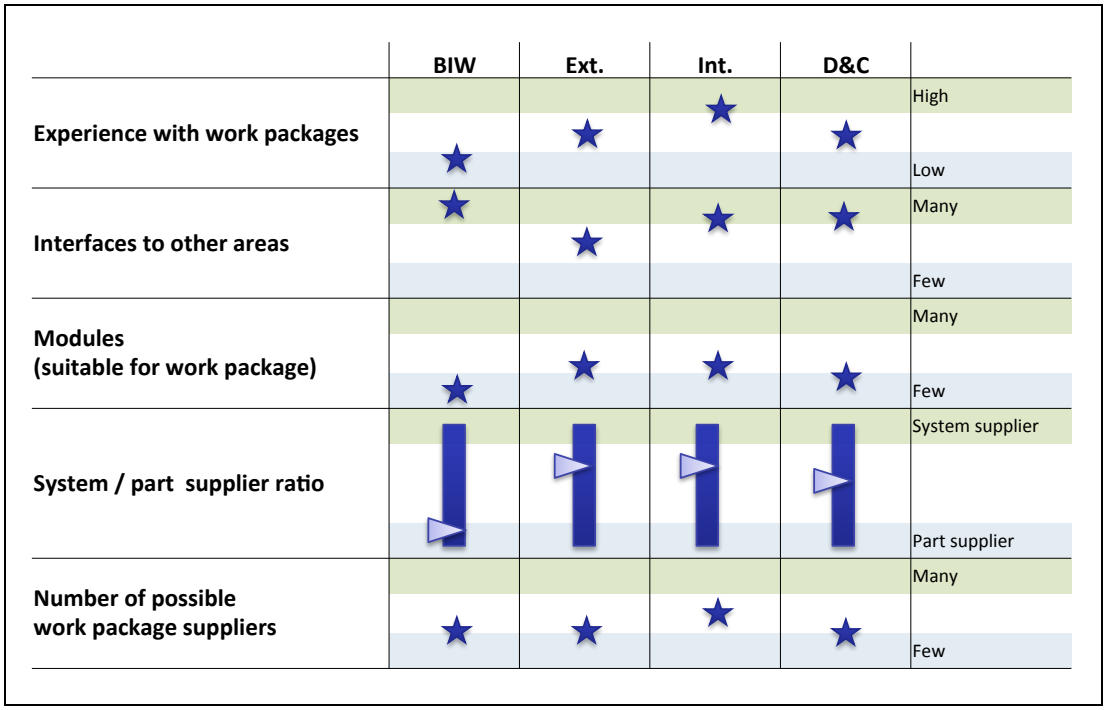


Figure 4.6: Experience with Work Packages and Influencing Factors (Own Illustration)

Figure 4.6 shows the different levels of experience within the Body & Trim department as well as factors that influence outsourcing in the form of packages. The Interior department has the most experience with this type of outsourcing. The head of this department has already defined some guidelines to assist outsourcing. Every department must deal with several interfaces to other areas, when outsourcing activities. However, the Body in White (BIW) department has to handle the highest amount of interfaces. The higher the number of interfaces is, the more effort for coordination is needed. This can result in elevated transaction costs (see section 2.2.2). Modules for which the outsourcing of engineering in the form of packages is suitable are quite limited for all departments. However, the Interior and Exterior department have a higher number of possible modules and, hence, more options for outsourcing packages. The BIW department works almost exclusively with part suppliers. All other departments also have a high number of system suppliers. If system suppliers are involved, it is quite hard to outsource parts of development. The reason for this is that MSF, for the most part, only performs integration tasks in such cases. These are not suitable for outsourcing. For the Interior department, there are more suppliers that have the competence to handle work packages and are suitable for the tasks.

4.4.3 Experience with Outsourcing Engineering

In 2011 there were, all in all, approximately 300 work orders and approximately 20 work packages in the Body & Trim department. There were 700 work orders, in total, at the Engineering Center Graz in the year 2011. The number of work orders for the departments Exterior, Interior, Body in White as well as Doors & Closures in 2011 is displayed in Figure 4.7.

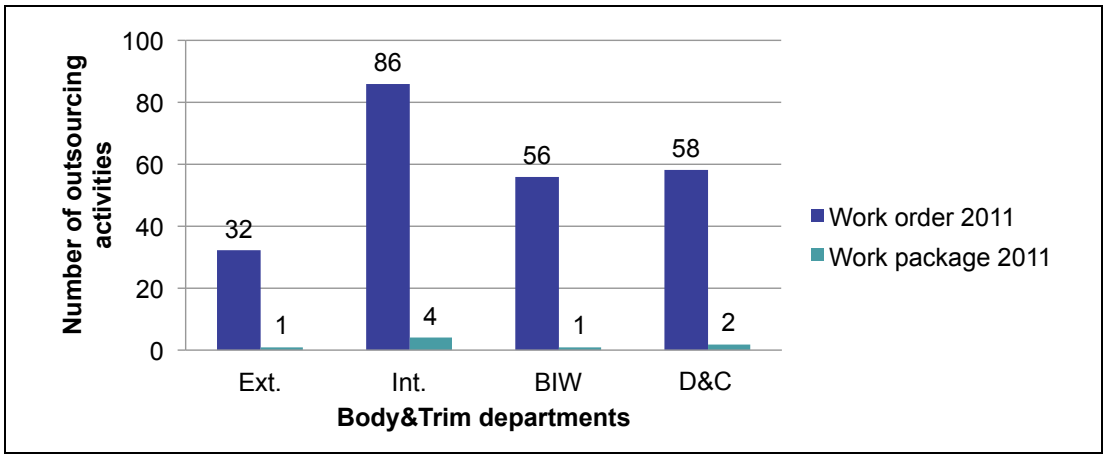


Figure 4.7: Number of Outsourced Activities (Own Illustration)

It can clearly be seen that the number of work orders is much higher than that of work packages. However, the scope of work packages can be much greater than that of work orders. They normally involve considerably more working hours (see Figure 4.8). As a result they have a greater impact. The 4 work packages in the Interior department resulted in more working hours than the 86 work orders.

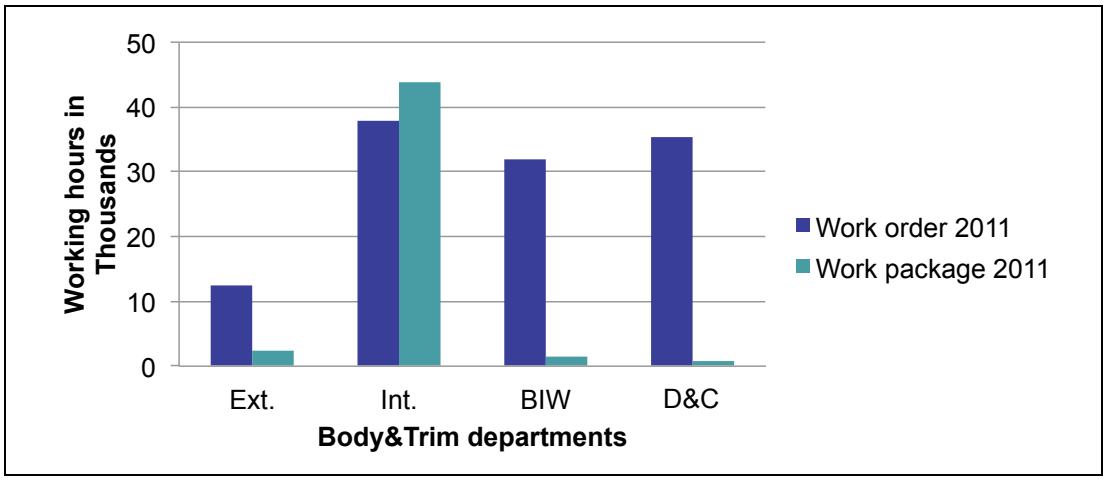


Figure 4.8: Working Hours of Outsourced Activities (Own Illustration)

4.5 Classification of the Outsourcing Process

According to the literature (see section 3.1.2), the development of a new product is a primary business process. This business process consists of several sub processes in which the product is developed. The outsourcing of body and trim engineering activities is one of these sub processes and can again be divided into several sub processes. Table 4.2 shows the sub processes that are analysed. Next to the name of the sub process, the process number is displayed. It consists of three parts. The first one indicates the form of outsourcing, i.e. work order (=WO) or work package (=WP). The second one is a consecutive number and the last one points out whether it is the as-is (=AI) or the to-be (=TB) process.

Work Order		Work Package	
Procurement process	WO-01-AI	Procurement process	WP-01-AI
Initiation of outsourcing	WO-02-AI	Initiation of outsourcing	WP-02-AI
Time capture process	WO-03-AI	Handling invoice	WP-01-AI
Handling Invoice	WO-04-AI		

Table 4.2: Sub Processes Analysed in the As-Is

At the moment, there are no set roles for the processes of outsourcing engineering activities. Each of the Body & Trim departments is responsible for outsourcing within its area. However, there is no designated process owner responsible for the complete process.

4.6 Documentation of the As-Is Situation

Before this thesis, there was no documented process for outsourcing engineering activities in the Body & Trim department. A process model of the current situation can help in understanding how the involved parties are connected. It enables the process participants to understand areas outside their field of activity. This thesis focuses on the process for the Body & Trim department. Consequently, the other areas are not analysed in depth. Nonetheless, all interfaces are displayed.

A flow chart is used for modelling the process. One of the reasons for this is that MSF already uses flow charts. The goal for creating the as-is model is to help the process participants understand the process in its full extent. The fact that the employees of MSF are already familiar with flow charts and the symbols that are used is advantageous. Moreover, flow charts are easy and simple to read process models (see 3.4.3). Pools are used for the as-is chart, in order to help visualise interfaces between departments.

In order to gain information about the process, both document analyses and interviews were carried out (see 3.5.2). At the beginning, there were several open and unstructured interviews with the members of the Project Management department and the Body & Trim department heads. Basic information was gathered and existing documents were identified in these interviews. This type of interview helped, particularly, in identifying problems. The process participants stated several frustration areas. However, only a few of them are within the scope of this thesis. During the interviews, the process participants were asked to recall the last time they performed the process. This was done to ensure that the current situation was reflected. The data from the documents and interviews was then used to draw a rough draft of the process. In structured interviews, an as-is model was generated for each of the four departments. The models showed that the processes were nearly the same for the four departments. Hence, only one general process model was generated. Afterwards, interviews with the other areas were conducted so as to detect interfaces and main tasks outside the scope of the Body & Trim department. A cross-functional flow chart was created with the information gathered. This flow chart was then adjusted and validated in an iterative process by conducting several structured interviews with all process participants.

4.6.1 The Process for Work Orders

Work orders require less administrative effort than the work packages. There is no complex bidding process dealing with several suppliers. Instead, just one suitable supplier is asked whether he has the required capacity. The procurement department negotiates hourly rates with the suppliers once a year. Hence, the hourly rates are known beforehand. Since work orders are commissioned in hours, it is necessary to capture the actual work hours

spent for the outsourced activities. Suppliers send an invoice once a month. The detailed as-is flowcharts for all the sub processes can be found in Appendix C. The processes for work orders are executed quite often. Everyone knows, basically, what has to be done, even though the responsibilities are not formally set. There is no standard for this process, at this time.

Procurement Process – WO-01-AI

This sub process begins with the decision to outsource engineering activities in the form of work orders. Input for the process is information and requirements of the activities to be outsourced. It ends with the purchase order to the supplier. Consequently, the output of the process is a purchase order with a specified number of working hours. The goal of the process is to order development services from an Engineering Center or an external supplier. Figure 4.9 shows a simplified model of the procurement process for work orders.

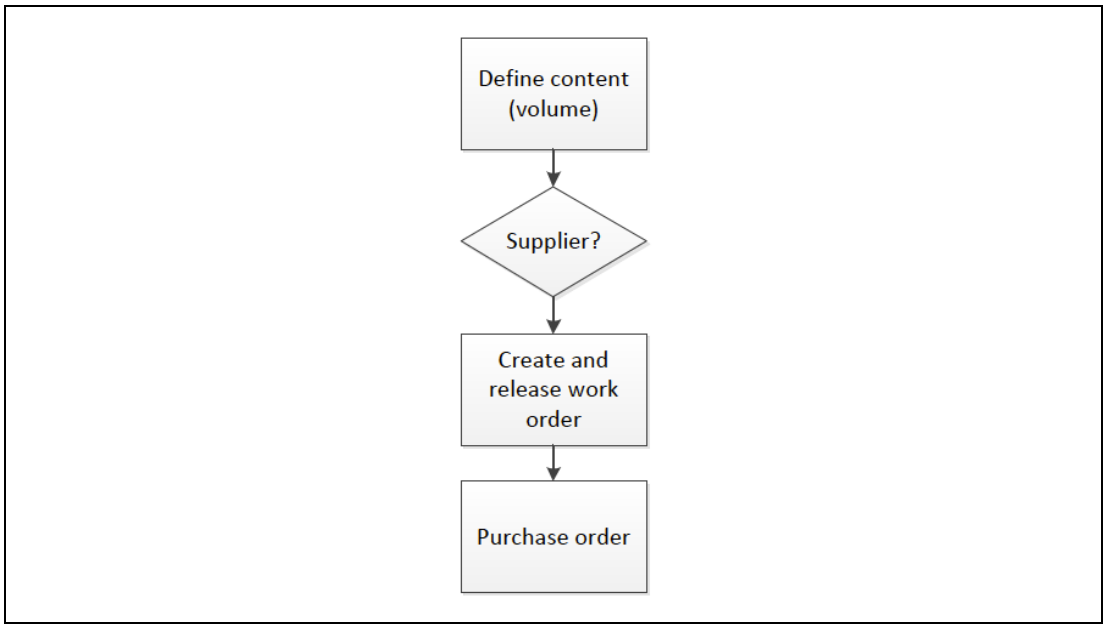


Figure 4.9: Simplified Procurement Process for Work Orders (Own Illustration)

In the procurement process, one of the Body & Trim departments, the project controlling department, the procurement department and the Body & Trim Assistance are involved. The activities of the Body & Trim department are performed by the department head, but can be also delegated to the group

leaders. In order to help to understand the complete process model displayed in Appendix C, a more detailed description is necessary. Each of the process steps of the process model in Appendix C is numbered. The additional information is labelled with the identifying process step number:

1. *Define content*
   The content of work, for which support is needed, is defined.

2. *Estimate volume*
   The man-hours required to handle the content of work defined in step 1 are estimated. They are largely based on experience and the number of working hours that would be necessary if the activity were to be performed in-house.

3. *Choose supplier*
   The department heads of the Body & Trim departments are familiar with the competences of external suppliers as well as the Engineering Centers. Based on this information and the hourly rate, the department head chooses the most suitable for the task.

4. *Ask preferred supplier if he has capacity*
   The department head enquires per email, telephone or face-to-face, if the supplier has the required capacity. If not, he has to choose another supplier.

6. *Send information to EA Assistance*
   The department head passes on the information, which is needed for creating a work order, to Body & Trim Assistance (EA Assistance). This is done by telephone, email or face-to-face. Sometimes information is not passed on in its entirety and EA Assistance has to contact the department head.

7. *Apply for allocation account number*
   EA Assistance contacts the project controlling department (ECK) and requests an allocation account number for the work order. The Exterior department already includes the allocation account number in the information, which is sent in step 6. Hence, this step is not needed for the Exterior department.

8. *Create WOFES*
   EA Assistance fills out the work order form (see Appendix B). In this step it is important to specify the content of work as well as the location where the activities are to be performed. If they are performed on the MSF premises and access to CAD resources is required it must be noted.

9. *Documentation of WOFES in Excel file*
   EA Assistance has an Excel file in which all work orders for each of the Body & Trim departments are documented. The file is needed to keep track of the work orders. After the work order form is filled out, EA Assistance updates the information to this file.

10. *Put WOFES into Freeflow*
    Freeflow is an automated workflow application for releasing work orders as well as purchase requisitions. In Appendix B the mask for creating a work order in Freeflow is displayed. All necessary information is inserted in this mask. Then Freeflow is started.

11. *Release of the work order by authority (Freeflow)*
    One by one, the authorities get a message and are asked to release the work order. To do so, they log into Freeflow and click on a release button. The work order must be accepted by the applicant (i.e. department head or group leader), the functional department head and the project leader.

12. *Check allocation account number and coverage*
    The ECK department checks to ensure that the allocation account number stated in Freeflow is correct and that the account has sufficient cover for the work order.

13. *Allocation of consecutive number for WOFES*
    This consecutive number helps to identify the worker order. Suppliers write this number on their invoices. During this step, the work order data is also entered into an Excel file which functions as a database for all work orders.

14. *Input of hours into EMIS capacity mask*
    The hours are inserted into the capacity mask of the Engineering Management and Information System (EMIS). At MSF the internal

calculation and controlling of development projects is done in working hours. This means that the Body & Trim departments have a limited number of working hours at their disposal for handling a given project. By inputting the hours of a work order in the EMIS capacity mask, the available hours are reduced by the outsourced ones. A work order is often commissioned for several months. Thus, the total amount of working hours is spread over these months.

15. *Board of directors loop (15-18)*
    This part of the process was added sometime in November 2011. Its purpose is to ensure that the Body & Trim departments also consider Engineering Centers as possible suppliers for working orders. Every work order has to be sent to the board of directors. The board of directors then decides whether to release it or not. In the event it is not released, the Body & Trim departments must make an enquiry at an Engineering Center. This part of the process was cancelled after the as-is presentation. Since then, the general manager of the Engineering Center Graz must approve the work order between step 13 and 14. This is done via Freeflow.

19. *Purchase order*
    This sub process ends when the purchase order is sent to the supplier. After this step, the supplier is officially commissioned to provide the requested activities.

Initiation of Outsourcing – WO-02-AI

This sub process is started after the purchase order is sent to the supplier and ends after he is integrated into the project. It is only needed if external people work on the MSF premises. The Body & Trim departments request a workplace, infrastructure (e.g. PC, telephone, email address) and an ID card. The work place and infrastructure is organised by a specific part of the project management department, i.e. EAP-K.

Time Capture Process – WO-03-AI

Time sheets are needed for work orders, as this form of outsourcing is commissioned in hours. The input for this sub process is the time sheet from the supplier and the output is the confirmed time sheet and the updated work order database. Furthermore, if the supplier has used internal CAD

resources, the CAD costs are allocated to the project. The goal is to know the number of working hours that where performed each month. Consequently, the process is executed once a month. Figure 4.10 shows a simplified model of the time capture process for work orders.

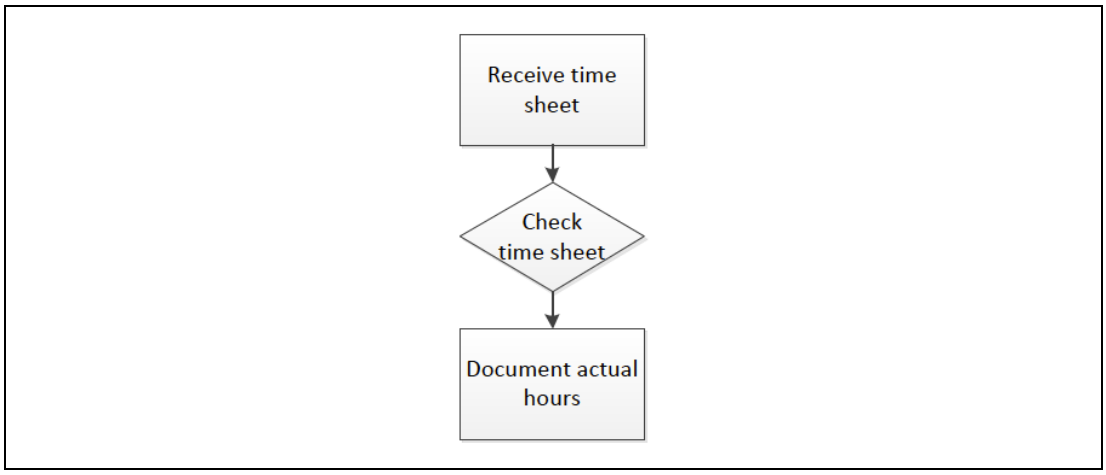


Figure 4.10: Simplified Time Capture Process for Work Orders (Own Illustration)

The following description helps to better understand the process model in Appendix C. The additional information is labelled with the identifying process step number:

2. *Write time sheet*
   When a supplier works externally he writes his own time sheet.

3. *Time registration with Taris*
   Suppliers that work on the MSF premises use the internal time capture system, i.e. Taris.

4. *Check time sheet (Project)*
   The project authorities have to confirm the time sheets of the suppliers. They check to see that the number of hours is correct and justified. Afterwards, they send the confirmed time sheets to EA Assistance as well as EAP-K. However, this is sometimes not done straightaway and EA Assistance has to request the time sheets after receiving the invoice.

5. *Input hours into Excel file*
   EAP-K has another Excel file to keep track of the work orders. It inputs the data of all work orders in this file.

7. *Apply for allocation of CAD costs to the project*
   If the supplier used an MSF CAD resource the costs of it must be allocated to the project. The EAP-K employee requests that the controlling department to do so.
8. *Fill out actual hours in WOFES*
   The hours stated on the work order form in the procurement process, were only estimated. At this process step the actual hours needed are recorded on the work order form.
9. *Input actual hours in Excel file*
   The actual hours are also entered into the Excel file.
10. *New WOFES necessary?*
    The Excel file shows how many of the hours commissioned by the work order have already been used. When the number of working hours start running out, EA Assistance asks the Body & Trim departments if a new work order is needed.

Handling Invoice – WO-04-AI

This sub process starts when the invoice from the supplier is received and ends with the release of the invoice. The purpose of this process is to check the invoice and release it after ensuring that everything is in order. Figure 4.11 shows a simplified model of the invoice handling process for work orders.

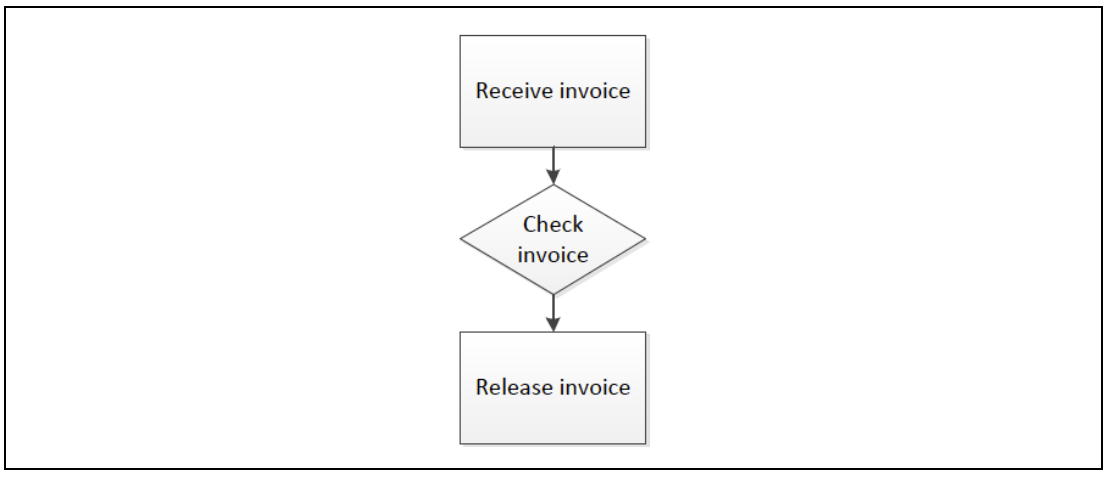


Figure 4.11: Simplified Invoice Handling Process for Work Orders (Own Illustration)

The following description helps to better understand the process model in Appendix C. The additional information is labelled with the identifying process step number:

1. *Start workflow*
   The invoice revision department receives the invoices and starts a workflow.

2. *Check invoice (workflow)*
   ECK receives the invoice and checks to see that it is in order from the managerial accounting perspective, e.g. if the account has enough coverage.

3. *Check invoice (workflow)*
   EA Assistance checks whether the number of hours stated on the invoice complies with the one from the confirmed time sheets. Further, it makes sure that the hourly rate is correct.

5. *Contact supplier*
   In the event of inconsistencies, EA Assistance must contact the supplier and clarify them.

6. *Adjustment necessary?*
   Normally, MSF does not reject invoices. If changes have to be made, the supplier is asked to consider them in the next invoice or send a notice of credit.

9. *Adjustment of hours in EMIS if necessary*
   In the procurement process, the amount of planned hours for a work order is inserted in the capacity mask of the Engineering Management and Information System (EMIS). After the work order is completed, ECK checks as to whether the planned number is in accord with the actual one. If not, the difference is inserted in the actual month.

4.6.2 The Process for Work Packages

Work packages are used to order large scopes of engineering activities. This makes it necessary to create detailed enquiry documents. They are then sent to at least three suppliers. After the quotes are received, they are validated and negotiations with the vendors take place. Then, a decision is made to

outsource to one of these suppliers. To do so, a purchase requisition must be created and released. The acceptance of services takes place at agreed milestones. Afterwards, the outsourcing provider sends an invoice. The complete flow charts for all sub processes are displayed in Appendix C. There are only very few fixed price work packages every year, but the number is rising.

Procurement Process – WP-01-AI

This sub process begins with the decision to outsource engineering activities in the form of packages. Input for the process is information about the project and the reasons for outsourcing. It ends with the purchase order to the chosen supplier. Hence, the output is the purchase of a well-defined package content. The goal of the process is to order development services from an Engineering Center or external supplier. Figure 4.12 shows a simplified process model of the procurement process for work packages. This process is only executed a few times a year and requires considerable administrative effort. There are some regulations for this process which were created, to a large extent, by the head of the Interior department.

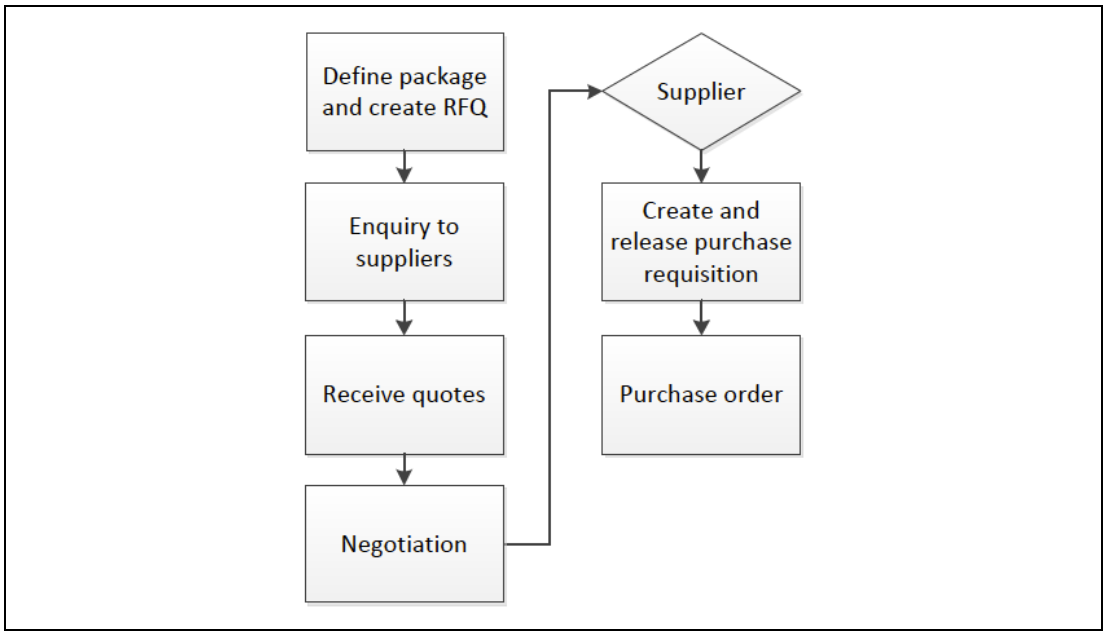


Figure 4.12: Simplified Procurement Process for Work Packages (Own Illustration)

The following description helps to better understand the process model in Appendix C. The additional information is labelled with the identifying process step number:

1. *Definition of the content and size of the package*
   It is crucial to outline the scope of the work package. The content and the outcome of the package must be well defined. Clearly measurable requirements must be set. Interfaces between the package and the rest of the project have to be considered.

2. *Definition of the business target*
   The business target defines how much a package is allowed to cost. Outsourcing a package should not cost more than what the internal production would cost. The business target is influenced by the project budget. It is important to consider the administrative- and support effort for outsourcing packages. All costs that arise with the outsourcing of a package need to be accounted for. Such costs are, for example, steering and transaction costs as well as costs for a resident. Residents are employees of the vendor who work at the buyer's site. They make collaboration easier and function as an interface. Residents need a working place as well as infrastructure, which costs money.

3. *Create the request for quotation (RFQ)*
   This is one of the main process steps for outsourcing in the form of packages. The RFQ consists of, among other things, the package definition, technical specifications, a responsibility chart, a visual bill of material (BOM) and a time schedule. The RFQ is described in more detail in section 4.7.

4. *Assign package number*
   Process step 4 and 5 are only performed by the Interior and Exterior department. They assign a defined number to each work package that consists of the year, the abbreviation for the department, a consecutive number and the version.

5. *Documentation of package in Excel file*
   The package is documented in a dedicated Excel file. To do so, the package number from step 4 is used.

6. *Check RFQ*

   The procurement department (CI) checks the RFQ from its point of view. Furthermore, it adds the purchasing portion to the RFQ, e.g. the purchasing policies, legal framework.

8. *Adjustment RFQ*

   If changes are needed, the Body & Trim department adjusts the RFQ.

9. *Choose suppliers for enquiry (min. 3)*

   The nomination of suitable suppliers is done in cooperation with the procurement and the Body & Trim department (EAx). The CI department suggests a few vendors from its portfolio and EAx adds some. A minimum of three suppliers must be chosen in order to guarantee a proper bidding process.

10. *Create bidder list*

    The bidder list gives an overview of the vendors and makes comparison easier as the offers of the suppliers are all recorded. The procurement department creates this list and keeps it until there is a decision for one of the suppliers. After negotiations, the list is updated with the new values. The head of the interior department has stated that he does not always get the bidder list from CI.

11. *Enquiry to supplier*

    The CI department sends an enquiry to the suppliers that were chosen in process step 9.

14. *Verification of quotes*

    The EAx department analyses the received quotes. They are compared with the RFQ, in order to ensure they contain everything that was asked for. The following questions are considered:

    - Is the quote in conformance with the RFQ?
    - Did the supplier quote the right content?
    - Is the effort calculated by the supplier similar to internal estimations?
    - Is renegotiation necessary?
    - Is it likely that problems will occur?
    - Are there any open questions?

16. *Clarify content*

    If there are any questions about the content of the quote, it is necessary to clarify them with the suppliers. In the case of technical details, the Body & Trim department corresponds directly with the vendor. The CI department handles everything else. Points that might need clarification are, for example, deadlines, technical issues, interfaces, the price and the content.

18. *Create decision matrix with all quotes*

    The head of the Interior department creates his own decision matrix, which shows the costs for all quotes.

19. *Negotiation*

    There are several negotiations with all the suppliers. These are attended by employees from the Body & Trim department, the procurement department and the project. All in all, there are up to five persons present from MSF. Negotiations require a considerable amount of time.

20. *Last call*

    If one of the vendors is an Engineering Center and the offer from an external supplier is cheaper, the Engineering Center is given the chance to improve its offer.

21. *Recommendation*

    The Body & Trim department head and the procurement department choose one of the suppliers. This vendor is then recommended to the authorities.

22. *Decision for one supplier by authority*

    The final decision for one supplier lies with the authority. Depending on the size and the importance of the work package, the authority can vary, i.e. project leader or general manager engineering

24. *Question package*

    If it is not possible to recommend a supplier or the authority is not satisfied with any of the suppliers, the whole package has to be questioned. There are three different options in this case:

    - To start from scratch and go back to step one
    - To adjust the package and send a modified enquiry

- To abort the outsourcing process and engineer the package in-house

28. *Apply for allocation account number*
    The project management department requests an allocation account number from ECK. This allocation account must have enough coverage for the package.

29. *Create purchase requisition (BANF)*
    The final quote of the chosen supplier is forwarded to the Body & Trim Assistance. There, the purchase requisition form is filled out (see Appendix B). It is necessary, at this point, to reference the RFQ as well as the latest, valid quote. Often, there are several versions of a quote. Furthermore, the supplier, the volume in Euro, the allocation account number as well as the start and end date of the package must be stated.

30. *Put purchase requisition into Freeflow*
    Freeflow is an automated workflow for releasing work orders and purchase requisitions. In Appendix B the mask for creating a purchase requisition in Freeflow is displayed. All the essential information needs to be stated and both the latest quote and the RFQ should be attached. After that Freeflow is started.

31. *Release of the purchase requisition by the authority*
    One by one, the authorities get a message and are asked to release the purchase requisition. To do so, they log into Freeflow and click on a release button. The purchase requisition must be accepted by the applicant (i.e. department head or group leader), the functional department head and the project leader.

32. *Purchase order*
    CI sends a purchase order to the chosen vendor. After this step, the supplier is officially commissioned to provide the package.

33. *Adjust capacity and cost planning*
    The project management department adjusts the capacity plan in the system. The Body & Trim department has less work to do on its own when it outsources. Hence, the capacity need is decreased by the number of working hours saved by the outsourced package. It is

important to consider the effort for the Body & Trim department that is needed to support and administer the work package. Furthermore, the budget has to be adjusted. Consequently, the capacity need is reduced but costs are added.

34. *Reject other quotes*
    The suppliers that did not get the order must be informed.

Initiation of Outsourcing – WP-02-AI

This sub process starts after the order confirmation is received and ends after the supplier is integrated into the project. Its aim is to ensure that residents have access to the necessary infrastructure. It functions in the same way as the initiation of outsourcing for work orders (see WO-02-AI). For the infrastructure request, the name of the resident, the start and end date of his stay at MSF as well as the needed equipment (e.g. CAD, PC or telephone) is required. In addition, a login and a partner email address has to be requested. Considerations must be made for residents, as it can take a substantial amount of time to obtain a visa.

Handling Invoice – WP-03-AI

Within the RFQ, certain milestones for a package are defined. At these points during the project an acceptance of services is performed. The Body & Trim department checks whether the outsourced activities were performed as agreed. Afterwards, the supplier usually sends an invoice. Figure 4.13 shows a simplified model of the invoice handling process for work orders.

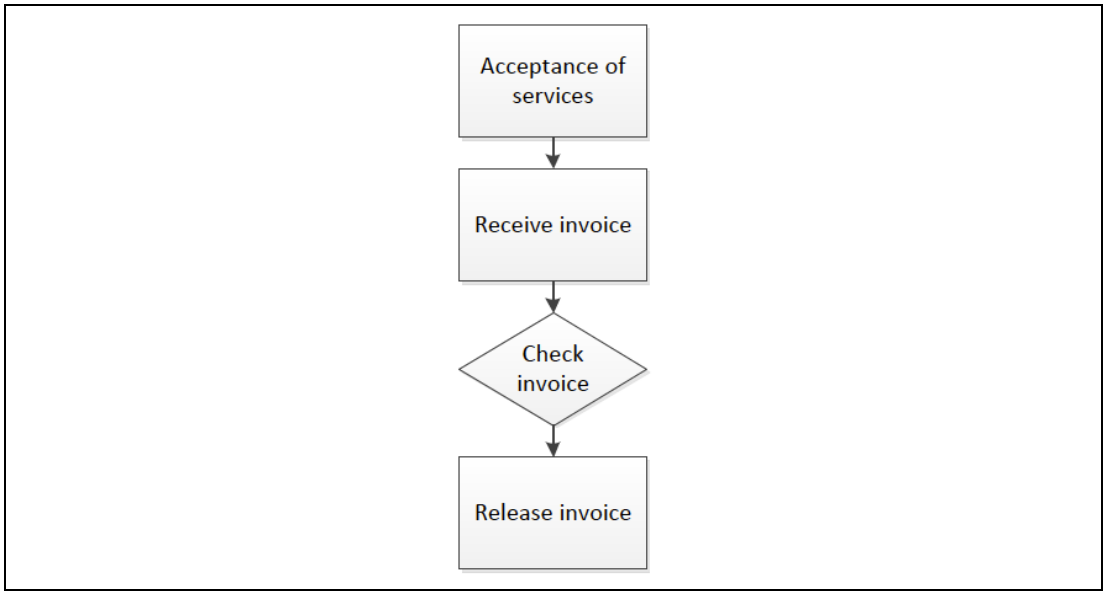


Figure 4.13: Simplified Invoice Handling Process for Work Packages (Own Illustration)

The following description helps to better understand the process model in Appendix C. The additional information is labelled with the identifying process step number:

1. *Acceptance of services*
   At certain milestones an acceptance of services is performed. These points of time during the project are defined in the RFQ. A check is made to ensure that the services rendered are consistent with the agreed performance.

2. *Check invoice*
   The invoice is compared with the services and costs defined in the quote. It is only released when it agrees with the outcome of process step 1. The payment plan and milestones are stated in the RFQ.

4. *Coordination with supplier*
   If there is an issue with the invoice the following further steps must be discussed. One reason for this can be that the services were not rendered as agreed. In this case, there are basically two ways, i.e. MSF performs the services which were not rendered or the supplier performs them. If the former is chosen the release of the invoice is declined. The supplier has to adjust his invoice and send a new one. For the latter, another acceptance of services is carried out after the supplier has completed the agreed services. There can also be a

decline of the invoice due to other reasons, e.g. incorrect balance of the invoice or the invoice date is not according to the payment plan.

8. *Release of invoice*
   When all agreed services are provided and the sum of the invoice is correct, it is released and the payment process is started.

4.7 Request for Quotation

Creating an RFQ is one of the most important process steps for outsourcing in the form of packages. It has to be clearly understandable and contain all necessary information. Otherwise, misunderstandings could arise and quotes from different suppliers are not likely to be comparable. At MSF, the RFQ consists of two parts, i.e. one technical part and one from the procurement department. The technical part is represented by a document labelled RFQ and several possible attachments, i.e. visual bill of material, interface agreement, master timing, non-disclosure agreement.

4.7.1 The Content of the Request for Quotation Document

There is no standardised RFQ for work packages within MSF. However, the RFQs within the functional department of Body & Trim are similar. In general they contain the following sections (Kofler, 2011a, pp. 1-11; Krendlesberger, 2011, pp. 1-10; Ornig, 2011, pp. 1-9; Wiesbauer, 2011, pp. 1-10):

- Change History
- Confidentiality and Patent Rights
- Target
- Terms
- Contacts
- Scope of Work
- Period of Execution
- Terms of Payment
- Regulations
- Offer Preparation / Offer Scenario

Change History

This section enables the reader to follow changes made to the RFQ. It contains a table that states the revision number, the revision date, a description of changes made and the name of the editor. (Kofler, 2011a, p. 3; Krendlesberger, 2011, p. 3; Ornig, 2011, p. 3; Wiesbauer, 2011, p. 3)

Confidentiality and Patent Rights

It is stated here that the supplier has to return the signed non-disclosure agreement (NDA) before sending his quote. Otherwise, his offer is not considered. In any event, the recipient of the quote is bound to confidentiality. When a vendor receives the order, another confidentiality agreement has to be signed. MSF reserves the right to apply for a utility model or patent for anything developed during the cooperation. (Kofler, 2011a, p. 3; Krendlesberger, 2011, p. 3; Ornig, 2011, p. 3; Wiesbauer, 2011, p. 3)

Target

The project for which support is requested is named. Furthermore, the basic model of what the cooperation should look like is described. The supplier is responsible for handling the interface between the Body & Trim department and his manpower. Therefore, it could be necessary that a resident, as it is termed, is sent to work within MSF's project team. A resident is an employee of the supplier who works at the MSF site for an agreed upon period of time. He coordinates the interfaces and makes collaboration easier. Furthermore, design guidelines, necessary standards, as well as the homologation and the market, can be set in this section. (Kofler, 2011a, p. 4; Krendlesberger, 2011, p. 4; Ornig, 2011, p. 4; Wiesbauer, 2011, p. 4)

Terms

This section states terms that are used in the RFQ. This is necessary to enable the vendor to understand the RFQ. (Kofler, 2011a, p. 5; Krendlesberger, 2011, p. 5; Ornig, 2011, p. 5; Wiesbauer, 2011, p. 5)

Contacts

This part of the RFQ displays the contact information of the parties involved at MSF. In addition, the supplier is requested to provide his contact

information. (Kofler, 2011a, p. 5; Krendlesberger, 2011, p. 5; Ornig, 2011, p. 5; Wiesbauer, 2011, p. 5)

Scope of Work

In this section the duties of the supplier are defined. The following points could be mentioned here (Kofler, 2011a, pp. 6-8; Krendlesberger, 2011, pp. 6-9; Ornig, 2011, pp. 6-8; Wiesbauer, 2011, pp. 6-9):

- *Content of Work:* Components which should be developed according to the bill of material, duration of development, tasks according to an interface agreement.

- *Data Supply and Acquisition:* Both the data format and the handling of data management is defined. Furthermore, it can be stated that the supplier is responsible for the input into the customer system and that the provision and consignment of data is included in the offer.

- *Assistance in the Simultaneous-Engineering Process:* The vendor is responsible for gathering the necessary information and also coordination with MSF. Expenses and travel costs are included in the offer.

- *Change Management:* This section defines how changes are handled. Usually, the quote must include all costs for changes. The only exceptions are customer-paid changes. Previously unannounced costs for changes will not be accepted. The supplier has to assess the effect of changes on the project content, targets, dates and costs. If modifications reduce the scope of the package this has to be taken into account when invoicing.

- *Documentation:* Standards for drawings are defined. The package ends with release of the drawings by the customer. Updates/Modifications over entire project duration must be included.

Period of Execution

The project start and end is defined. The vendor has to plan his manpower for the project duration and has to nominate a deputy, to substitute in the

event the project leader is absent. (Kofler, 2011a, p. 10; Krendlesberger, 2011, p. 8; Ornig, 2011, p. 7; Wiesbauer, 2011, p. 9)

Terms of Payment

In this section of the RFQ the payment plan is defined. (Kofler, 2011a, p. 11; Krendlesberger, 2011, p. 10; Ornig, 2011, p. 9; Wiesbauer, 2011, p. 10)

Regulations

The regulations can include legal requirements, industry standards, other regulations and design requirements. (Kofler, 2011a, pp. 8-9; Krendlesberger, 2011, p. 9; Ornig, 2011, p. 8; Wiesbauer, 2011, pp. 10-11)

Offer Preparation / Offer Scenario

This chapter defines what the quotes should look like and what they should include. In addition, the deadline for sending the quote is also stated here. (Kofler, 2011a, p. 11; Krendlesberger, 2011, p. 10; Ornig, 2011, p. 9; Wiesbauer, 2011, p. 11)

4.7.2 Attachments of the Request for Quotation

There can be several files attached to the RFQ document. Procurement's portion is always attached. Depending on the size and type of the work package, there can be several attachments from the Body & Trim department, i.e. bill of material, master timing, interface agreement, non-disclosure agreement. The attachments are described as follows:

- *Part of the Procurement Department:* The procurement part of the RFQ contains purchasing policies as well as the legal framework.
- *Bill of Material:* The BOM gives an overview of all parts that should be developed by the supplier.
- *Master Timing:* The master timing is a time schedule with all the important milestones and gates of the project.
- *Interface Agreement:* The interface agreement is very important for outsourcing. Therefore, it is covered in its own section (see 4.7.3)

- *Non-Disclosure Agreement:* The NDA ensures confidentiality between the parties during the quotation phase.

4.7.3 The Interface Agreement

The interface agreement regulates the cooperation between multiple parties. Presently, only the Exterior and the Interior department have already used an interface agreement for outsourcing in the form of packages. The Exterior department uses a very simple version of an interface agreement and the Interior department uses, what is known as, a RASIC-chart.

Interface Agreement Exterior

The interface agreement used by the Exterior department is shown in Figure 4.14. The head of this department is of the opinion that an interface agreement should be as simple as possible, but as complex as needed. An easy to read interface chart helps the supplier to understand the RFQ.

Project CULT
Work Interface Chart

Activities	Magna Steyr	MS India	Comment
Project Management			
Common activities			
Organise SE-Team meetings	x		
Attend SE-Team meetings	x	x	
Business trips to MSF (Resident)		x	
Report to MSF Project Management	x		
Report (Status, techn. activities,...) to MSF SE Meeting		x	
Product Development			
Styling creation	x		
Responsibility for fixation concept (internal + to vehicle)		x	
Consider step + gap requirements (vehicle)		x	
Material selection / responsibility (suitable for application/based on requirement in the spec. book)		x	
Investigate + confirm general feasibility		x	
Propose changes (2D, 3D) based on vehicle requirements	x		

Figure 4.14: Work Interface Chart from the Exterior Department (Kofler, 2011b)

The interface agreement of the Exterior department is a table with all activities that are needed for a package. Next to the activity column, are two columns indicating whether MSF or the vendor performs the activity.

Interface Agreement Interior

The Interior department uses what is known as a RASIC-chart. RASIC stands for Responsible, Approval, Support, Information, Check (Wiesbauer, 2010, p. 1):

- *Responsible:* That which is designated with an R is responsible for completing the activity, fulfilling the target and disseminating information. For every task there must be one R and only one.
- *Approval:* That which is designated with an A must take decisions and release responsibility. For a task there can be one or no A.
- *Support:* That which is designated with an S is responsible for support. A task can have zero, one or multiple Ss.
- *Information:* That which is designated with an I must be informed. A task can have zero, one or multiple Is.
- *Check:* That which is designated with a C is responsible to check the task. A task can have zero, one or multiple Cs.

Figure 4.15 shows the design of the Interior department's RASIC template.

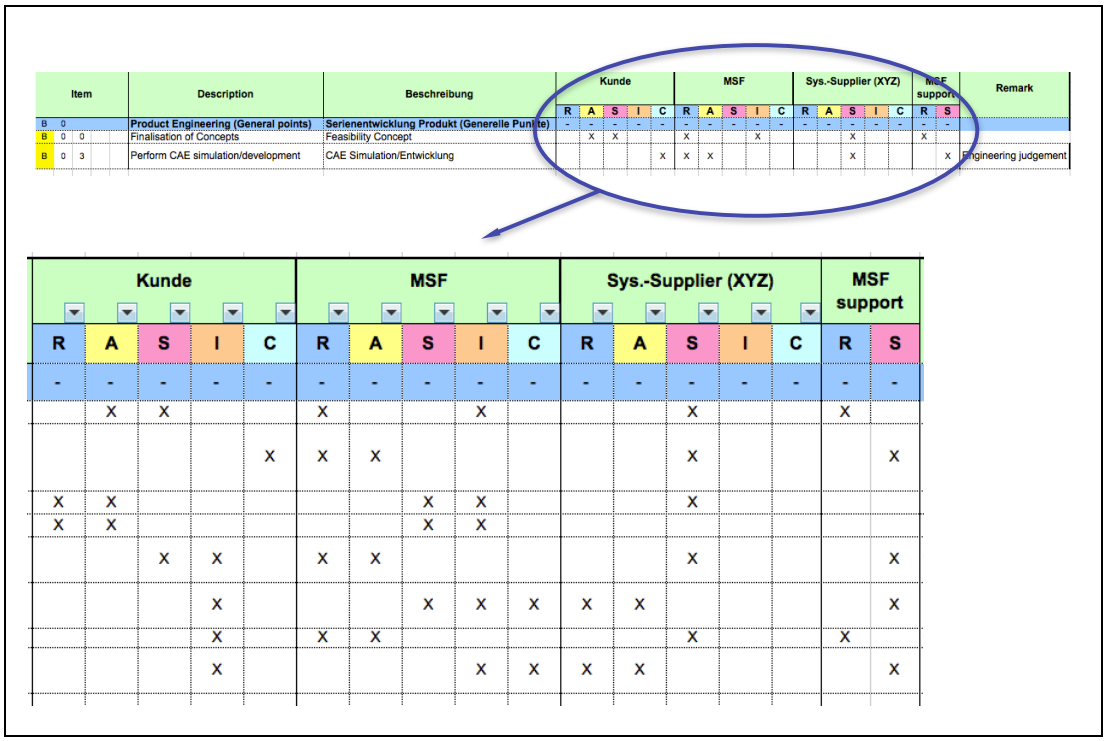


Figure 4.15: Overview and Detail of the Interior Department's RASIC-Chart (Wiesbauer, 2010, p. 1)

In addition to the RASIC columns, the table has additional columns for the item number, the description in English, the description in German and one for remarks. Main tasks needed for a project are stated in rows. Every member of the cooperation has a column for Responsible, Approval, Support, Information and Check. The member's responsibility for a given task is indicated with an X.

The RASIC of the Interior department shows the cooperation for the whole project. This makes it very complex. Normally, there are four parties involved in a project: the customer, MSF, system suppliers and the MSF support. The package vendors are represented by the MSF support. The RASIC is very helpful for an overview of the whole project as well as all the interfaces.

4.8 Analysis of the As-Is Situation

For the analysis of the as-is situation the frustration and the time lens are used (see section 3.5.4). Since the main input for the processes is working time, costs can also be estimated. To do so, the outcome of the process time analysis is multiplied by an approximated hourly rate.

4.8.1 Frustration Lens

The frustration lens had a huge impact on identifying problems within the process. Process participants were asked about things that frustrate them. This was done during the mapping process as well as after the model was completed. The number of problems that were brought up was quite high. Consequently, only frustration factors that are within the scope of this thesis were considered. The remaining ones were then investigated further. The findings with the biggest impact are displayed in section 4.8.3.

4.8.2 Time and Cost Lens

In addition to the frustration lens, the time lens was used. The following process participants were asked to estimate the time for process steps within their area: the head of the Interior department, the head of the procurement department, the group leader of the project management team as well as employees from the project management and Body & Trim Assistance.

If someone had a problem with approximating the duration of an activity, he was asked to state a minimum and a maximum. Afterwards, it was easier for them to estimate an average process time. Both the process time and the cycle time were recorded for the time lens.

The detailed overview of the process and cycle times can be found in Appendix D. There is a table for each of the sub processes. Process WO-03-AI and WO-04-AI are together on one sheet as they are both needed for the payment process. The following columns are used:

- *Process Step:* Process step number and process description
- *Probability:* Probability that the process step is executed
- *Employees:* Number of employees involved in the process step simultaneously
- *Duration ø:* Estimated process time by the process participants
- *Duration Total:* Probability x Employees x Duration ø
- *Cycle Time ø:* Process participants' estimated cycle time
- *Cycle Time Total:* Probability x Cycle Time ø
- *Department:* The department performing, or responsible, for the process step

Table 4.3 shows the result of the time analysis. For the time capture process (WO-03-AI) only the cycle time for some of the process steps is estimated. The Body & Trim Assistance and the project management (EAP-K) parts of the process are independent of each other. The EAP-K part must be performed by the end of the month. It is executed at the same time, all together, for all work orders. The cycle time for the invoice handling process varies. Cycle time is not an issue for this process, since payment is not settled before the end of the month.

Process	Process Time [min]	Cycle Time [days]
Work Order		
Procurement Process (WO-01-AI)	227.50	15
Initiation of Outsourcing (WO-02-AI)	124.50	9
Time Capture Process (WO-03-AI)	61.75	-
Handling Invoice (WO-04-AI)	33.00	-
Work Package		
Procurement Process (WP-01-AI)	5,390.00	46
Initiation of Outsourcing (WP-02-AI)	192.00	9.5
Handling Invoice (WP-03-AI)	75.00	-

Table 4.3: Result of the Process and Cycle Time Analysis

The time analysis confirms that the procurement process for work packages needs considerablly more administrative effort than the one for work orders. The process time required to order one package is nearly 24 times the one of work orders.

Process Costs

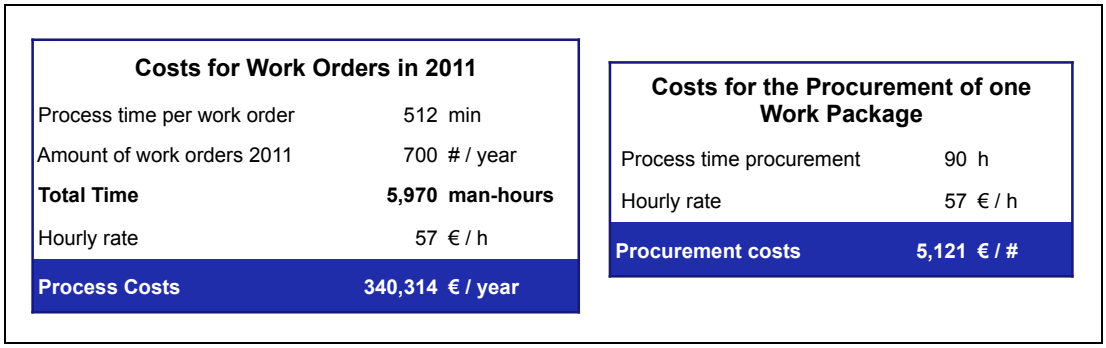
The process time, which was estimated during the time analysis, can be used to calculate rough process costs. An average work order lasts three months. Hence, the total amount of time usually spent for a work order can be calculated as illustrated in Formula 4.1.

$$Total\ time\ per\ work\ order = Procurment + 3 \times (Time\ capture + Handling\ invoice)$$

Formula 4.1: Total Time Spent per Work Order

This results in a total process time per work order of 511.75 min. In 2011 there were, all in all, approximately 700 work orders, which results in costs of 340,314 Euros at an hourly rate of 57 Euro per hour (see Figure 4.16). When work orders are performed at the MSF premises the costs per work order are

much higher. The reason for this is that internal infrastructure is needed, which needs to be arranged.



Costs for Work Orders in 2011		
Process time per work order	512	min
Amount of work orders 2011	700	# / year
Total Time	**5,970**	**man-hours**
Hourly rate	57	€ / h
Process Costs	**340,314**	**€ / year**

Costs for the Procurement of one Work Package		
Process time procurement	90	h
Hourly rate	57	€ / h
Procurement costs	**5,121**	**€ / #**

Figure 4.16: Estimated Process Costs (Own Illustration)

The procurement costs for one package is calculated (Figure 4.16). To do so, the process time is multiplied with an hourly rate. The result shows that the procurement of one work package costs 5,121 Euros.

4.8.3 Findings for Work Orders

Several frustration factors were identified during the as-is analysis. This section describes the most important ones for work orders.

Cycle Time

The process for the procurement of work orders takes too much time. As a result, the suppliers sometimes have to provide the service in advance. Consequently, there are costs but no order. One of the reasons for long cycle times was the board of directors' loop (WO-01-AI process step 15-18). This loop was cancelled after the first checkpoint presentation of this thesis. It slowed down the process considerably. Due to the fact that it was not integrated into Freeflow, Body & Trim Assistance was unable to check the status. Now, the loop is integrated into Freeflow. Between process steps 13 and 14 the general manager of the Engineering Center Graz has to release the work order.

Information / Data not Forwarded or Incorrect

Process participants do not always receive all the information and data they need to perform a process step. In such cases, they have to request such

information from other process participants. This takes time and slows down the process. Sometimes, the input received is incorrect. In such cases, process participants are forced to clarify things. Employees cited several times that if everything were clear their process steps would be quite short. However, in many instances that is not the case.

Examples for such instances are identified as follows:

- Information forwarded to create work order is not complete
- Time sheet is not forwarded to Body & Trim Assistance and EAP-K
- Allocation account number is incorrect
- Not enough coverage of the account
- Infrastructure and ID-card is not always requested by the Body & Trim department

Excel Files

There are many Excel files with the same purpose and similar data. Some department heads, the Body & Trim Assistance, the project management, the project controlling and the procurement departments have an Excel file with all work orders. They need these files to keep track of the work orders.

Freeflow is Static

Freeflow is an automated workflow and speeds up the release process for work orders as well as purchase requisitions. However, this system is static and has no database. Consequently, it is not possible to use it for tracking or to request information. This is the reason for the need of the Excel files. The procurement department further complained that Freeflow is too slow.

4.8.4 Findings for Work Packages

The as-is analysis of the work package processes resulted in the identification of a number of problems within the processes.

Tracking is Difficult

Tracking the status of work packages is difficult and demands considerable effort. At the moment, there is no database that contains the data of all work packages. As a result, tracking and monitoring is only possible by asking various process participants. This consumes a substantial amount of working time. At the moment, the Interior and the Exterior department keep a list of all work packages in their departments. However, the information saved in these files is quite limited.

Decision Finding

After the negotiations a decision has to be made for one of the suppliers. This decision is mainly based on the experience of the Body & Trim department heads. The procurement department head stated that he feels that the Body & Trim department heads are sometimes biased. It seems that they have favourites and do not really consider others. In his opinion, any one of the suppliers, chosen in step 9 of the procurement process, should have a chance at winning the order. The bidder list gives an overview of all the quotes and assists in the decision finding process. The head of the Interior department stated that this list is not always forwarded to him. Therefore, he creates his own overview sheet for quotes.

Project Management Not Involved

The project management department bears the cost responsibility for projects. However, it is not always completely involved in the procurement process of engineering activities. Sometimes, it is not informed about outsourcing. The same is true for the invoice handling process. The project management department has to monitor the projects. It has to be able to inform the functional department head about the status. At the moment, monitoring work orders and work packages is difficult and is very time consuming.

Request for Quotation

The RFQ for work packages is similar but not standardised. It is probably the most important element for outsourcing in the form of work packages. A detailed and understandable description is needed to ensure that the right thing is quoted, quotes from different suppliers are comparable and sharing

of risk is possible. The head of the procurement department stated that the RFQ part of the Body & Trim department should only contain specification of services. The Body & Trim department heads sometimes include legal sections in the RFQ. They want to make sure that suppliers comply with the RFQ. This could result in the exact opposite happening. Such legal sections could cause the voiding of the procurement part of the RFQ. The procurement department head further pointed out that the legal framework is handled by his part of the RFQ. He stated that sometimes only two out of five given quotes comply with the RFQ in the first submission.

Failure of Work Packages

The Body & Trim departments have experienced failures and complications with outsourcing in the form of work packages in the past. This can cause severe problems and result in extensive costs. Consequently, the risk of failure in outsourcing must be minimised.

4.9 Developing the To-Be Process

This thesis proposes a set of measures that can help MSF to improve the processes for outsourcing engineering activities. The suggested changes are applied to the as-is process in order to create a to-be process.

4.9.1 Measures Used to Create the To-Be Process

Several measures are used to create the to-be process (see Figure 4.17). The suggested actions outlined in this section are based on the literature research and the process analysis performed.

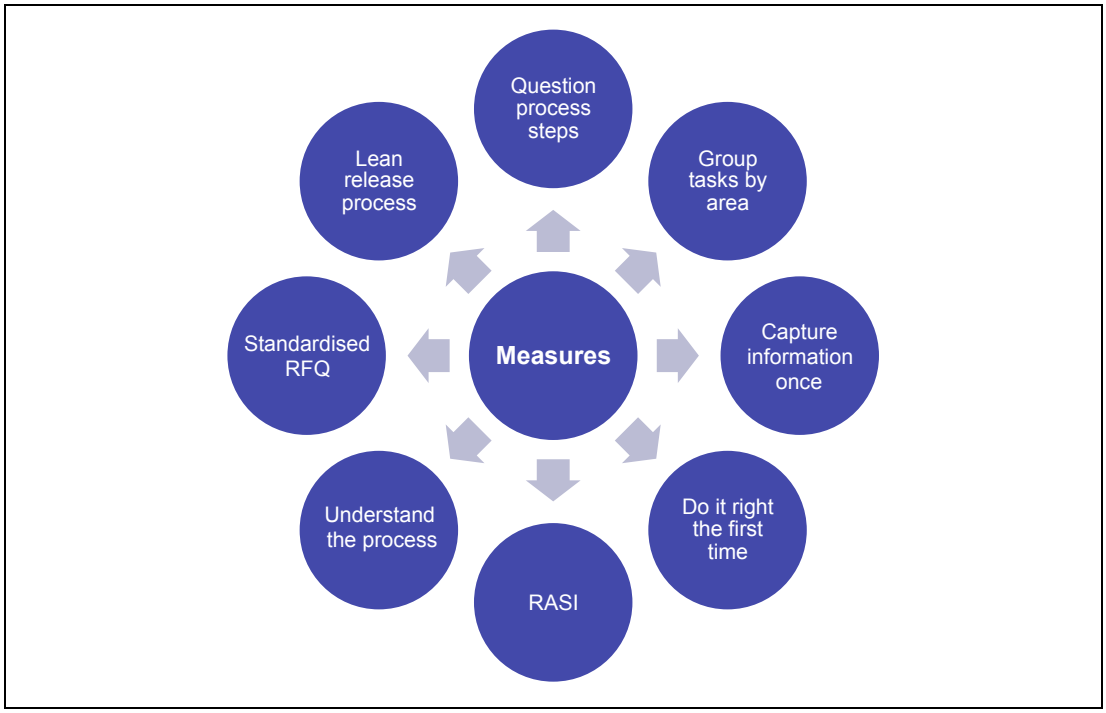


Figure 4.17: Measures for the To-Be Process (Own Illustration)[1]

The measures are explained in more detail in the following paragraphs.

Question Process Steps

Every single process step of the as-is process is questioned as to its necessity. Only process steps that add value are kept. Furthermore, the question of whether the right person performs the activity is asked. The process participant who is most suitable for the process step should perform it.

Group Tasks by Area

One of the main problems for outsourcing in the form of work orders is that the cycle time of the procurement process is too long. Therefore, the order of the activities is questioned. A process participant should perform as many tasks as possible before the process moves on to the next one. When the process flow changes, from one process participant to another, it always costs time. This is even worse for organisational units. Employees are responsible for many tasks. So the part of the outsourcing processes within

[1] Considerations based on (Madison, 2005, pp. 151-162)

their responsibility represents just a small fraction of their duties. They are usually not able to perform the process activities immediately upon receipt of the input. Hence, there are waiting times. Grouping the tasks by area can reduce these waiting times.

RASI

For each process step RASI, i.e. responsible, approval, support and information, is stated. This ensures that the responsibilities within the process are clear. The as-is analysis showed that participants do not always get the necessary input or are not properly informed about the status. By visualising RASI this can be prevented.

Lean Release Process

Currently, both work orders and purchase requisitions need to be released by several authorities. This prolongs the cycle time considerably. There should be clear orders for the decision from top management. However, people who have the most information should make the decision.

Madison states that the decision should be pushed down to a level where the work is actually performed. If decisions are reviewed multiple times, there is less incentive for a high quality decision the first time. (Madison, 2005, p. 155)

Capture Information Once

The same data is required at several process steps. At the moment, there is data redundancy and several process participants gather data. Information should only be captured once, at the source, and then shared. This also eliminates a source of mistakes. If there is data redundancy, there is also the risk that the data is inconsistent.

Do it Right the First Time

The to-be process is designed in a way that ensures that activities are performed right the first time. This helps to save resources and shorten the cycle time. The time needed to correct problems can be extensive.

Understand the Process

Every process participant should have an idea of how the process works. It is necessary that he realises interdependencies. This enables employees to perform their tasks right the first time. Process maps help to gain a better understanding about the process. At the beginning of this thesis employees of the Body & Trim department had only limited knowledge about who does what in the outsourcing process.

Standardised Request for Quotation

The RFQ for work packages should be standardised within MSF. RFQs are not always the same and their content depends on the work package. However, it is possible to standardise the structure as well as several of its elements. This enables suppliers to understand it more easily. If it is always structured in the same way, the vendors become familiar with it. Furthermore, it takes less time to create one. Process participants know exactly what they have to write into the RFQ and large parts are pre-written. The parts that have to be included need to be clearly stated. Care must be taken to prevent the content of the RFQ being contradictory, e.g. technical and purchasing side. In addition to the RFQ itself, the attachments also need to be standardised. There should be only one type of interface agreement. The one used by the Exterior department seems more suitable for the procurement process. It should be kept as simple as possible, so as to foster understanding of the RFQ. Consequently, the chances that the quotes are in conformance with the RFQ are higher. For cooperation during the project, a RASIC chart like the one from the Interior department should be used. To create such a uniform RFQ, the current ones should be analysed and combined. It is important to also involve the procurement department in this process.

4.9.2 Assisting Tools

A failure of the outsourcing initiative can cause considerable costs as well as severe problems, e.g. customer dissatisfaction. This is especially true for outsourcing in the form of packages, because they have a higher impact than work orders. A number of assisting tools such as utility analysis, risk analysis

and supplier database are proposed for the procurement process, which would be helpful in preventing failures.

Utility Analysis

To create a more objective decision finding process for outsourcing in the form of packages a utility analysis (see Figure 4.18) is proposed. During the interviews the most important criteria for choosing a supplier were identified as:

- Cost: The price for the package as well as administrative and transaction costs are considered
- Competence: How capable is the supplier of providing the package?
- Communication: How good is the communication between MSF and the vendor? Are there existing interfaces? What do they look like? Are the organisational cultures compatible? Are there language problems?
- Know-How spillover: Is it likely that the supplier will use the knowledge gained for his own products or competitors? Is there a chance that the supplier will go directly to the OEM?
- Adherence to Schedules: Will the vendor be able to meet the schedules? If residents are needed, it takes time to apply for a visa.

Criteria	Weight	Supplier A		Supplier B		Supplier C	
		Degree of Fulfilment	Total	Degree of Fulfilment	Total	Degree of Fulfilment	Total
Cost	20	9	180	6	120	3	60
Competence	30	5	150	8	240	4	120
Communication (Interfaces, Culture...)	20	9	180	5	100	7	140
Know-How Spillover	10	1	10	4	40	3	30
Adherence to Schedules	20	4	80	9	180	4	80
Total	100		600		680		430

Figure 4.18: Utility Analysis for Outsourcing in the Form of Packages (Own Illustration)

All criteria have to be evaluated according to its degree of fulfilment for each supplier. The degree of fulfilment is represented by a number between one and ten. Whereby, ten indicates that the supplier fulfils the criteria to 100 per cent. One stands for a very bad performance. For each criterion, a weight factor is chosen. The values from Figure 4.18 are just suggestions. The total amount of points for one criterion is the product of the weight factor and the degree of fulfilment. The highest amount of points a supplier can reach, in total, is 1000.

This utility analysis should only be used as an assisting tool. It helps to find a more objective choice. However, the department head makes the final decision about which supplier should be recommended.

Risk Analysis

The risks for outsourcing packages to a given vendor should be evaluated. To do so, a risk analysis is proposed (see Figure 4.19). Possible risks are identified and both their severity and probability is rated. The risk factor is calculated by multiplying the severity and the probability. Actions to lower the risk can be suggested.

Risk Analysis							
Supplier: Supplier A	**Project: xxxx**				**Date: xx.xx.xxxx**		
Risk	**Severity**	**Prob-ability**	**Risk Value**	**Recommended Actions**	**New Severity**	**New Prob-ability**	**New Risk Value**
Language problems	7	9	63	Resident at MSF	7	5	35
Missing know-how	8	7	56	Support by MSF	8	3	24
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.

Figure 4.19: Risk Analysis (Own Illustration)

The recommended model is based on a Failure Mode and Effects Analysis. It can help to prevent problems in choosing the right supplier for outsourcing.

Supplier Database

There should be a lessons learned session after each outsourcing project. During such a session, the suppliers are rated according to their performance. The same criteria proposed for the utility analysis could be

used for assessment. The result of the lessons learned, as well as the supplier evaluation, should be saved in a supplier database. This database acts as an important input for future outsourcing initiatives.

4.9.3 IT-System for Outsourcing Engineering Activities

Many of the problems identified in the as-is analysis could be eliminated by an IT-System. At the moment MSF is using Freeflow to assist with outsourcing of engineering activities. Unfortunately, this system does not support queries or reports. Hence, Freeflow cannot be used for tracking and monitoring. Many of the process participants stated that they would like to be able to monitor work orders and packages more easily. Before MSF had Freeflow, the work order and purchase requisition form was filled out manually and then handed from one authority to the next for releasing. Freeflow now makes this much easier. However, it is not the ideal way. At the moment, the work order and purchase requisition forms are still filled out manually. They are scanned, put into Freeflow and released by pressing a button. Since the forms are no longer signed, there is no reason to still keep them. It takes time to fill them out, print, scan and archive them. This thesis proposes using an IT-system which assists in the process for outsourcing engineering activities. In order to enable smooth and lean outsourcing processes such an IT-system must fulfil several requirements (see Figure 4.20).

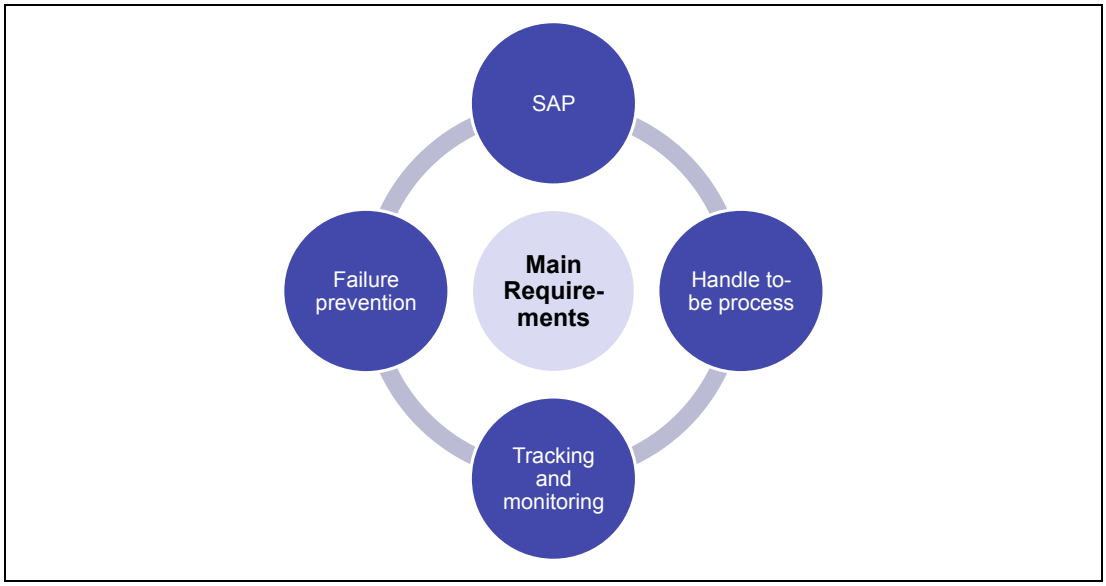


Figure 4.20: Main Requirements for the IT-System (Own Illustration)

SAP

The procurement and the controlling department use SAP. The system should be compatible with, or integrated into SAP, in order to avoid an isolated application. Otherwise, there will be additional effort expended getting the data into SAP. Furthermore, it cannot be guaranteed that the data is up to date. The system needs access to the hourly rates of suppliers as well as the allocation account numbers.

Handle To-Be Process

The system must be able to handle the process visualised in section 4.10. Some of the process steps are automated. This helps to save costs and time. The system automatically forwards information to process participants who need it.

Tracking and Monitoring

Tracking and monitoring of work orders and work packages must be possible. To do so, all the data concerning work orders and work packages needs to be saved in the system. It must be possible to display the data for a single order, as well as to filter it by several criteria, e.g. department and time frame. Furthermore, it should be possible to create reports about the cycle times. The system has to show the actual status of each work order and work package. The procurement process needs to be able to see which process step a work order or work packages is in at any given moment.

Failure Prevention

The system must have failure prevention mechanisms. If something is missing or incorrect, the system detects this and alerts the user. At the moment, the allocation account number is quite often wrong or does not have enough coverage. To avoid this, the system must check the allocation account number.

4.10 To-Be Process

The combination of all measures proposed in this system resulted in the to-be process. The layout for each of the to-be sub processes is the same. The following columns are used:

- Input: Input that is of importance for the process step
- Process: The process flow itself
- Output: Output that is of importance for the process step
- Responsible (R)
- Approval (A)
- Support (S)
- Information (I)

Neither the input nor the output is displayed for every process step. This helps to keep the model easy to read. Within the process models, abbreviations for the departments and other involved parties are used (see Table 4.4).

CI	Procurement department
EA	Functional department Body & Trim
EA Ass't.	Body & Trim Assistance
EAP	Project Management department
EAP-K	Sub area of EAP; Steering of the functional department
EAx	One of the departments of the EA departments
ECK	Project controlling
GM	General Manager Engineering Center Graz
ML	Module leader
PL	Project leader
Proj.	Project
SE-TL	Simultaneous-engineering team leader
Sup.	Supplier
Sys.	The proposed IT-system
/	Or = one of the stated parties
.	And = all stated parties

Table 4.4: Abbreviations Used in the Process Models

Table 4.5 shows an overview of all to-be sub processes. Next to the name of the sub process, the process number is displayed. It consists of three parts. The first one indicates the form of outsourcing, i.e. work order (=WO) or work package (=WP). The second one is a consecutive number and the last one points out whether it is the as-is (=AI) or the to-be (=TB) process.

Work Order		Work Package	
Procurement process	WO-01-TB	Procurement process	WP-01-TB
Initiation of outsourcing	WO-02-TB	Initiation of outsourcing	WP-02-TB
Time capture process	WO-03-TB	Handling invoice	WP-01-TB
Handling Invoice	WO-04-TB		

Table 4.5: Sub Processes Analysed in the To-Be

In the following sections, the processes for work orders, as well as work packages, are displayed. After each section with process maps, a section with explanatory notes follows. These notes help to better understand the process charts.

4.10.1 The Process for Work Orders

The to-be processes for work orders are considerably leaner than the as-is ones. They take up less process- and cycle time. This is possible thanks to an optimised order of the process steps. Furthermore, several as-is process steps are eliminated and some are automated. The built-in failure prevention avoids unnecessary loops.

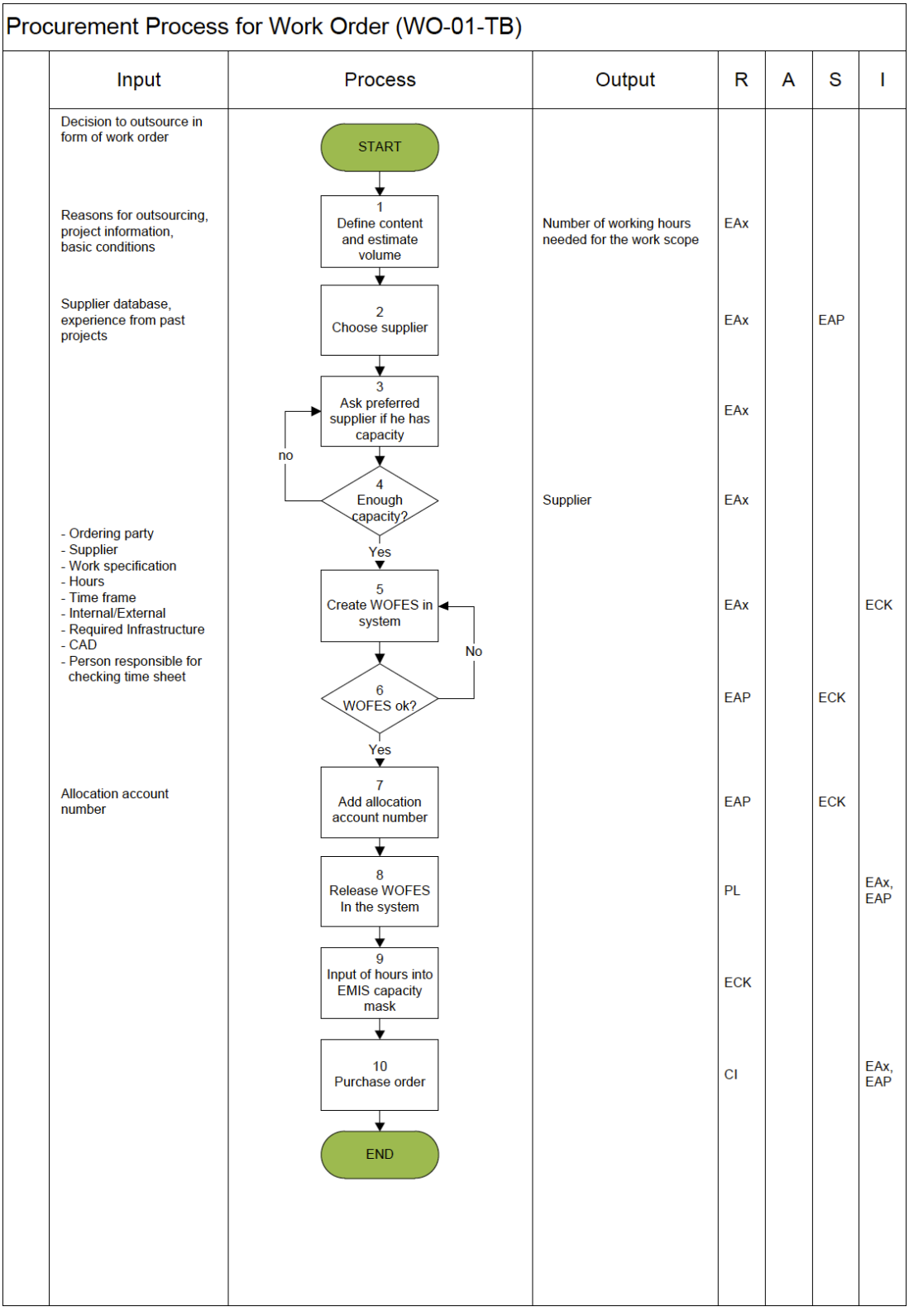


Figure 4.21: To-Be Procurement Process for Work Orders (Own Illustration)

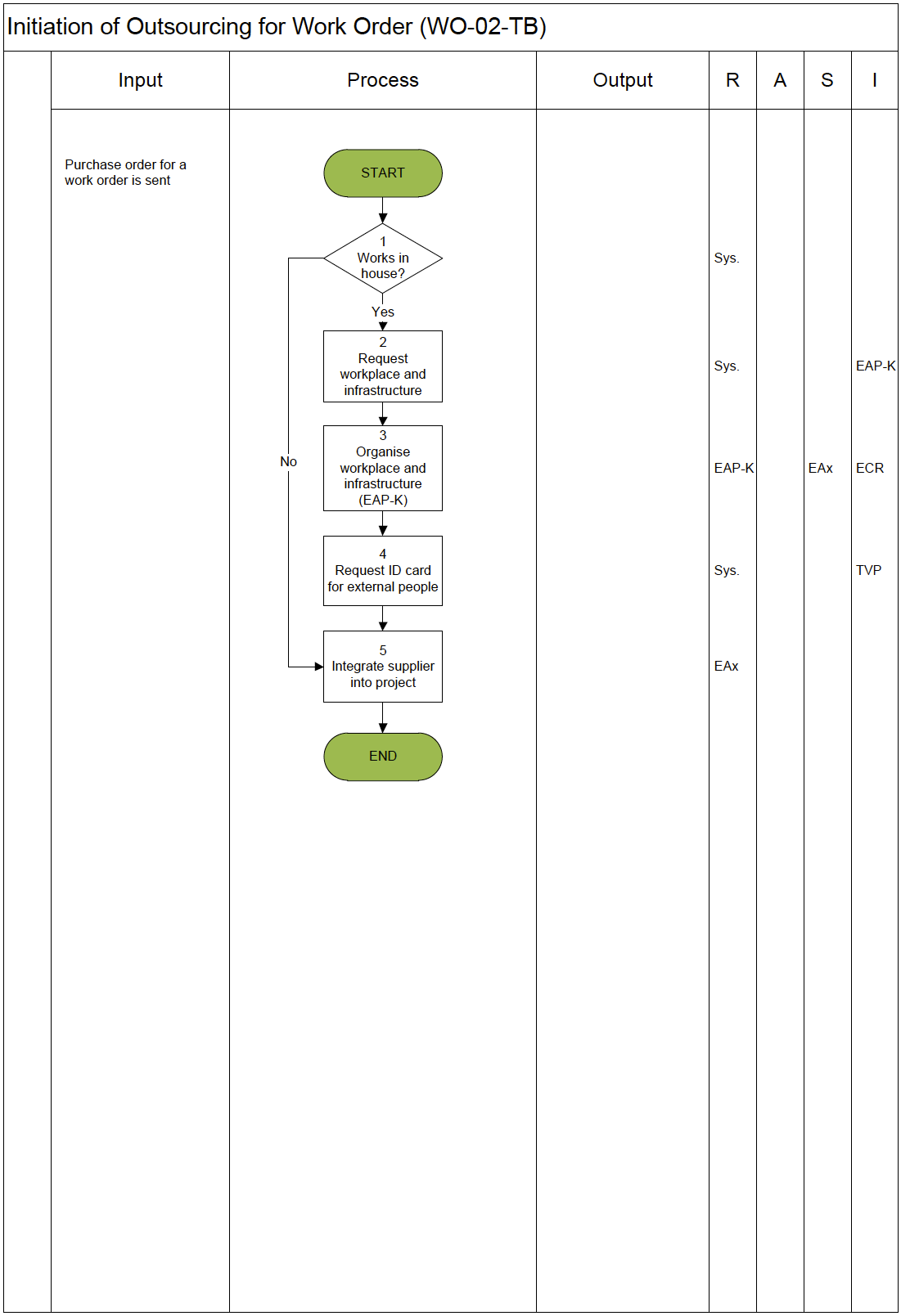


Figure 4.22: To-Be Initiation of Outsourcing Process for Work Orders (Own Illustration)

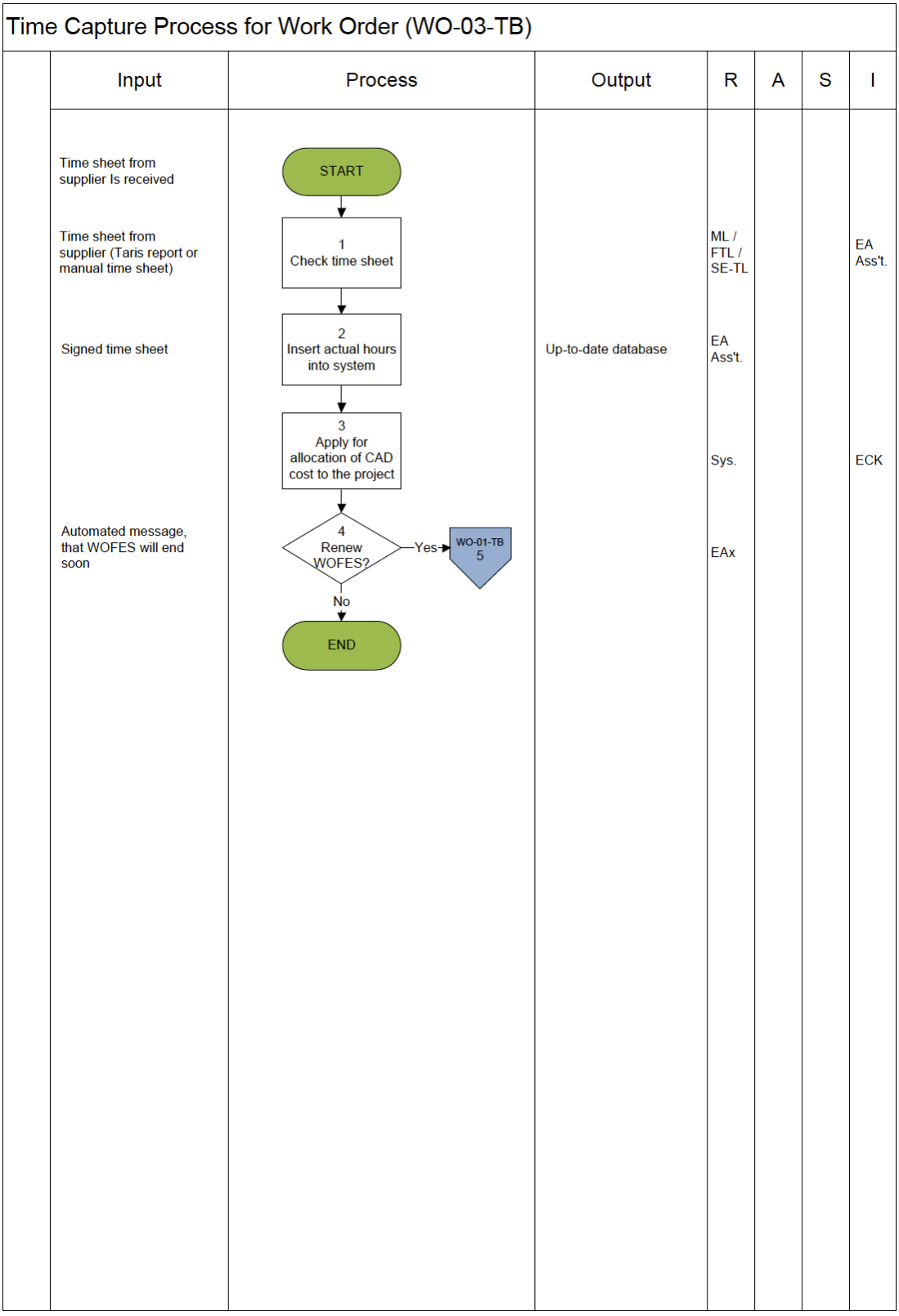


Figure 4.23: To-Be Time Capture Process for Work Orders (Own Illustration)

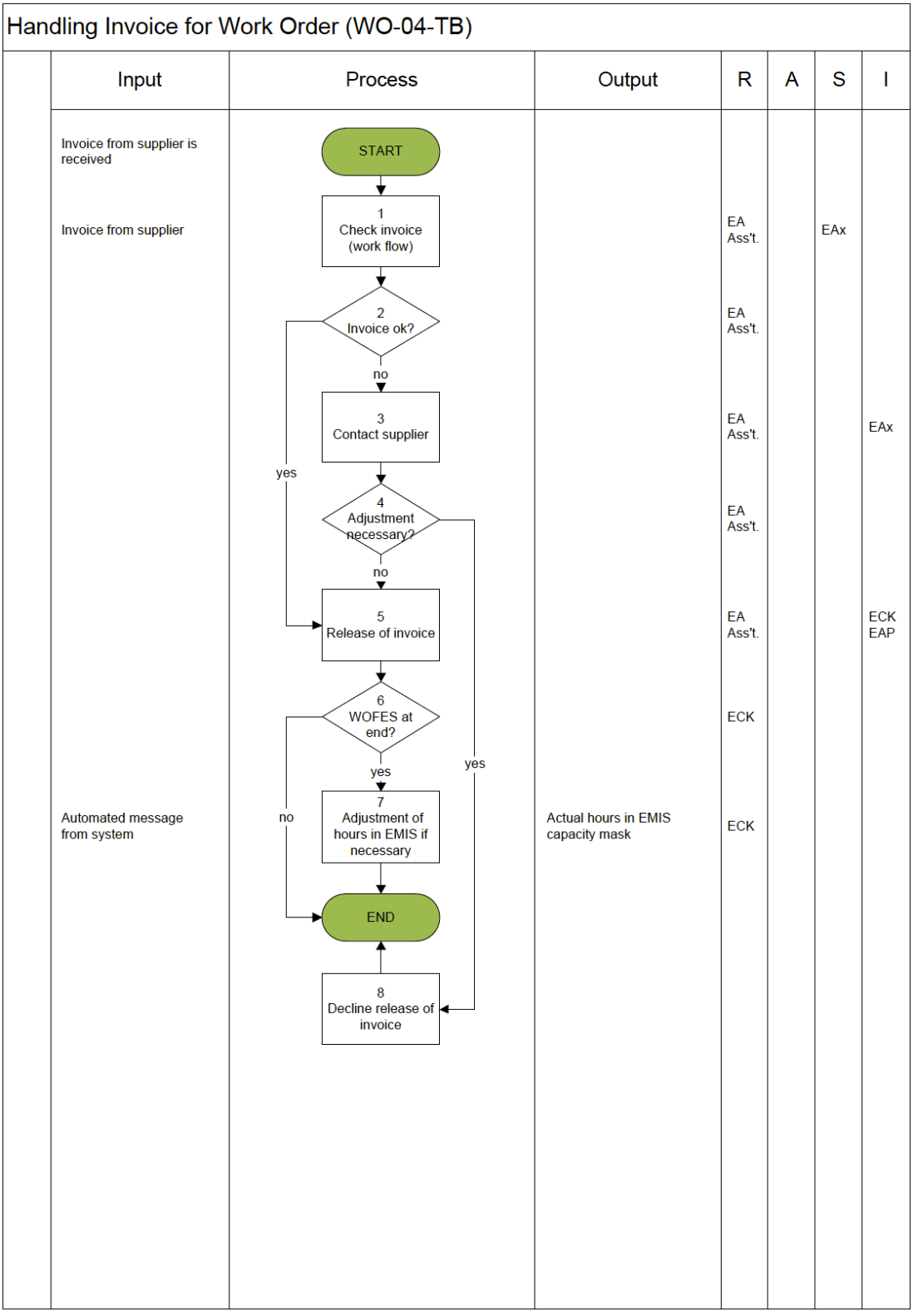


Figure 4.24: To-Be Invoice Handling Process for Work Orders (Own Illustration)

4.10.2 Explanatory Notes for the Work Order Processes

In the following section, additional information for the work order sub processes will be given. The information is labelled with the process step number. Only process steps that need further explanation are mentioned, hence, the numbering is not consecutive.

Procurement Process – WO-01-TB

5. *Create WOFES in the System*
   It makes more sense to create the work order directly at the EAx department. Forwarding all the necessary information involves the same effort for EAx as typing it into the system. Moreover, a possible source of errors is eliminated in this way.

6. *WOFES ok?*
   The EAP department checks, whether the work order is in order from its point of view, since it bears the cost responsibility for projects.

7. *Add allocation account number*
   When everything is in order, EAP requests an allocation account number at ECK. This ensures the correct allocation account number for work orders. The system should automatically check whether there is enough coverage. As a result, later checks are not necessary and there is no additional effort due to incorrect allocation account numbers.

8. *Release WOFES*
   Since EAx created the work order and EAP has already checked it, the project leader should be able to release the work order.

10. *Purchase order*
    The person who is responsible for checking the time sheets should be noted on the purchase order.

Initiation of outsourcing – WO-02-TB

The workplace, infrastructure and ID-card for external people are automatically requested by the system.

Time Capture Process – WO-03-AI

2. *Insert actual hours into system*
   The actual hours are directly inserted into the system. Hence, there is no need to keep Excel files. The data can always be looked up in the system.

3. *Apply for allocation of CAD costs to the project*
   This process step is automated within the system.

Handling Invoice – WO-04-TB

The procurement process (WO-01-TB) guarantees that the allocation account number is correct and that there is enough coverage. Consequently, there is no need for ECK to check the invoice.

1. *Check Invoice*
   The invoices are assigned to the right work order by the system. EA Assistance checks to see that both the hours and the hourly rate in the system are in accordance with the invoice.

5. *Release Invoice*
   EA Assistance checks the invoice and should, therefore, also be responsible for releasing it.

4.10.3 The Process for Work Packages

Outsourcing in the form of packages handles huge scopes of projects. Hence, a failure of such an outsourcing initiative can cause considerable damage. The outsourcing process should try to prevent this. There are several tools used within the to-be process to do so. It defines the input, as well as output, for the individual process steps and guarantees a standardised approach.

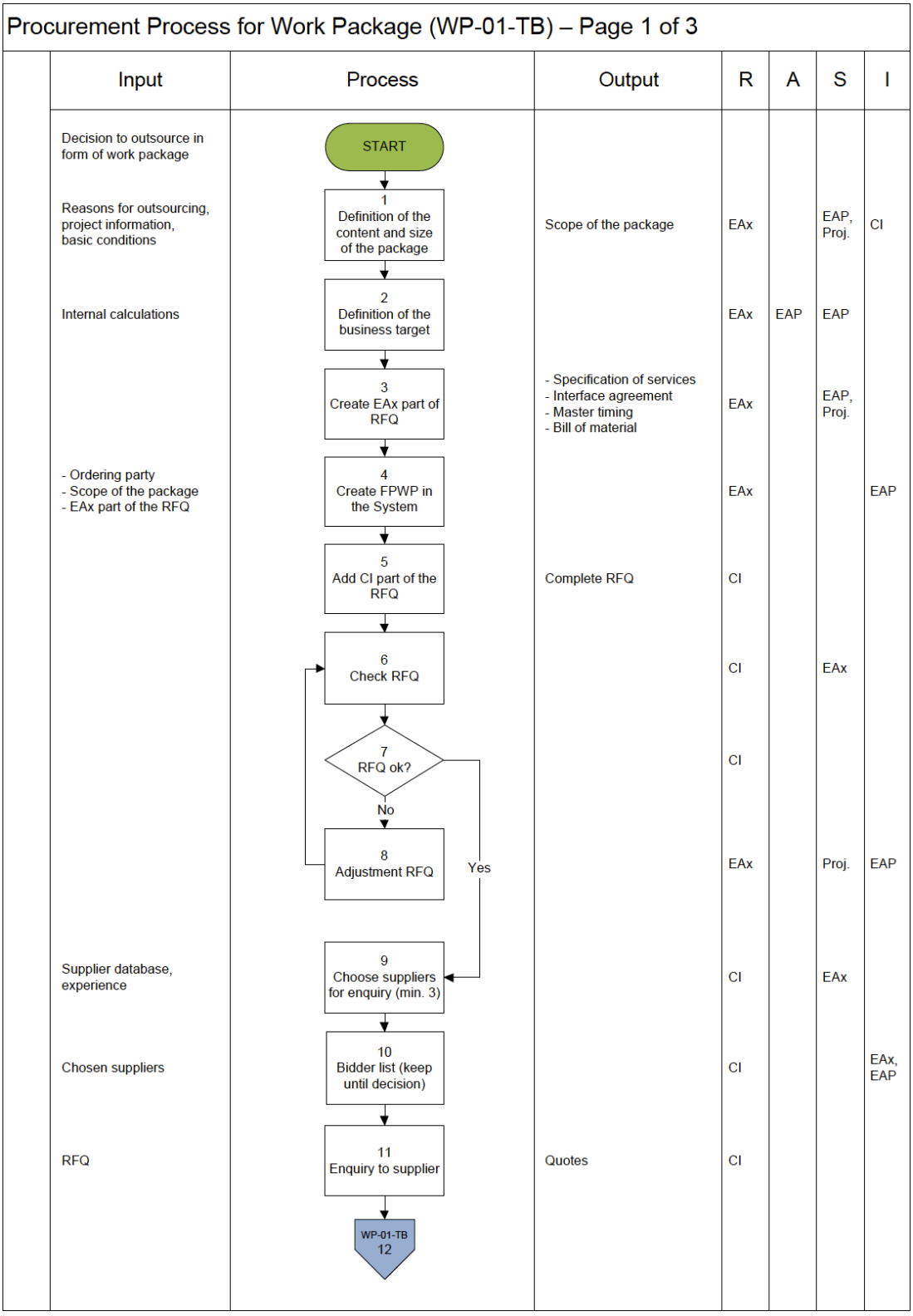


Figure 4.25: To-Be Procurement Process for Work Packages (1 of 3) (Own Illustration)

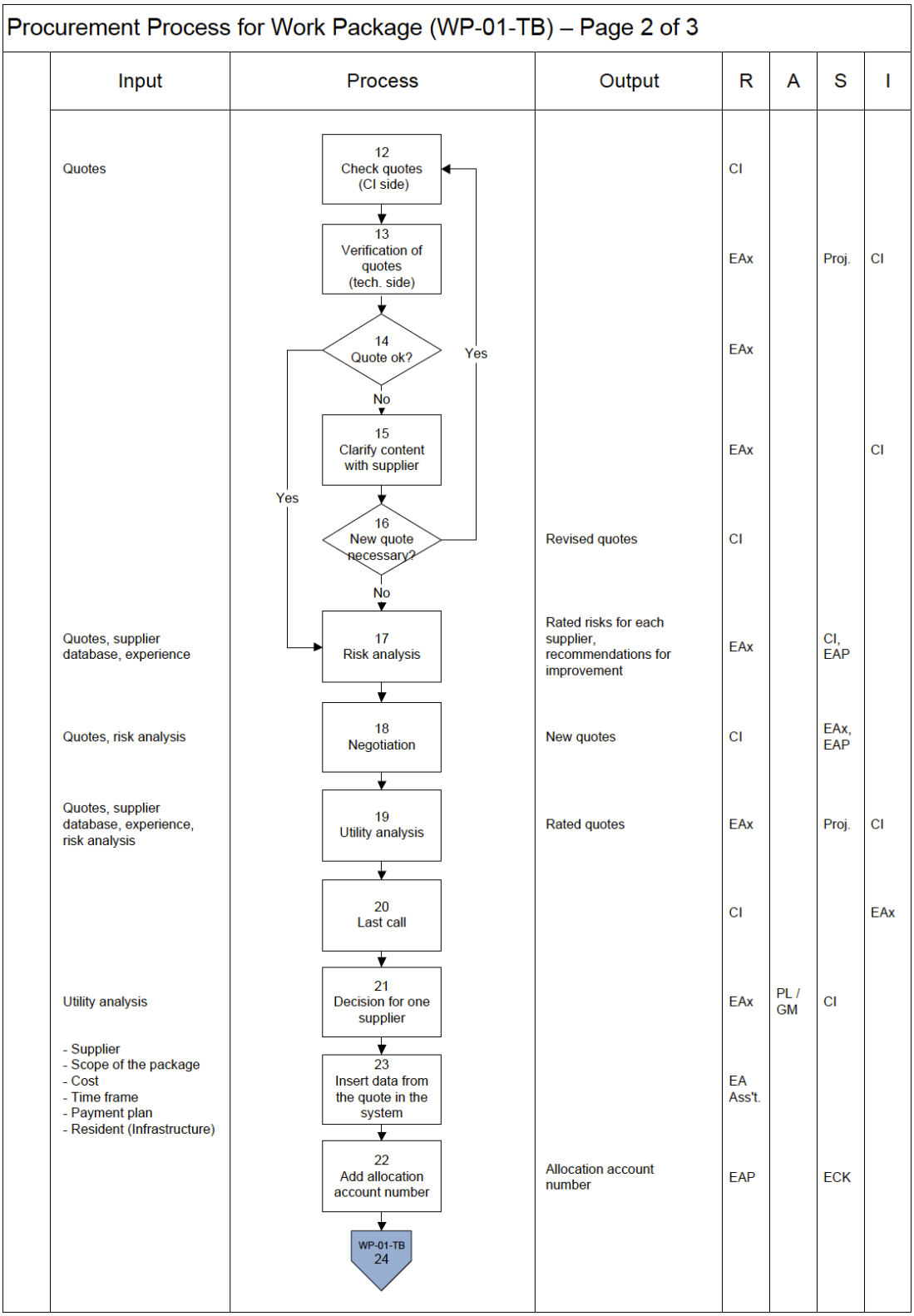


Figure 4.26: To-Be Procurement Process for Work Packages (2 of 3) (Own Illustration)

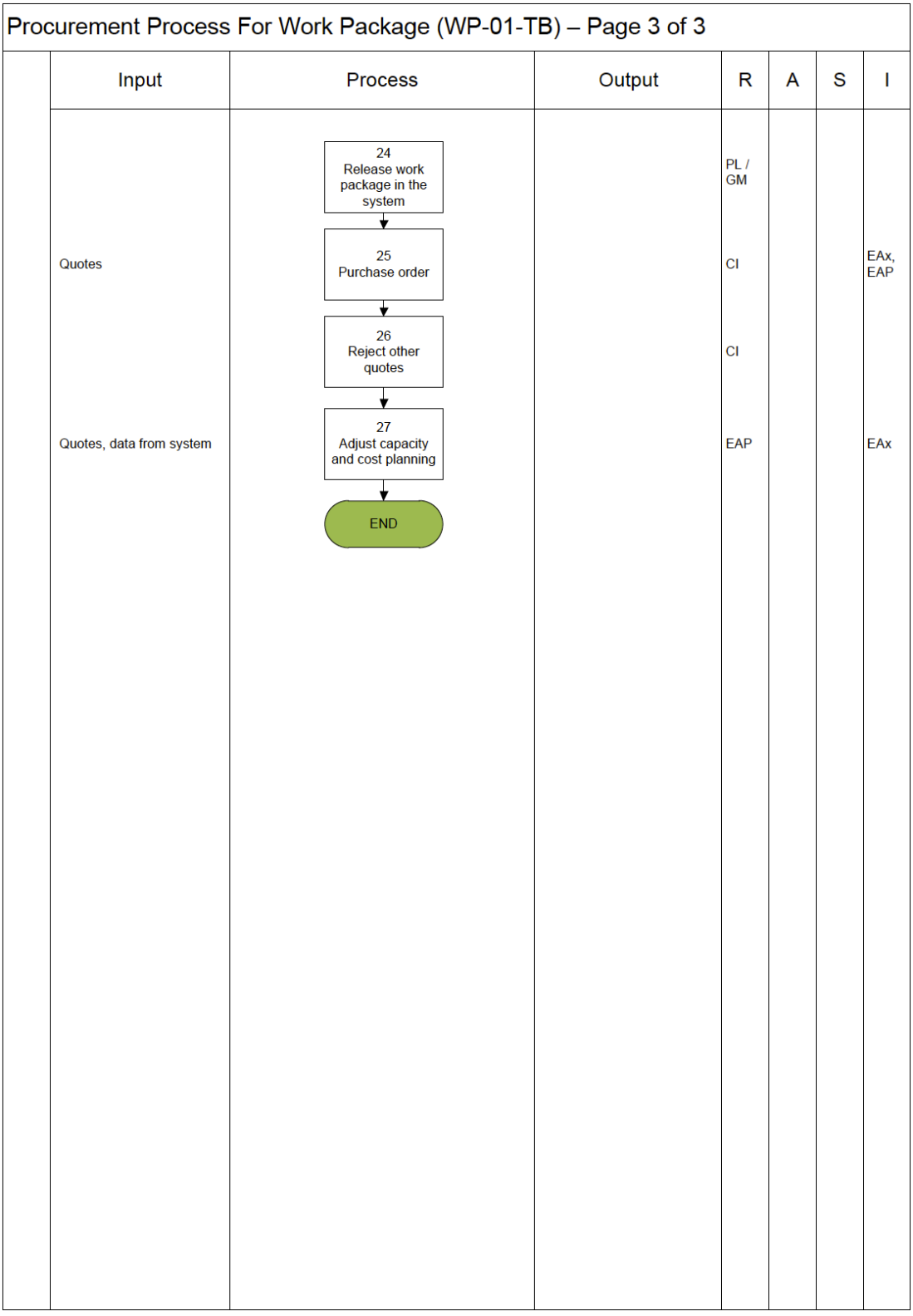


Figure 4.27: To-Be Procurement Process for Work Packages (3 of 3) (Own Illustration)

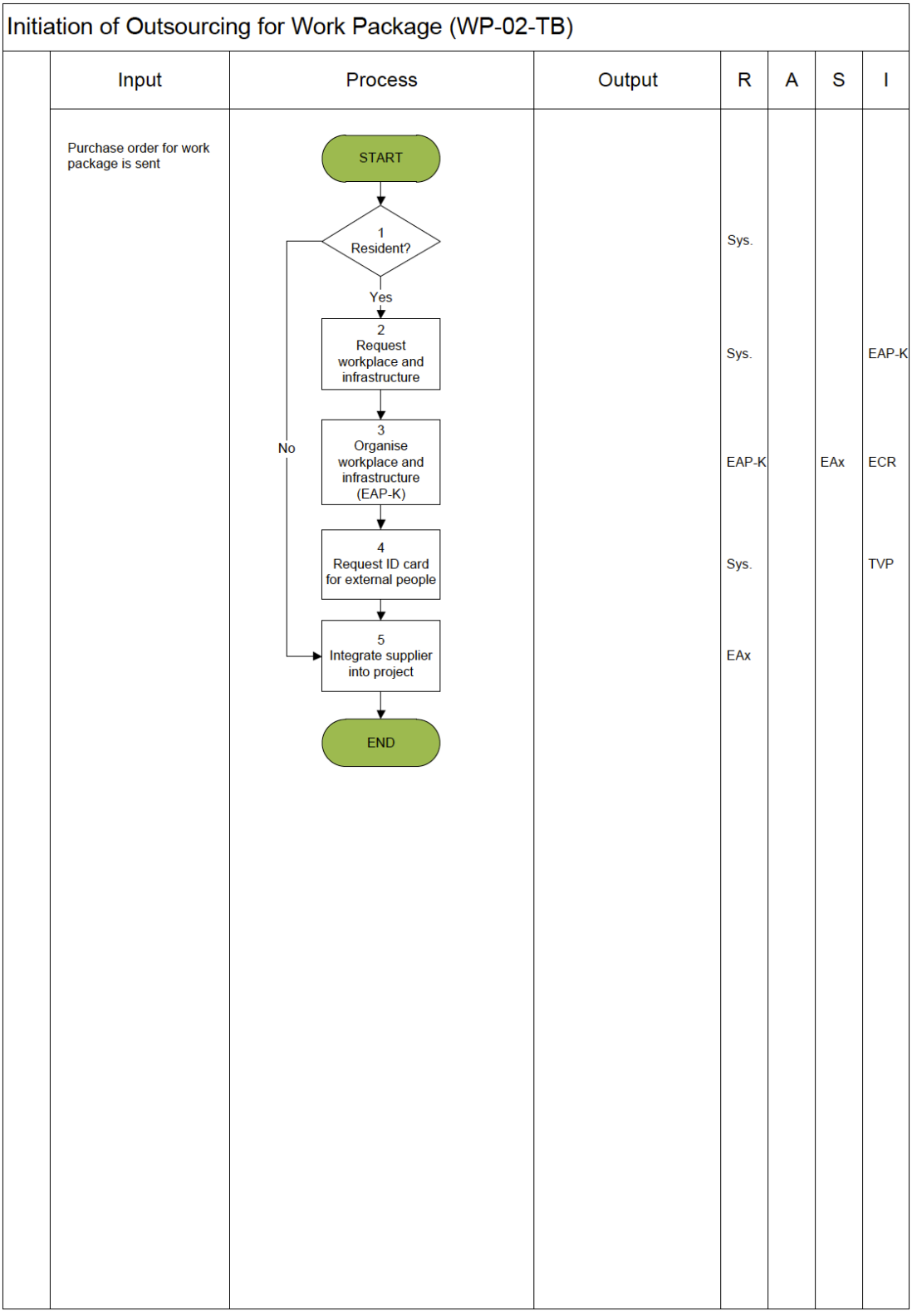


Figure 4.28: To-Be Initiation of Outsourcing Process for Work Packages (Own Illustration)

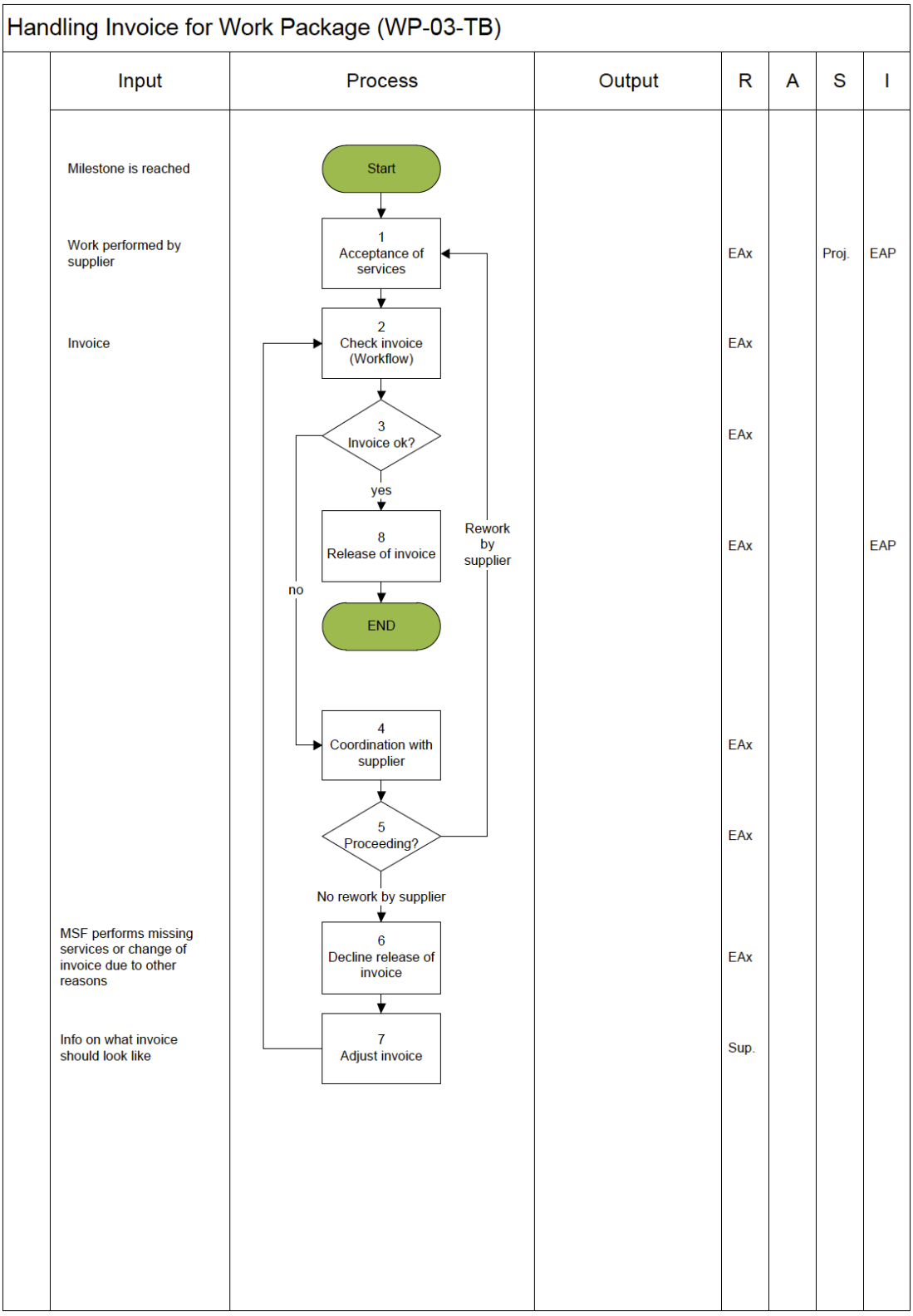


Figure 4.29: To-Be Invoice Handling Process for Work Packages (Own Illustration)

4.10.4 Explanatory Notes for the Work Order Processes

In the following section, additional information for the work package sub processes will be given. The information is labelled with the process step number. Only process steps that need further explanation are mentioned, hence, the numbering is not consecutive.

Procurement Process – WP-01-TB

3. *Create EAx part of RFQ*
   The RFQ is standardised, which enables the process participants to generate it faster and more easily. Furthermore, it guarantees conformance with the CI part.

4. *Create FPWP in the System*
   A work package is created in the system. The information is continuously updated as the process proceeds. The RFQ is uploaded into the system.

9. *Choose suppliers for enquiry (min. 3)*
   The supplier database (see 4.9.2) helps to identify suitable suppliers and enables MSF to draw from past experience.

13. *Verification of quotes (tech. side)*
    Thanks to the standardised RFQ, quotes are more likely to be in compliance.

17. *Risk analysis*
    This step helps to prevent the failure of outsourced work packages. Risks for each supplier are identified and recommendations for lowering these risks are given (see 4.9.2). The EAx department heads are forced to think in detail about the future cooperation with the supplier.

19. *Utility analysis*
    The utility analysis helps the EAx department heads find the most suitable suppliers (see 4.9.2).

21. *Decision for one supplier*
    The EAx department heads recommend one of the suppliers. The final decision lies with the project leader or engineering general manager depending on the size of the work package.

24. Release work package in the system

There is no need for the EAx department heads to release the work order, since they ordered EA Assistance to start the release process in the system.

4.10.5 Remarks for the Implementation

The to-be process is the result of several measures acting together. The proposed IT-system represents a major change which would require a substantial investment. However, it will be necessary to have such a system in the long-term to guarantee an efficient process and enable tracking as well as monitoring. Other measures can be applied quite easily. Start with these low hanging fruits. There is not much effort in implementing them, but they make the process significantly shorter.

One of the proposed changes is to take decisions were there is the most information. If MSF does not want to make such a radical change there could be two types of work orders, i.e. a normal one and an express one. The express process can be used for outsourcing to Engineering Centers. It is very lean and looks like the proposed to-be process. A more thorough release process is used for outsourcing to external suppliers.

Figure 4.30 displays the estimated impact of the changes on the outsourcing process for work orders. The values are based on the time analysis sheet shown in Appendix E. The process costs are calculated in the same way as in section 4.8.2 with an hourly rate of 57 Euros.

	Process Time [min]		Cycle Time [days]	
	As-Is	To-Be	As-Is	To-Be
Procurement process	228	**165**	15	**8**
Time capture process	62	**25**	-	**-**
Handling Invoice	33	**28**	-	**-**

	As-Is	To-Be	
Process Costs	340,314	**215,460**	€ / year

Figure 4.30: Estimated Impact of the Changes on the Outsourcing Process for Work Orders (Own Illustration)

4.11 Conclusion

In this chapter the current situation for outsourcing engineering activities within the body & trim department is documented and analysed. There are two forms for outsourcing development in the Body & Trim department, i.e. work orders and work packages. The former are commissioned in hours and are designed for smaller scopes. The latter, handle large scopes and are commissioned in monetary units. Every process participant basically knows what to do. However, the process is not designed in an optimised way. Process participants only have limited knowledge about what happens outside their own area of responsibility. One of the reasons for this is that the company, as well as the process, has changed over the years. There is no process owner who is responsible for optimising the process. The stated as-is process shows how the activities are executed at the moment. It builds the basis for improvement. The as-is analysis identified several problem areas. Measures are proposed to eliminate these problem areas and a to-be process is developed. This optimised process is considerably leaner and the responsibilities for each process step are clearly stated. It can help MSF to perform outsourcing of engineering activities in a more efficient way and lowers the risk of the failure of outsourcing.

5 Conclusion and Outlook

Today's market is driven by globalisation and increased customer demands. Organisations are forced to shorten their new product development cycle to stay competitive. In recent years, outsourcing of development has become more and more popular. Outsourcing offers a number of opportunities for companies. However, it is also accompanied by considerable risks. Outsourcing initiatives need to be well planned and thought through. This thesis records and analyses the processes for outsourcing engineering activities with the Body & Trim department at MSF. Several problem areas are identified and recommendations for improvement are given. Companies put a lot of effort into the process management of production processes. However, administrative tasks are often not analysed in detail. They often offer a high potential for improvement.

Before this thesis there were no available process models for the outsourcing processes. Process participants had only very limited knowledge about what happens in the other areas of the process. Since there was virtually no documentation about the processes, an extensive number of interviews was required to create an as-is process map. The process model was drawn in an iterative process. Slowly, interfaces between functional areas became clear. It was believed that the way in which the various Body & Trim departments outsourced engineering activities differed. However, this was found not to be true. There are just minor variations. This thesis identified two main types of outsourcing engineering activities at MSF, i.e. work order for external services and fixed price work package. Work orders are used for smaller scopes and are commissioned in hours. Work packages, on the other hand, are used to outsource a major, well-defined scope of work at agreed costs. This thesis shows how engineering activities are outsourced in the Body & Trim department at the moment. The as-is process model forms the foundation for further steps. In order to improve the process for outsourcing engineering activities, MSF has to understand the current situation. The analysis of the as-is processes shows several frustration areas. The processes are not structured in an efficient way and responsibilities are not clearly set. The system currently being used for releasing outsourcing orders is not ideal. Outsourcing in the form of work orders takes too much time and suppliers need to perform services upfront. Information and data is not

always forwarded and there is an extensive amount of redundant data. Tracking and monitoring is essential for work packages. Failure of such outsourcing initiatives can cause considerable damage. However, tracking and monitoring is only possible in a limited way and needs a high expenditure of effort. The Project Management department bears the cost responsibility for development projects but is not completely involved in the outsourcing process. The documents used for an enquiry at the supplier are not standardised. Tools that assist in the decision finding process are limited. In previous years, the Body & Trim departments experienced failures, which resulted in backsourcing of activities.

This thesis proposes several measures to improve the outsourcing process. The processes for work orders are restructured in an efficient and effective way. This enables lower cycle- as well as process times. There is a potential to cut cycle times nearly in half. Assisting tools, as well as failure prevention mechanisms, are suggested for outsourcing in the form of packages. A to-be process is developed with these measures. It enables tracking and monitoring of work orders as well as work packages. The responsibilities for each process step are clearly stated. This thesis can help organisations to improve their outsourcing process.

Outlook

This thesis builds the base for improvement actions. MSF has to decide what further actions it wants to take. If it decides to move on, a process owner for the outsourcing process should be chosen and continuous improvement needs to be ensured. The generated to-be process was not tested in practice. Hence, changes to the process could be necessary when realising it. There should be regular reviews and lessons learned that help to improve the process. Furthermore, policies for when to use which form of outsourcing should be established. For the to-be process, an IT-system that assists the outsourcing processes is proposed. A rough set of requirements for this system is given. However, if MSF decides to proceed, further analysis of the requirements and the general framework for this system is needed. Before implementing it, all other changes should be applied to the processes, so as to see if the proposed process works.

The internal calculation, as well as controlling for projects at MSF, is based on working hours. However, work packages are commissioned in monetary

units. Consequently, the costs for the project need to be converted to working hours in order to be able to consider them in the internal systems. An estimated hourly rate is used for this purpose. This process should be looked into and the way things are done at the moment should be questioned. Further, the issue of what happens to costs savings, which are generated by outsourcing, should be defined. In order to motivate the departments to save costs there needs to be an incentive.

Additionally, the way in which work orders are handled in the Engineering Management and Information System (EMIS) should be investigated. At the moment, commissioned hours are deducted from the project budget after the purchase order. At that time, the working hours are not yet performed. Consequently, the budget stated in EMIS is not the complete budget. To get the complete budget, hours which have not yet been performed but already commissioned have to be added. The hours for work orders displayed in EMIS are planned hours. If the planned hours deviate from the actual hours, an adjustment is made after the completion of the work order. The difference is accounted for in the current month.

6 Abbreviations

BIW	Body in White
BPMN	Business Process Modelling Notation
CI	Procurement department
DH	Department head
EA	Functional department Body & Trim
EAA	Department Integrated Validation
EA Ass't.	Body & Trim Assistance
EAE	Department Exterior
EAI	Department Interior
EAP	Project Management department
EAP-K	Sub area of EAP; Steering of the functional department
EAR	Body in White department
EAT	Doors / Closures / Roof systems department
EAx	One of the departments of the EA (i.e. EAE,EAI,EAR,EAT)
ECK	Project controlling department
EMIS	Engineering Management and Information System
EPC	Event-driven process chain
FFR	Invoice Revision department
FPWP	Fixed price work package
GL	Group leader
GM	General Manager Engineering Graz
ML	Module leader
MSF	MAGA STEYR Fahrzeugtechnik
NDA	Non-disclosure agreement
NPD	New product development
ODC	Offshore Development Centre
OEM	Original equipment manufacturer
PL	Project leader
Proj.	Project
RASIC	Responsible Approval Support Information Check
RFQ	Request for quotation
R&D	Research and development
SE-TL	SE Team Leader
Sys.	The proposed IT-system
WOFES	Work order for external services

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Appendix A

List of Interviews

Interviewee	Date	Department
Roberto Krenn	16.01.2012	EAP
Gerhard Krachler	18.01.2012	EAP
Gerhard Dertzmanek	19.01.2012	EAP
Ralf Masser	19.01.2012	EAP
Anton Scheucher	23.01.2012	EAP
Denise Lakosche	23.01.2012	EA Ass't.
Joachim Wiesbauer	23.01.2012	EAI
Heinz Krendlesberger	30.01.2012	EAT
Gernot Kofler	30.01.2012	EAE
Adolf Ornig	01.02.2012	EAR
Karl Holzmann	01.02.2012	EAP-K
Bernhard Geiger-Reinbacher	02.02.2012	EAA
Ralf Masser	23.02.2012	EAP
Joachim Wiesbauer	23.02.2012	EAI
Ralf Masser	06.03.2012	EAP
Heinz Krendlesberger	07.03.2012	EAT
Johann Unger	13.03.2012	EAP-K
Joachim Wiesbauer	14.03.2012	EAI
Denise Lakosche	14.03.2012	EA Ass't.
Adolf Ornig	26.03.2012	EAR
Ralf Masser	27.03.2012	EAP
Denise Lakosche	27.03.2012	EA Ass't.
Johann Unger	28.03.2012	EAP-K
Joachim Wiesbauer	28.03.2012	EAI
Heinz Krendlesberger	28.03.2012	EAT
Gernot Kofler	28.03.2012	EAE
Klaus Kolarik	30.03.2012	CI
Karin Polschak	05.04.2012	ECK
Ralf Masser	30.03.2012	EAP
Adolf Ornig	05.04.2012	EAR
Heinz Krendlesberger	05.04.2012	EAT
Ralf Masser	04.04.2012	EAP
Joachim Wiesbauer	11.04.2012	EAI
Joachim Wiesbauer	13.04.2012	EAI
Karin Polschak	13.04.2012	ECK
Ralf Masser	18.04.2012	EAP
Johann Unger	18.04.2012	EAP-K
Klaus Kolarik	18.04.2012	CI
Karin Polschak	19.04.2012	ECK
Joachim Wiesbauer	19.04.2012	EAI
Ralf Masser	05.06.2012	EAP
Denise Lakosche	05.06.2012	EA Ass't.

Scenario Analysis for Outsourcing Complete Vehicles

		S-01 1. Szenario			S-02 2. Szenario			S-03 3. Szenario		
Kurzbeschreibung										
Partner		Gesamtfahrzeugentwicklungspartner 1			Gesamtfahrzeugentwicklungspartner 2			Gesamtfahrzeugentwicklungspartner 3		
Leistungsumfang		Chassis, Body, Interior, Funktionale Integration, QualitätssicherungAbsicherung,			Chassis, Body, Interior, Gesamtintegration, E/E-Integration, Sub-Lieferantennominierung			Logistik Serienteile, Qualitätssicherung, Absicherung, Freizeichnung, Änderungsmang.		
Erst-/Folgeprojekt		Erstprojekt			Folgeprojekt			Folgeprojekt		
Finanzielle Bewertung										
Bewertungsgrundlage		EOBC			EOBC			EOBC		
Return on Investement		194%			79%			122%		
Amortisationszeitraum		2,2 Jahre			2 Jahre			-		
Kosten (in Tausend Euro)										
Koordination/Monitoring		10 000			5 000			5 000		
Prozesstransformation		20 000			5 000			12 000		
Entsendungskosten		10 000			5 000			8 000		
Infrastruktur		20 000			5 000			10 000		
Implementierungszeitraum		8 Monate			5 Monate			6 Monate		
Komplementarität in %		97			83			79		
Max. erreichbare		500			500			500		
Summe		485			410			395		
Empfehlung		empfehlenswert			empfehlenswert			bedingt		
Nr.	Outsourcing-Anforderung	Rel. Gew.	Sc.	Gew X Sc.	Rel. Gewicht	Sc.	Gew. X Sc.	Rel. Gew.	Score	Gew. X Sc.
OA-001	Integrations-Know-How	1	5	5	1	20	4	1	20	4
OA-02	Varianten	0,75	4	3	0,75	3	2,25	1	5	5
OA-003	Einhaltung Produktion	0,75	4	3	0,75	4	3	0,75	3	2,25
OA-004	Einhaltung Ziele Kosten	1	5	5	1	4	4	1	4	4
OA-005	Einhaltung Datenschutz	0,75	3	2,25	0,75	3	2,25	0,75	3	2,25
OA-007	Prod.techn. Integration	0,75	4	3	0,75	3	2,25	0,75	3	2,25

Schneider, K. (2011). *Modernes Sourcing in der Automobilindustrie* (p. 173). Wiesbaden: Gabler

Delta Analysis for Outsourcing Complete Vehicles

Anforderung OA-002: Abbildung der Variantenvielfalt					
	Leistung	**Prozess**	**Information**	**Applikation**	**Infrastrukt.**
Delta	Kompetenz Varianten-management beim Partner nicht vorhanden	Variantenmanagement beim Partner nicht etabliert -> Verlagerung mit Kosten verbunden Kein unternehmens-übergreifender Prozess für Variantenabgleich Partner-OEM -> zusätzlicher interner Aufwand	Keine konsolidierten, zentral abrufbaren Variantenin-formationen	Keine über-greifende Planungs-applikation Applikation nicht mandantenfähig	Stammdaten-repository fehlt Backbonean-bindung fehlt Arbeitsumgebung für OEM-Mitarbeiter vor Ort beim Partner
Einfluss auf die Fremd-vergabe	Voraussetzung Varianten-management nicht gegeben	Investitionen seitens OEM Abhängigkeiten des Partners	Redundante Datenhaltung (Sicherheit)	Siehe Prozess Sicherheits relevante Aspekte	
Em-pfehlung	Kompetenzen Varianten-management des Partners überprüfen	Etablierung unternehmens-übergreifender Variantenmanagement-prozess Analyse der Prozessabhängigkeiten (z.B. zum Änderungs-management- und Freigabeprozess)	Fachliche Auswahl der intern/extern benötigten Detailinformationen und kreieren der Informationsobj.	Etablierung der Applikationen bzw. Schnittstellen s.o. Überprüfen von Sicherheits-kritischen Aspekten Aufbau übergreifender Produkt-dokumentation	
Abhängig-keiten	Anforderung OA-012 Änderungs-management	Anforderung OA-013 Abbildung flexibler Vertriebsprozess			

Schneider, K. (2011). *Modernes Sourcing in der Automobilindustrie* (p. 174). Wiesbaden: Gabler

Risk Analysis for Outsourcing Complete Vehicles

Risikokategorien		Risikofaktoren	Eintritts-wahr-scheinlich-keit	Schadens-höhe
Exogene Risiken	Wirtschaftliche, sozio-kulturelle, ökologische, politische Risiken	Neue Bilanzierungsvorschriften Neue Umweltauflagen Regulierung in Kapitalmärkten Konsolidierung des Tier-0,5-Zuliefermarktes Terroranschläge		
Endogene Risiken	Geschäftsrisiko	Know-how-Abfluss Verhandlungsnachteil des OEM in Folgeprojekten Marktrisiko des OEM (negatives Image) Nicht-Erreichung strategischer Ziele Verwässerung der Marke		
	Projektrisiko	Nichterreichung von Zielen, Budget- und Zeitrahmen (z.B. Erreichung SOP) Mitarbeiterfluktuation beim Partner Insolvenz des Partners Risiko der Abhängigkeit		
	Leistungs- und Verantwortungs-Risiko	Leistungsrückverlagerung zum Auftraggeber Risiko der unzureichenden Verantwortungsübernahme Nichterfüllung von Qualitätsanforderungen Risiko der eingeschränkten Sub-Lieferantensteuerung		
	Prozess-/IT-Risiko	Kosten der Prozesstransformation für Prozess Prototypenbau Kosten der Prozessentflechtung zwischen Entwicklung und Produktion Organisatorische Anpassungen beim Partner		
	Sozio-ökonomische Risiken	Mangelnde Akzeptanz neuer Projektstrukturen		

Schneider, K. (2011). *Modernes Sourcing in der Automobilindustrie* (p. 177). Wiesbaden: Gabler

Management Recommendation for Outsourcing Complete Vehicles

	S-01 1. Szenario		S-02 2. Szenario		S-03 3. Szenario
Kurzbeschreibung					
Partner	Gesamtfahrzeugent-wicklungspartner 1, E/E-Entwicklungsdienst-leister 1		Gesamtfahrzeugent-wicklungspartner 1, E/E-Entwicklungsdienstleister 2		Gesamtfahrzeug-entwicklungspartner 2
Ort der Leistungserstel-lung	Partnerstandort		Partnerstandort		Partnerstandort
Leistungsumfang	Chassis, Body, Inter-ior, Gesamtintegrati-on, Qualitätssiche-rung, Freizeichnung, Änderungsmang., Entwicklung,		Chassis, Body, Interior, Gesamtintegration, E/E-Integration, Logistik Qualitätssicherung, Ände-rungsmang. Entwicklung		E/E-Steuerung, Logis-tik Serienteile, Quali-tätssicherung, Absiche-rung, Freizeichnung, Änderungsmang.,
Erst-/Folgeprojekt	Erstprojekt		Folgeprojekt		Folgeprojekt
Finanzielle Bewer-tung					
Bewertungsgrundlage	EOBC		EOBC		EOBC
Return on Investement	194%		79%		122%
Amortisationszeitraum	2,2 Jahre		2 Jahre		-
Kosten (in Tausend Euro)					
Koordination/Monitoring	10 000		5 000		5 000
Prozesstransformation	20 000		5 000		12 000
Entsendungskosten	10 000		5 000		8 000
Infrastruktur	20 000		5 000		10 000
Impl.zeitraum	8 Monate		5 Monate		6 Monate
SWOT-Analyse					
Stärken	-		Geringe Aufwände		Geringe Aufwände
Schwächen	Hoher Initialaufwand		-		-
Chancen	-		Ausbau Partnerschaft		Synergieeffekte
Risiken	fachliches Know-How		Kulturverständnis		Verhandlungsmacht
Komplementarität %	**87**		**93**		**79**
Max. Punktzahl	**500**		**500**		**500**
Summe	**435**		**465**		**395**
Empfehlung	**geeignet**		**sehr geeignet**		**bedingt geeignet**

Schneider, K. (2011). *Modernes Sourcing in der Automobilindustrie* (p. 180). Wiesbaden: Gabler

Appendix B

Form for Work Orders

MAGNA STEYR
Fahrzeugtechnik AG & Co KG

Arbeitsauftrag für Fremdleistungen

Dieses Formular ist der PZB-09.00.00 zugeordnet.

Auftrag erteilt von: **Auftrags Nr.:** Abt./Gruppe: Name: Tel: Datum:								
Auftragnehmer und Standort *:			Auftrag übernommen von:					
Arbeitsbeschreibung (Haupt- Aktivitäten/Tätigkeiten)*: EINSATZORT*: Mit CAD*: ja/nein								
Terminvorgabe*:	Vorgabe in Stunden*	Geleistete Stunden						
		Monat:	Monat:	Monat:	Monat:	Monat:	Monat:	Summe:
Leistung								
Summe								
Internes Konto*: **Projekt*:**	**Übernahme:** Leistung und Stunden in Ordnung Name: Datum:							
		Projektleiter		Bereichsleiter		Aussteller		
Unterschrift durch Name: Datum:								

*.... Mussfelder (bitte ausfüllen)

MAGNA STEYR Fahrzeugtechnik (n.d.). *Arbeitsauftrag für Fremdleistungen*. Unpublished internal document.

Purchase Requisition Form (Work Packages)

MAGNA STEYR

MAGNA STEYR
Fahrzeugtechnik AG & Co KG

☐ ***Bestellanforderung***
☐ ***Anfrageanforderung***

Übermittlung durch Post oder Fax: 5636 Einkauf bzw. 4124 Prüfmittelüberwachung

Nr.:	Empfänger im F.D. C:		**Bestellnummer an Lieferant:**	

Anfordernde KSt.:	**Anzuliefernde KSt.:**	**Datum:**	**Bei C eingelangt am:**

Vorgeschlagene Lieferanten:

☐ Prüfmittel[1] ☐ Kalibrierzertifikat ☐ Rückmeldung | Gefährlicher Stoff[3] ☐ ja ☐ nein

Menge	**Mengen-einheit**	**Bezeichnung/Artikel**	**Mat-Nr. Konto-Nr.**	**Soll-Liefertermin**

Übermittelte Dokumente:

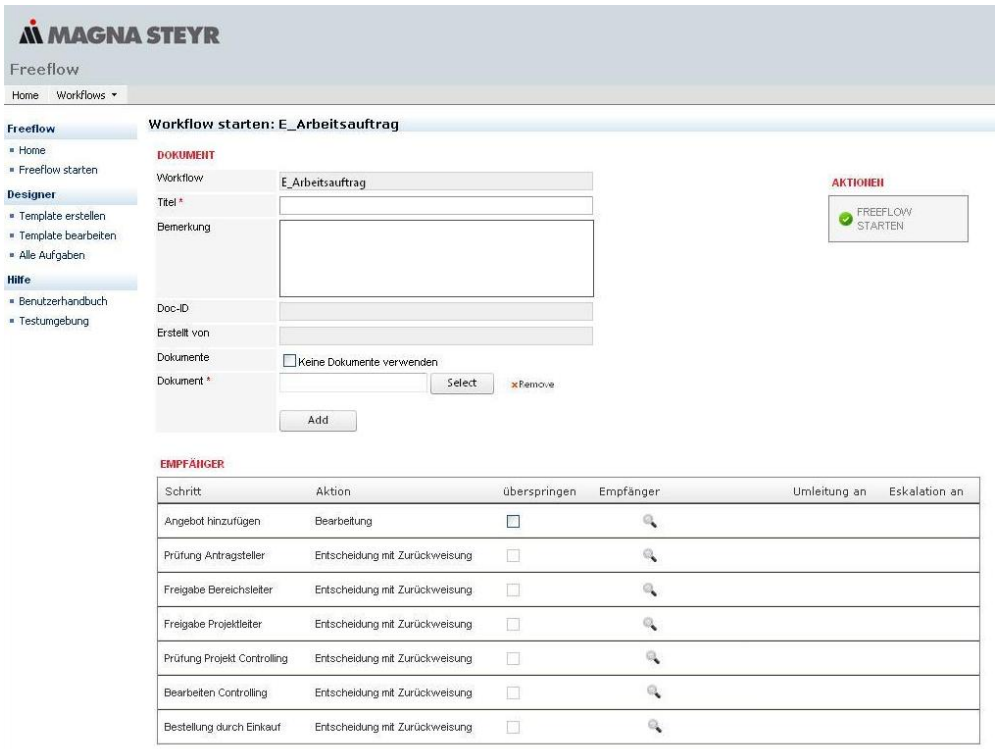
Anforderer:	**Prüfung:**	**Freigabe:**[2]
Name(in Blockschrift): Tel.:	Name(in Blockschrift):	Name(in Blockschrift):
Unterschrift: Datum:	Unterschrift: Datum:	Unterschrift: Datum:
Prüfmittelüberwachung:	Unterschrift:	Datum:

[1] Bei angeforderten Prüfmitteln ist zur Gültigkeit zusätzlich die Unterschrift des Leiters der Prüfmittelüberwachung QMP erforderlich!
[2] Die Bestellanforderung hat nur mit Unterschrift des Freigabe-Berechtigten Gültigkeit!
[3] Gefährliche Stoffe sind verbindlich zu klassifizieren. Definition der gefährlichen Stoffe siehe Intranet: Geschäftsfelder / T / TU Umweltmanagement und Arbeitssicherheit / Publikationen/Dokumente

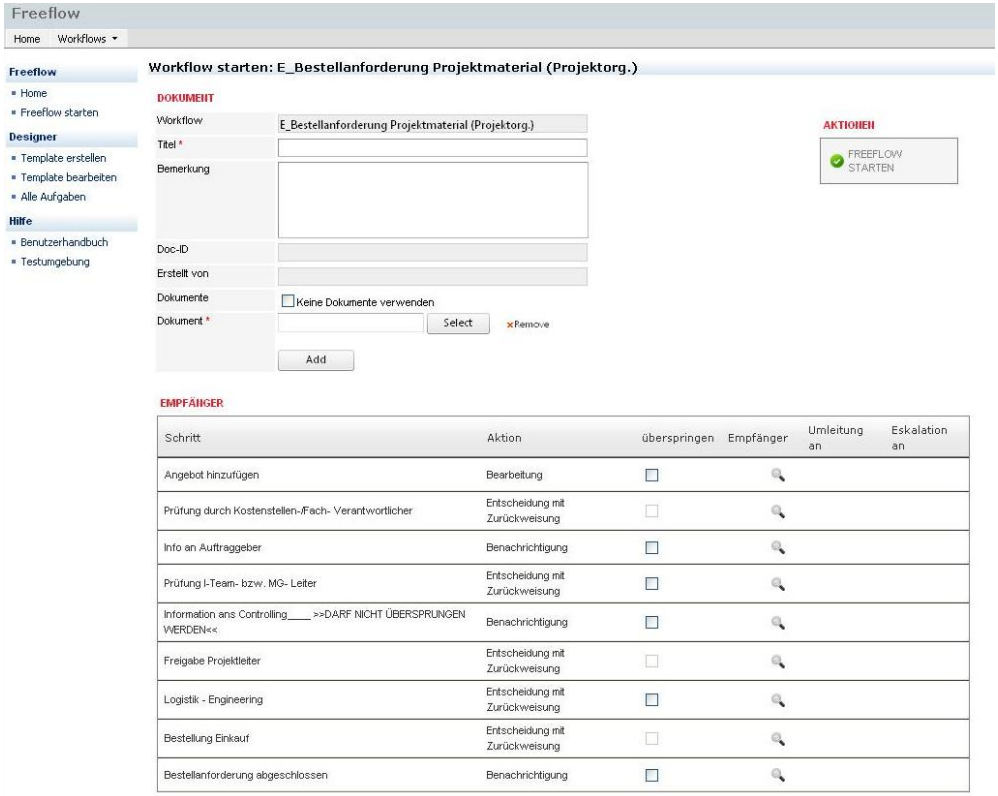
Strichliert umrandete Felder werden vom SCM-Einkauf ausgefüllt !

MAGNA STEYR Fahrzeugtechnik (n.d.). *Arbeitsauftrag für Fremdleistungen*. Unpublished internal document.

Create a Work Order in the Freeflow



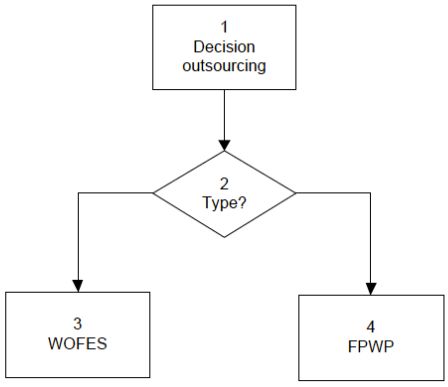
Create a Purchase Requisition in the Freeflow



Appendix C

As-Is Processes for Outsourcing Engineering Activities

	Department EAx	Processes / Legend



Work Order

Procurement process	WO-01-AI
Initiation of outsourcing	WO-02-AI
Time capture process	WO-03-AI
Handling invoice	WO-04-AI

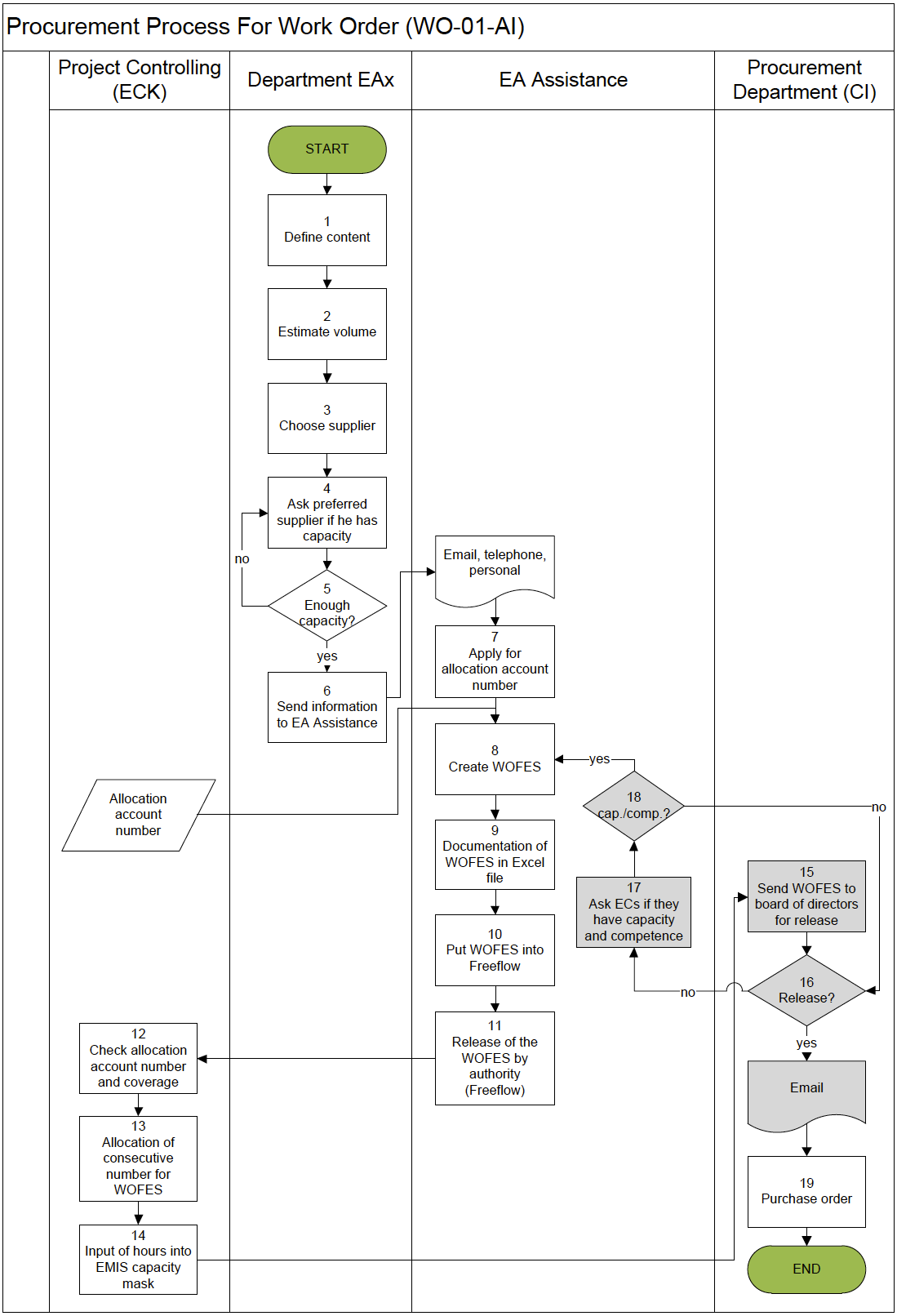
Work Package

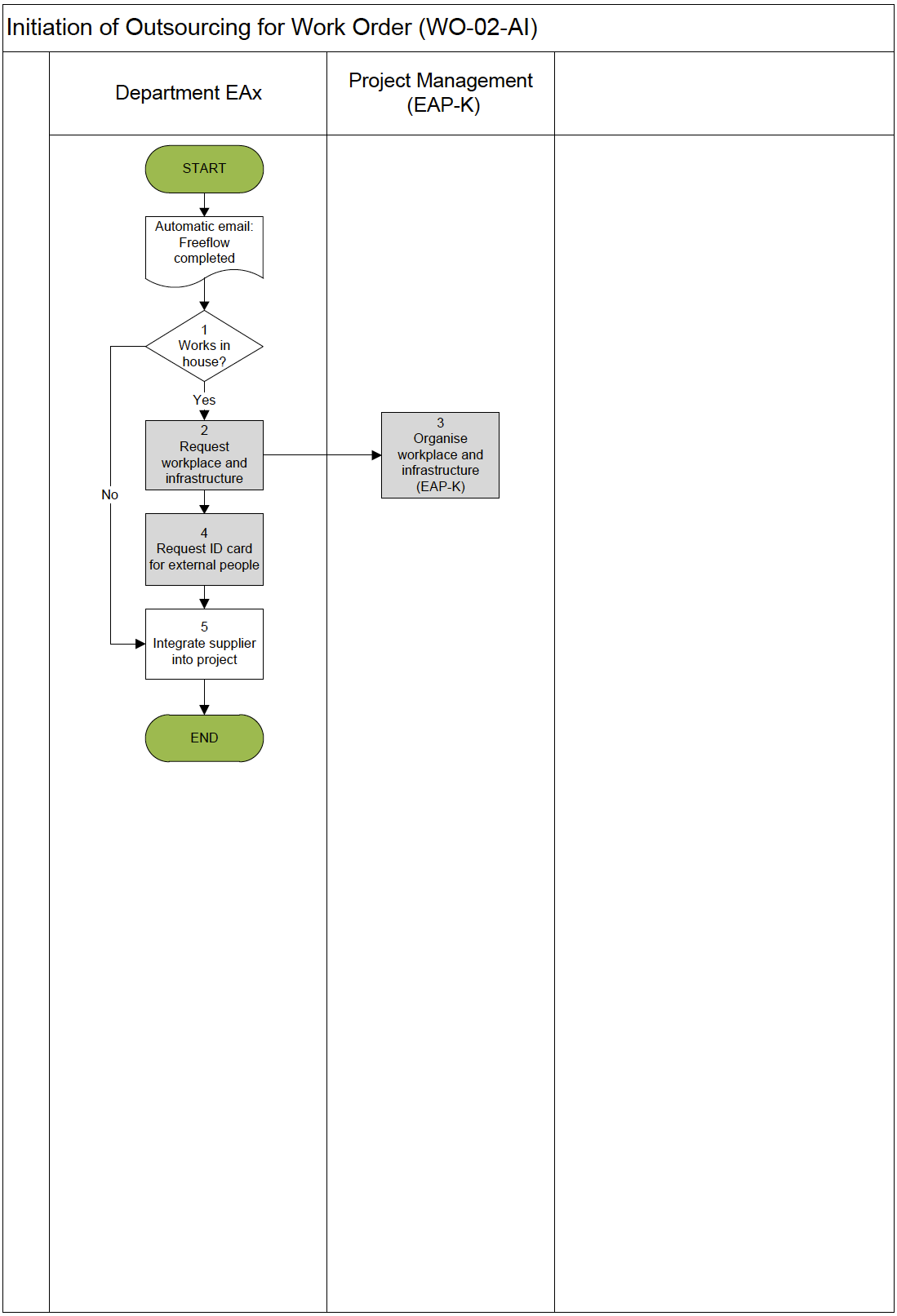
Procurement process	WP-01-AI
Initiation of outsourcing	WP-02-AI
Handling Invoice	WP-03-AI

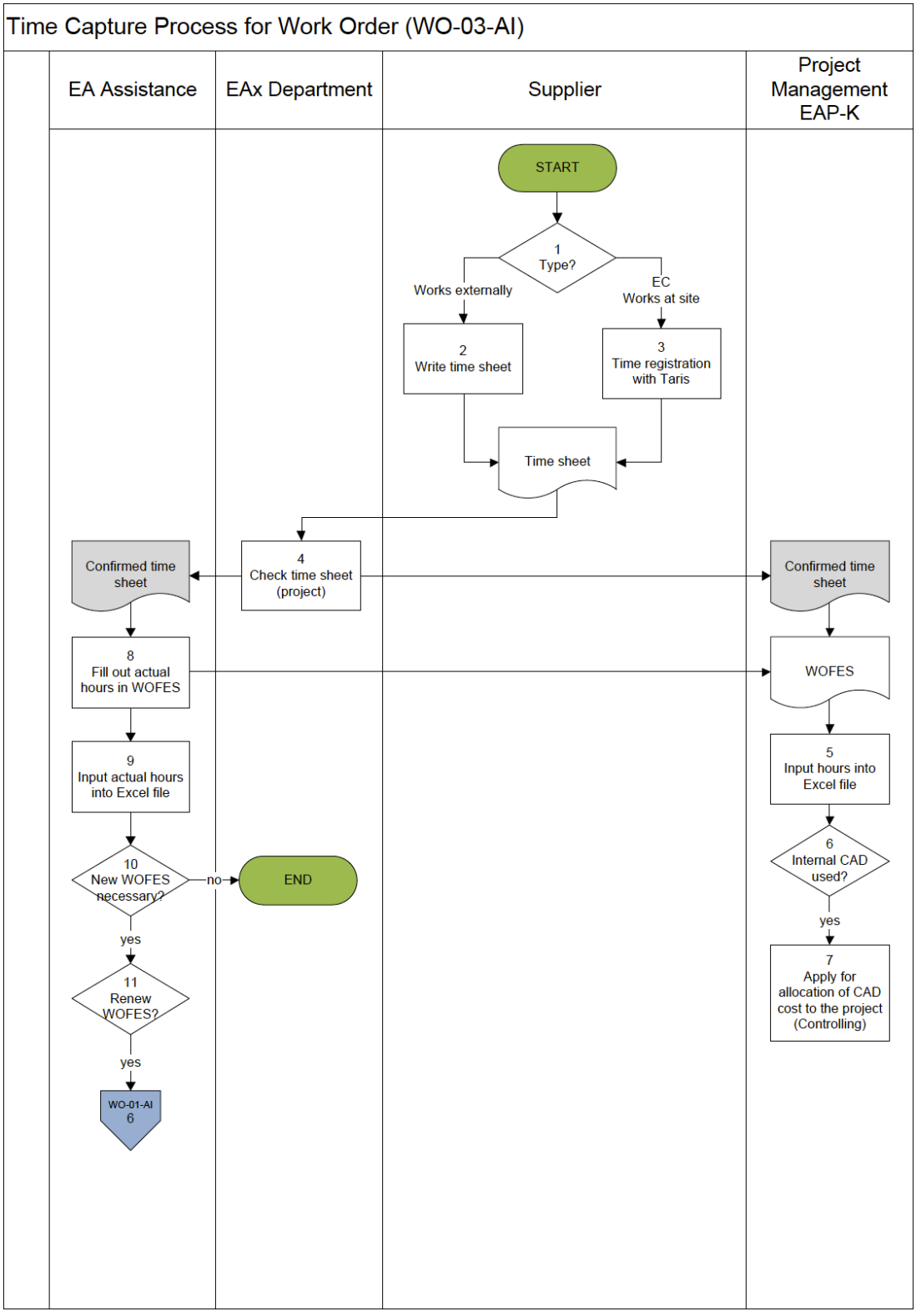
Legend:

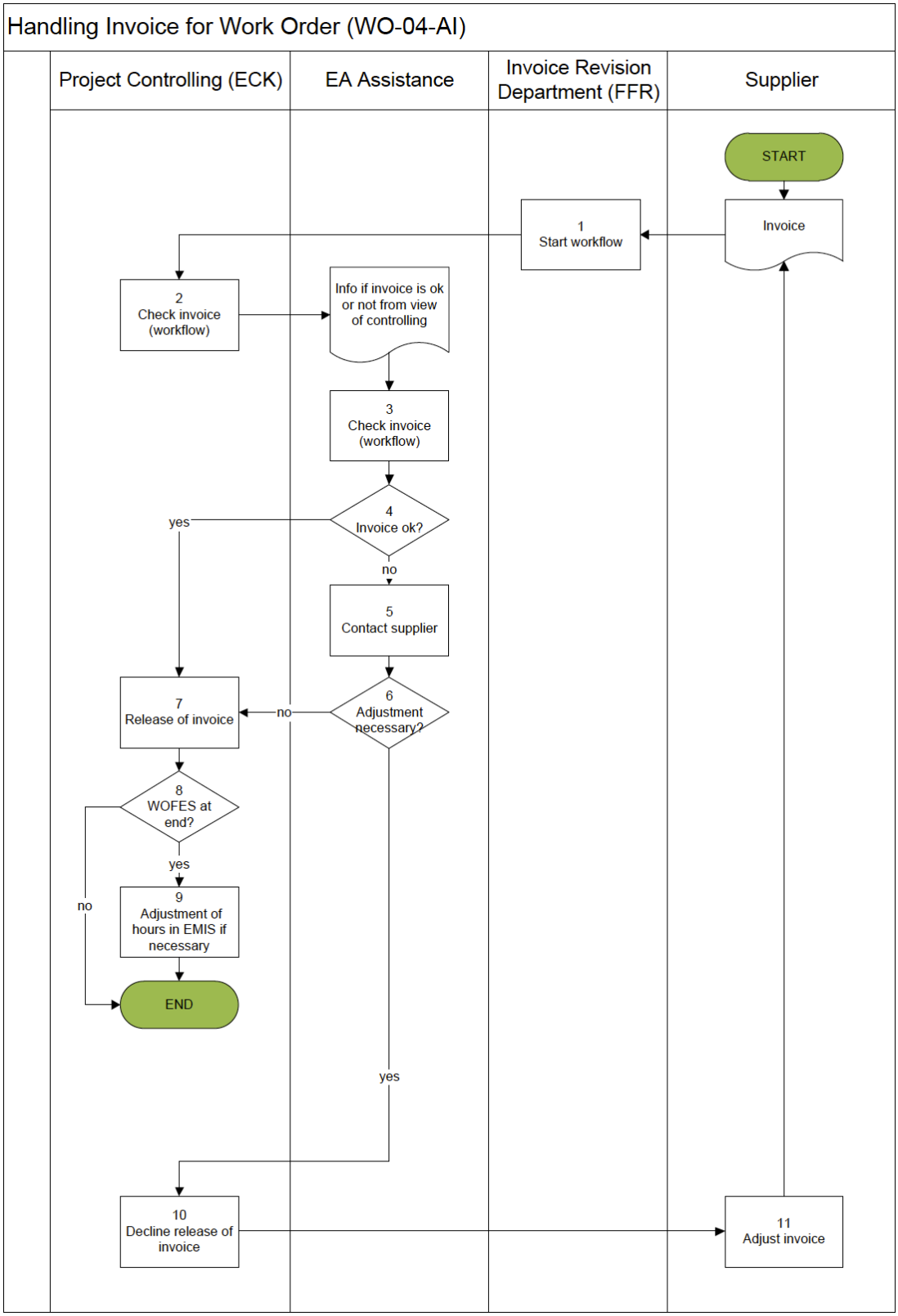
Standard

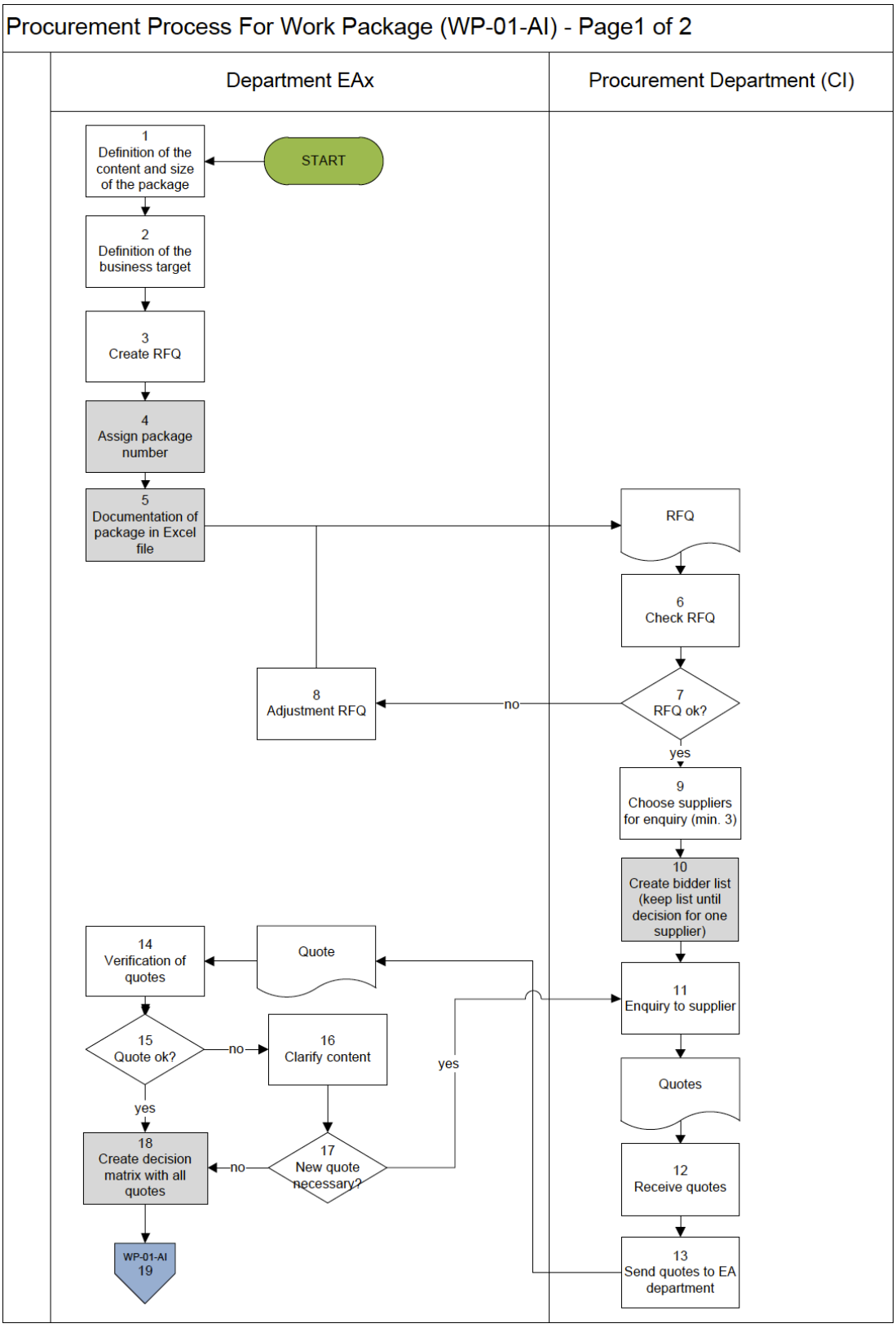
Not always performed or not by all parties

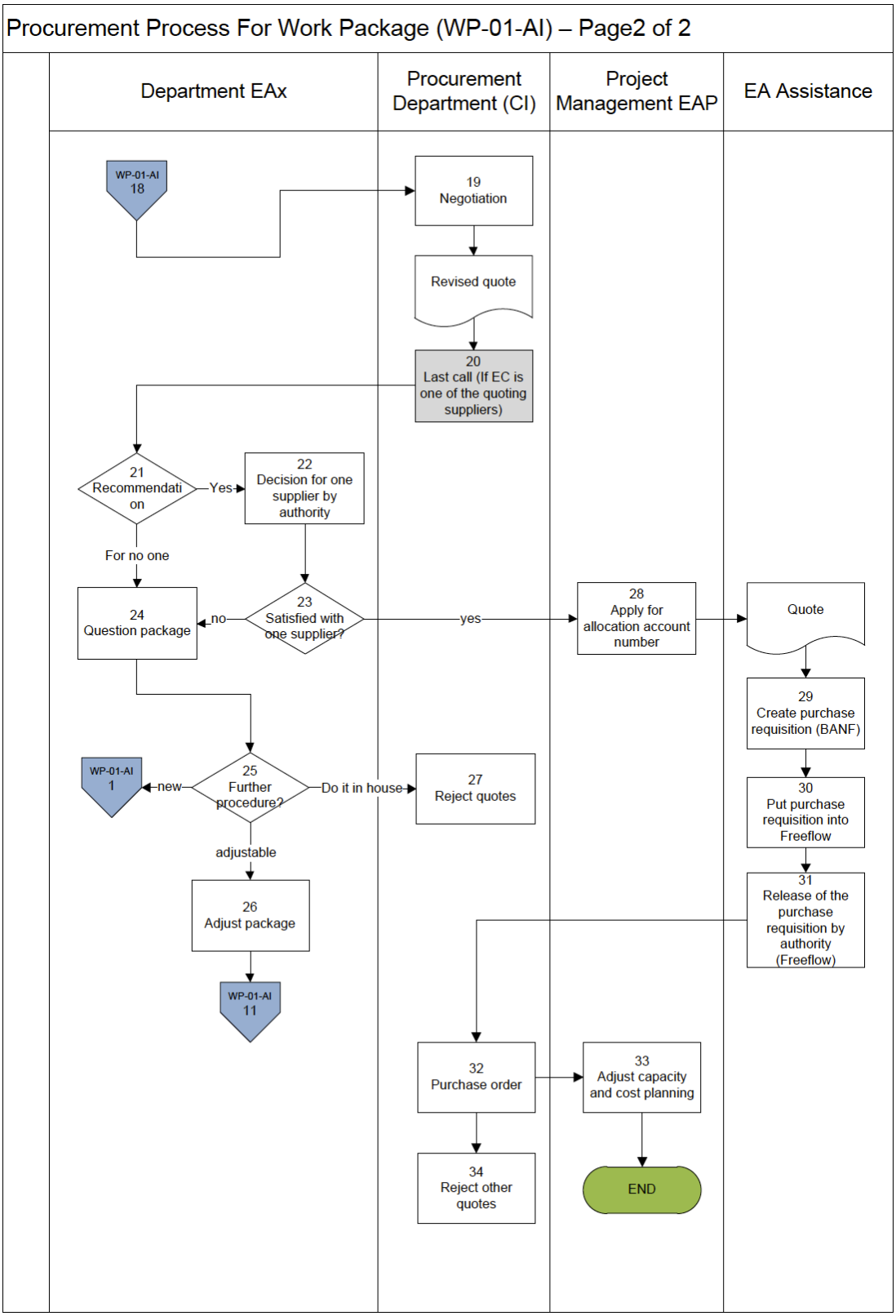

Procurement Process For Work Order (WO-01-AI)
Project Controlling (ECK)
Department EAx
EA Assistance
Procurement Department (CI)
START
1 Define content
2 Estimate volume
3 Choose supplier
4 Ask preferred supplier if he has capacity
5 Enough capacity?
no
yes
6 Send information to EA Assistance
Email, telephone, personal
7 Apply for allocation account number
8 Create WOFES
Allocation account number
9 Documentation of WOFES in Excel file
10 Put WOFES into Freeflow
11 Release of the WOFES by authority (Freeflow)
12 Check allocation account number and coverage
13 Allocation of consecutive number for WOFES
14 Input of hours into EMIS capacity mask
18 cap./comp.?
yes
no
17 Ask ECs if they have capacity and competence
15 Send WOFES to board of directors for release
16 Release?
no
yes
Email
19 Purchase order
END

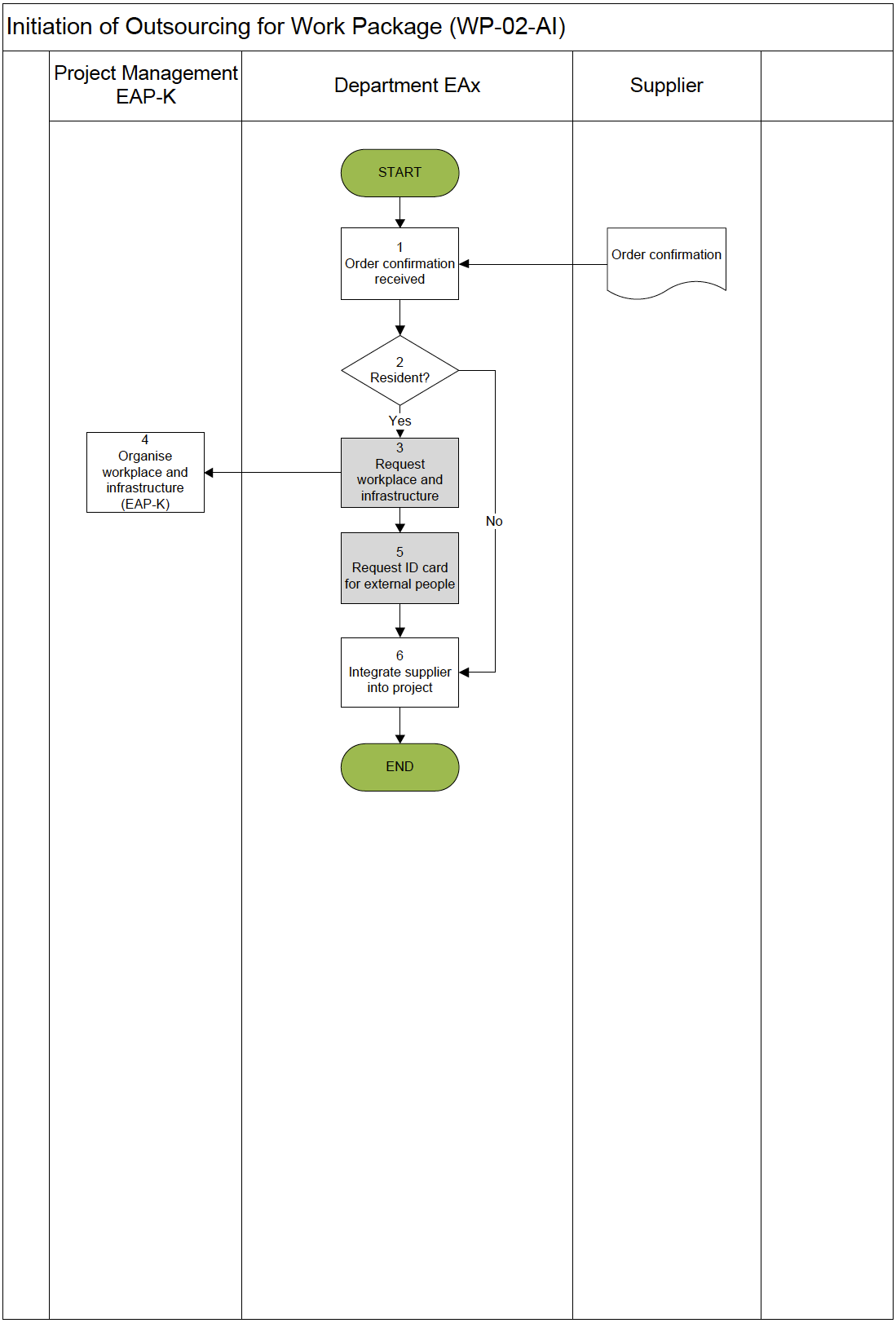

Initiation of Outsourcing for Work Order (WO-02-AI)
Department EAx
Project Management (EAP-K)
START
Automatic email: Freeflow completed
1 Works in house?
Yes
No
2 Request workplace and infrastructure
3 Organise workplace and infrastructure (EAP-K)
4 Request ID card for external people
5 Integrate supplier into project
END


Time Capture Process for Work Order (WO-03-AI)
EA Assistance
EAx Department
Supplier
Project Management EAP-K
START
1 Type?
Works externally
EC Works at site
2 Write time sheet
3 Time registration with Taris
Time sheet
4 Check time sheet (project)
Confirmed time sheet
Confirmed time sheet
8 Fill out actual hours in WOFES
WOFES
9 Input actual hours into Excel file
5 Input hours into Excel file
10 New WOFES necessary?
no
END
6 Internal CAD used?
yes
yes
7 Apply for allocation of CAD cost to the project (Controlling)
11 Renew WOFES?
yes
WO-01-AI 6

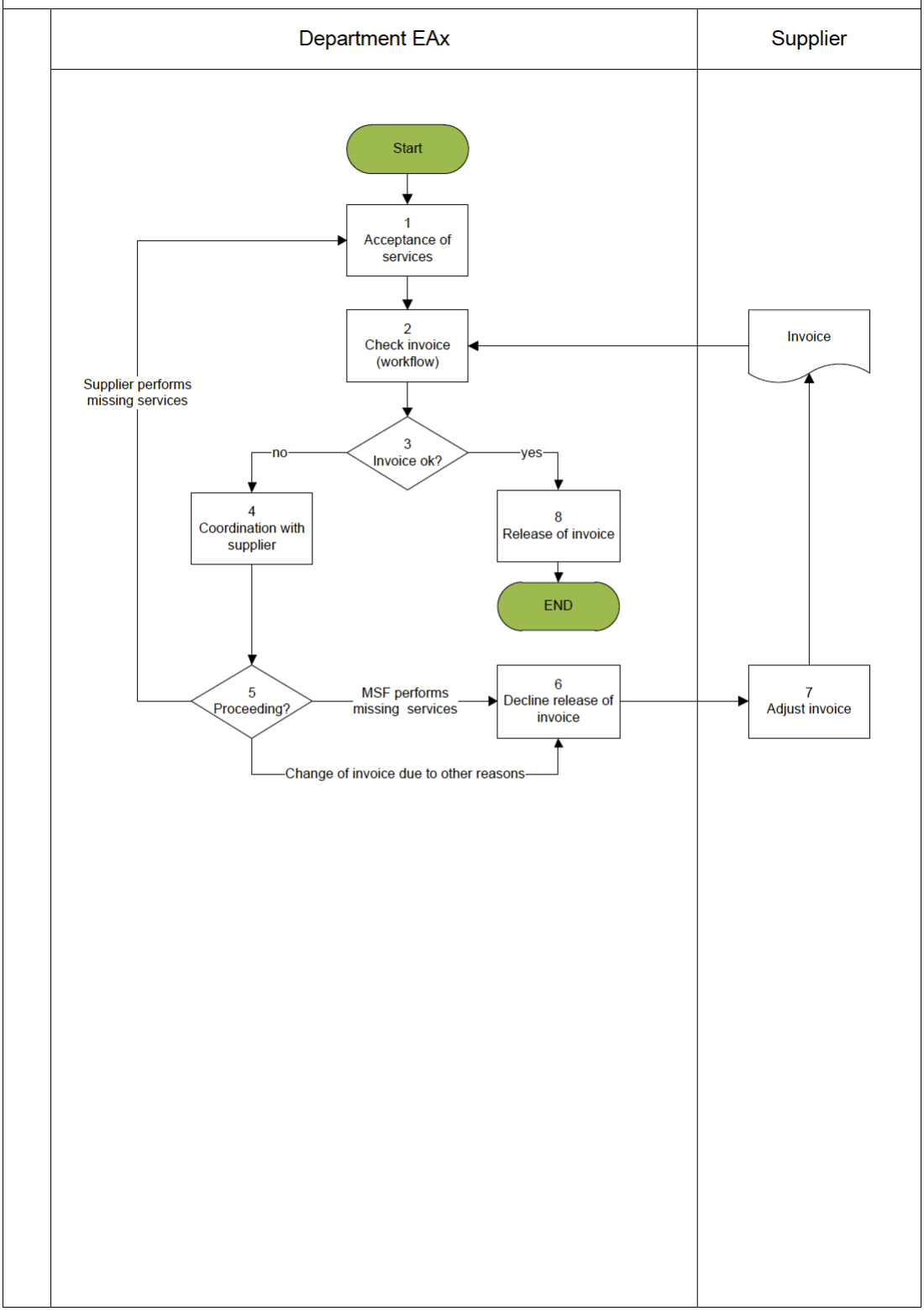

Handling Invoice for Work Order (WO-04-AI)
Project Controlling (ECK)
EA Assistance
Invoice Revision Department (FFR)
Supplier
START
Invoice
1
Start workflow
2
Check invoice (workflow)
Info if invoice is ok or not from view of controlling
3
Check invoice (workflow)
4
Invoice ok?
yes
no
5
Contact supplier
6
Adjustment necessary?
no
7
Release of invoice
8
WOFES at end?
yes
no
9
Adjustment of hours in EMIS if necessary
END
yes
10
Decline release of invoice
11
Adjust invoice


Procurement Process For Work Package (WP-01-AI) - Page1 of 2
Department EAx
Procurement Department (CI)
START
1 Definition of the content and size of the package
2 Definition of the business target
3 Create RFQ
4 Assign package number
5 Documentation of package in Excel file
RFQ
6 Check RFQ
7 RFQ ok?
no
8 Adjustment RFQ
yes
9 Choose suppliers for enquiry (min. 3)
10 Create bidder list (keep list until decision for one supplier)
11 Enquiry to supplier
Quotes
12 Receive quotes
13 Send quotes to EA department
Quote
14 Verification of quotes
15 Quote ok?
no
16 Clarify content
yes
17 New quote necessary?
yes
no
18 Create decision matrix with all quotes
WP-01-AI 19


Procurement Process For Work Package (WP-01-AI) – Page2 of 2
Department EAx
Procurement Department (CI)
Project Management EAP
EA Assistance
WP-01-AI 18
19 Negotiation
Revised quote
20 Last call (If EC is one of the quoting suppliers)
21 Recommendation
Yes
22 Decision for one supplier by authority
For no one
24 Question package
no
23 Satisfied with one supplier?
yes
28 Apply for allocation account number
Quote
29 Create purchase requisition (BANF)
30 Put purchase requisition into Freeflow
31 Release of the purchase requisition by authority (Freeflow)
WP-01-AI 1
new
25 Further procedure?
Do it in house
27 Reject quotes
adjustable
26 Adjust package
WP-01-AI 11
32 Purchase order
33 Adjust capacity and cost planning
34 Reject other quotes
END


Initiation of Outsourcing for Work Package (WP-02-AI)
Project Management EAP-K
Department EAx
Supplier
START
1 Order confirmation received
Order confirmation
2 Resident?
Yes
No
3 Request workplace and infrastructure
4 Organise workplace and infrastructure (EAP-K)
5 Request ID card for external people
6 Integrate supplier into project
END

Handling Invoice for Work Package (WP-03-AI)



Appendix D

Time Analysis Procurement Process for Work Orders (WO-01-AI)							
	Process Step	Prob-ability	Emplo-yees	Duration (min) ø	Duration (min) Total	Cycle t. (days) ø	Depart-ment
1	Define content	100%	1	30	30		EAx
2	Estimate volume	100%	1	30	30		EAx
3	Choose supplier						EAx
4	Ask preferred supplier if he has capacity	100%	1	30	30	4	EAx
5	Enough capacity?						EAx
6	Send information to EA Assistance	100%	1	5	5		EAx
7	Apply for allocation account number	100%	1	5	5		EA Ass't.
8	Create WOFES	100%	1	10	10	1	EA Ass't.
9	Documentation of WOFES in Excel file	100%	1	3	3		EA Ass't.
10	Put WOFES into Freeflow	100%	1	5	5		EA Ass't.
11	Release of the WOFES by authority (Freeflow)	100%	3	5	15	3	EA Ass't.
12	Check allocation account number and coverage	50%	1	5	2.5		ECK
12.5	Enquiry necessary for step 12	50%	1	60	30		ECK
13	Allocation of consecutive number for WOFES	100%	1	5	5	3	ECK
14	Input of hours into EMIS capacity mask	100%	1	5	5		ECK
19	Purchase order	100%	1	10	10	2	CI
Sub Total					**185.5**	**13**	
Additional Steps:							
	Maintain supplier portfolio + new suppliers (from project)	100%	1	30	30		CI
	Request allocation account number	100%	1	10	10		EAP
	Release of WOFES by the general manager Engineering Center Graz	100%	1	1	2	2	
Total					**227.5**	**15**	
Special Cases:							
17	Loop: have to ask EC				240	3	

Time Analysis Initiation of Outsourcing for Works Order (WO-02-AI)							
	Process Step	Prob-ability	Duration (min)		Cycle t. (days)		Depart-ment
			ø	Total	ø	Total	
2	Request workplace and infrastructure	100%	10	10	1.5	1.35	EAx
3	Organise workplace and infrastructure	90%	75	67.5			EAP-K
3.5	No equipment existing in house (higher effort)	10%	420	42	3	0.3	EAP-K
4	Request ID card for external people	100%	5	5	5	5	EAx
Sub Total				**124.5**		**6.65**	
Additional Steps:							
	Relocating infrastructure	100%	150	150	2.5	2.5	ECR
Total				**274.5**		**9.15**	

Time Analysis Time Capture + Handling Invoice for Work Orders (WO-03-AI + WO-04-AI)						
	Process Step	Prob-ability	Duration (min)		Cycle t. (days)	Depart-ment
			ø	Total	ø	
Time Capture Process (WO-03-AI)						
5	Check time sheet	80%	10	8	7	EAx
5.5	Check time sheet --> enquiry necessary	20%	60	12		EAx
6	Input hours into Excel file	100%	3.5	3.5	By end of month	EAP-K
6.5	Time sheet not received --> enquire	70%	22.5	15.75		EAP-K
7	Internal CAD used?	100%	4	4		EAP-K
8	Apply for allocation of CAD cost to the project	100%	2	2		EAP-K
9	Fill out act. hours in WOFES	100%	10	10	1	EA Ass't.
9.5	Time sheet not received --> enquire	30%	5	1.5		EA Ass't.
10	Input hours into Excel file	100%	5	5		EA Ass't.
11	New WOFES necessary?					EA Ass't.
Sub Total Time Capture				**61.75**		
Handling Invoice (WO-04-AI)						
2	Check invoice (work flow)	100%	5	5	Limted by invoice date	ECK
3	Check invoice (work flow)	100%	15	15		EA Ass't.
5	Contact supplier	10%	30	3		EA Ass't.
7	Release of invoice	100%	5	5		ECK
9	Adjustment of hours in EMIS if necessary	100%	5	5		ECK
Sub Total Handling Invoice				**33**		
Total				**94.75**		

Time Analysis Procurement Process for Work Packages (WP-01-AI)							
	Process Step	Prob-ability	Emplo-yees	Duration (min) ø	Duration (min) Total	Cycle t. (days) ø	Depart-ment
1	Definition of the content and size of the package	100%	1	180	180		EAx
2	Definition of the business target	100%	1	60	60	7	EAx
2	Assistance for definition of business target	100%	1	60	60		EAP
3	Create RFQ						EAx
4	Assign package number	100%	1	390	390		EAx
5	Documentation of package in Excel file						EAx
3	Assistance for creating RFQ	100%	1	60	60		EAP
6	Check RFQ	100%	3	120	360		EAx
6	Check RFQ	100%	1	60	60	7	CI
8	Adjustment RFQ	100%	1	120	120		EAx
9	Choose suppliers for inquiry (min. 3)	100%	1	30	30		EAx
9	Choose suppliers for inquiry (min. 3)	100%	1	60	60		CI
10	Create bidder list	100%	1	5	5		CI
11	Inquiry to supplier	100%	1	20	20	1	CI
12	Receive quotes	100%	1	60	60		CI
13	Send quotes to EA department	100%	1	5	5	7.5	CI
14	Verification of quotes	100%	1	420	420		EAx
16	Clarify content	100%	3	60	180	10.5	EAx
17	New quote necessary?	100%	1	120	120		EAx
19	Negotiation	100%	2	1440	2880		CI
20	Last call (If EC is one of the quoting suppliers)	100%	1	10	10	5	EAx
28	Apply for allocation account number	100%	1	120	120	1	EAP
29	Create purchase requisition (BANF)	100%	1	10	10		EA Ass't.
30	Put purchase requisition into Freeflow	100%	1	5	5	1	EA Ass't.
31	Release of the purchase requisition by authority (Freeflow)	100%	4	5	20	4	EAx
32	Purchase order	100%	1	15	15		CI
33	Adjust capacity and cost planning	100%	1	120	120	2	EAP
34	Reject other quotes	100%	1	20	20		CI
Total					5,390	46	

Time Analysis Initiation of Outsourcing for Work Packages (WP-02-AI)						
Process Step		Prob-ability	Duration (min) ø	Duration (min) Total	Cycle t. (days) ø	Depart-ment
2	Request workplace and infrastructure	100%	5	5	1.5	EAx
3	Organise workplace and infrastructure	90%	150	135		EAP-K
3.5	No equipment existing in house (higher effort)	10%	420	42	3	EAP-K
4	Request ID card for external people	100%	10	10	5	EAx
Sub Total				**192**	**9.5**	
Additional Steps:						
	Relocating infrastructure	100%	150	150	2.5	ECR
Total				**342**	**12**	

Time Analysis Handling Invoice for Work Packages (WO-03-AI)				
Process Step		Duration (min) ø	Cycle t. (days) ø	Depart-ment
1	Acceptance of services	75		EAx
2	Check invoice (Workflow)			EAx
3	Invoice ok?			EAx
8	Release of invoice			EAx
4	Coordination with supplier			EAx
5	Further proceeding?			EAx
Total		**75**		

Appendix E

Time Analysis Procurement Process for Work Orders (WO-01-TB)							
Process Step		Prob-ability	Emplo-yees	Duration (min) ø	Duration (min) Total	Cycle t. (days) ø	Depart-ment
1	Define content and estimate volume	100%	1	60	60	4	EAx
2	Choose supplier	100%	1	30	30		EAx
3	Ask preferred supplier if he has capacity						EAx
4	Enough capacity?						EAx
5	Create WOFES in system	100%	1	10	10		EAx
6	WOFES ok?	100%	1	5	5	1	EAP
7	Add allocation account number	100%	2	5	10		EAP
8	Release of the WOFES	100%	1	5	5	1	PL
14	Input of hours into EMIS capacity mask	100%	1	5	5	-	ECK
19	Purchase order	100%	1	10	10	2	CI
Sub Total					**135**	**8**	
Additional Steps:							
	Maintain supplier portfolio + new suppliers (from project)	100%	1	30	30		CI
Total					**165**	**8**	